

INSTALLATION RESTORATION PROGRAM
PHASE II - CONFIRMATION/QUANTIFICATION

STAGE 1

FINAL REPORT
FOR

UNITED STATES AIR FORCE PLANT NO. 59
JOHNSON CITY, NEW YORK

March 1988

Prepared by:

Fred C. Hart Associates, Inc.
530 Fifth Avenue
New York, NY 10036

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USAF Technical Program Manager:
James W. Better

Prepared For:

Headquarters Air Force Systems Command
Aeronautical Systems Division/Facilities Management (ASD/PMDA)
Wright-Patterson Air Force Base, Ohio 45433-6503

United States Air Force Occupational
and Environmental Health Laboratory (USAFOEHL)
Brooks Air Force Base, Texas 78235-5501

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) In accordance with the procedures developed for the Department of Defense (DOD) Installation Restoration Program (IRP), a Phase II, Stage I site investigation has been performed at the USAF Plant No. 59 (AFP 59) in Johnson City, New York. AFP 59 is located in an industrial area adjacent to the Susquehanna River. The site overlies the Clinton Street-Ballpark Valley aquifer which consists of glacial valley fill sediments of clay, silt, sand and gravel. This aquifer is a major source of groundwater in the area and has been designated a "sole source" aquifer. As part of the field investigation a total of three shallow monitoring wells were installed to depths of 26-29 feet. Three shallow test borings (10 feet) were also drilled near the plating operations. Fifteen (15) subsurface soil samples plus QA/QC samples were submitted for laboratory analysis. The soil samples showed trace levels of EP Toxicity metals which were below EP Toxicity maximum contaminant levels. Groundwater samples were (Continued on attached sheet)			
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collected from the 3 wells installed during the investigation and from one production well at the site. Two metals (cadmium and lead) and two organics (trichloroethene and trans-1,2-dichloroethene) were detected in samples at levels equal to or in excess of current relevant criteria, standards or guidance values. Analytical results indicate some correlation with chemicals reportedly stored and used in industrial processes at AFP 59 in the past. The distribution of similar contaminants in groundwater and soil were inconsistent throughout the site. The highest level of lead in groundwater was found in the upgradient well, indicating that the contamination may be originating from an off-site source. Volatile organics were only found in one shallow monitoring well and the deeper on-site production well. These wells are located downgradient/cross-gradient to AFP 59. This indicates that the contamination in the deeper zone of the aquifer may also have an off-site origin. A major receptor near AFP 59 is the impact this contamination may have on municipal water supply wells within 1000 feet southwest of the site. The results of this investigation indicate that additional Phase II efforts are required to assess the full extent of contamination at the site.

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PREFACE

As requested by the U.S. Air Force Occupational and Environmental Health Laboratory (USAFOEHL), Fred C. Hart Associates, Inc. (HART) has prepared the following IRP Report for Phase II confirmation work at the Air Force owned General Electric operated Air Force Plant No. 59 (AFP 59) in Johnson City, New York. This work was conducted under USAF contract No. F33615-84-D-4404, Task No. 0007 and was in accordance with an EPA-approved work plan. This report provides a summary of investigations requested in the USAF June 1986 Scope of Work found in this report as Appendix B.

The following HART personnel were involved with the preparation of this report:

James Mack - Contract Management

Robert Goldman - Project Management, Recommendations

Vanessa DeVillez - Field Program, Geology, Hydrogeology

Jill Greenberg - Hazard Assessment, Risk Assessment

HART would like to acknowledge the assistance provided by General Electric during the investigation. In particular, Mr. Patrick Gilligan, Environmental Engineer at the AFP 59 facility, is recognized for devoting a great deal of time to coordinating plant activities to facilitate the field program.

This work was accomplished between August 1986 and March 1988. Mr. James W. Better of the Technical Services Division, USAF Occupational and Environmental Health Laboratory (USAFOEHL) was the Technical Monitor.

Approved,

A handwritten signature in dark ink, appearing to read "James P. Mack" with a small "RG" or similar mark at the end.

James P. Mack
Contract Project Manager

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INSTALLATION RESTORATION PROGRAM
PHASE II - CONFIRMATION/QUANTIFICATION
UNITED STATES AIR FORCE PLANT NO. 59
JOHNSON CITY, NEW YORK

EXECUTIVE SUMMARY

In accordance with the procedures developed for the Department of Defense (DOD) Installation Restoration Program (IRP), a Phase II, Stage 1 site investigation has been performed at the United States Air Force Plant No. 59 (AFP 59) in Johnson City, New York (Figure 1). A Phase I Records Search of plant documents was performed in October 1984 by CH₂M HILL, Gainesville, Florida. The Phase I report identified one main area of the plant property suspected to be a potential source of contamination. During this Phase II investigation, a second potential source of heavy metal contamination from plating operations (contamination of the soil underneath the Plating Building) was identified (Figure 2). The field investigations and discussion of results were undertaken with the intent to fulfill the requirements of the USAF Phase II investigation philosophy.

Area No. 1 - Former Underground Waste Oil Storage Tanks. Area No. 1 was identified during the 1984 IRP Phase I - Records Search as a potential concern due to spillage associated with several underground oil storage tanks and the close proximity of municipal water supply wells. The Clinton Street-Ballpark Valley aquifer, the aquifer underlying the site, has been designated as a "sole source" aquifer in the Johnson City area. Historical data indicate that waste oils were routinely spilled in this area and could have caused groundwater contamination.

Area No. 2 - Plating Building. General Electric identified Area No. 2 as an area of concern at the beginning of the Phase II investigation. The potential source of contamination in this area is plating wastes, and is a concern because of the toxicity and persistence of the heavy metals found in plating wastes. GE personnel identified this area while repairing a (CL5121A)

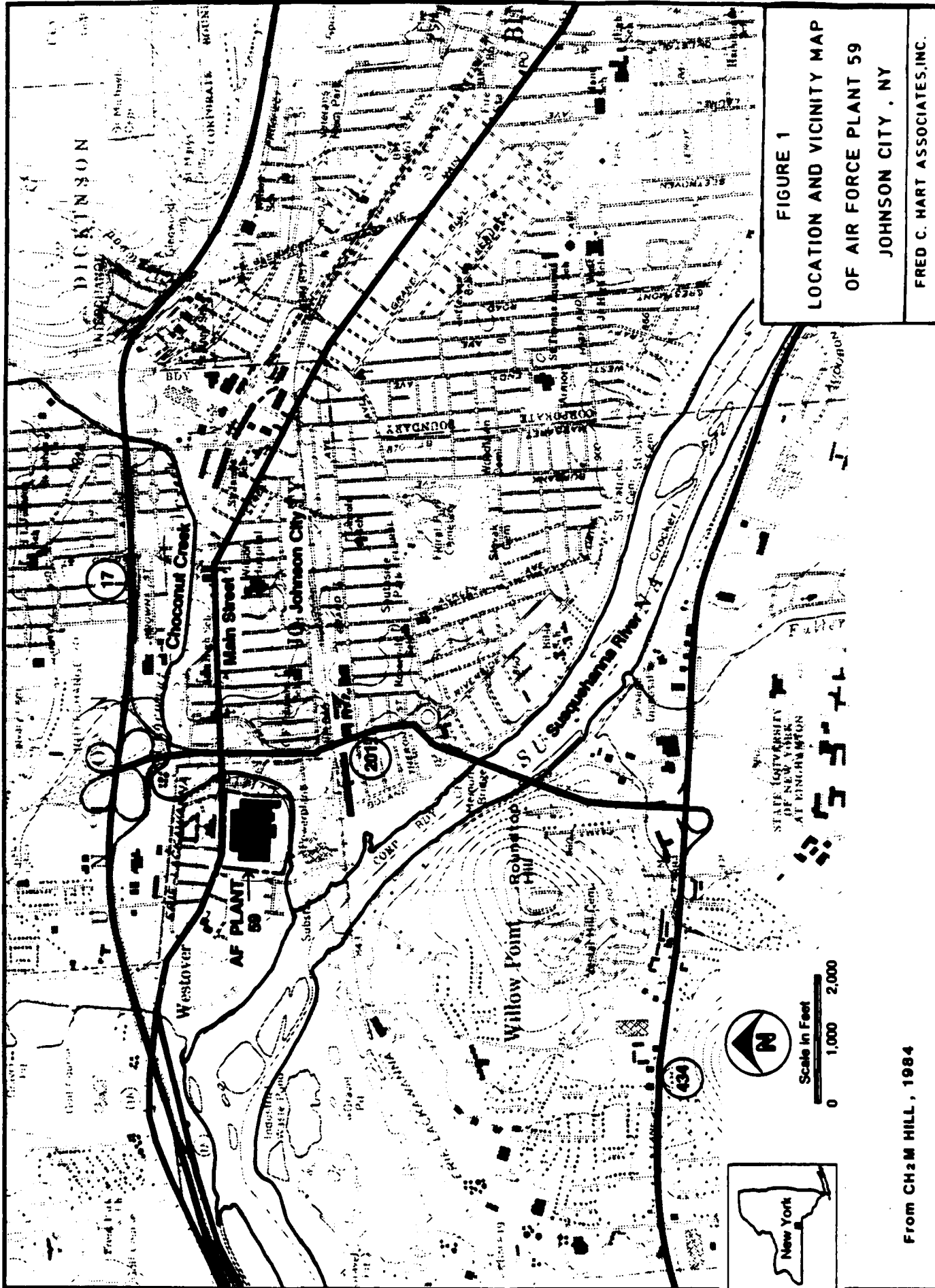


FIGURE 1
LOCATION AND VICINITY MAP
OF AIR FORCE PLANT 59
JOHNSON CITY, NY
FRED C. HART ASSOCIATES, INC.

From CH2M HILL, 1984

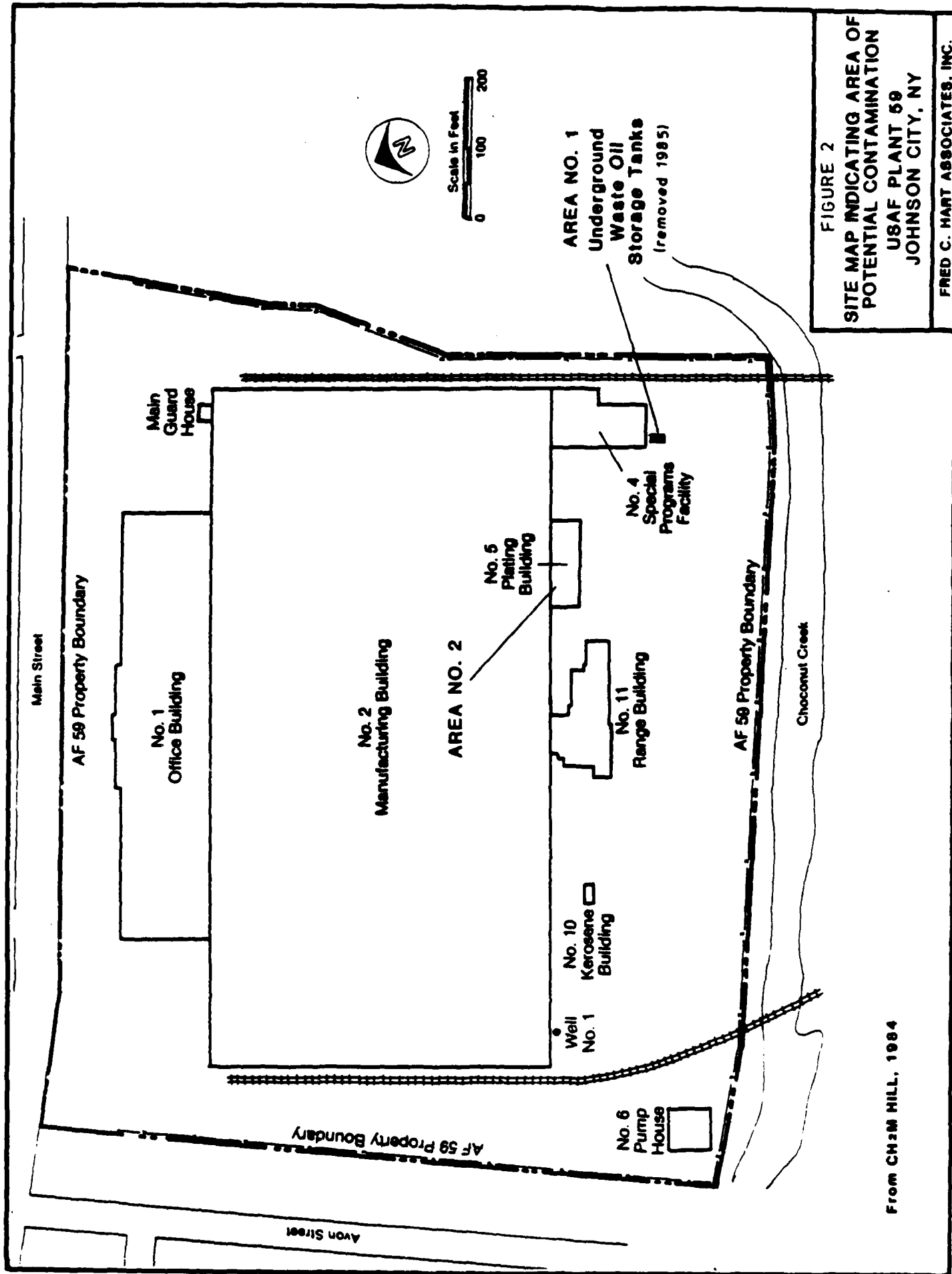


FIGURE 2
SITE MAP INDICATING AREA OF
POTENTIAL CONTAMINATION
USAF PLANT 59
JOHNSON CITY, NY
FRED C. HART ASSOCIATES, INC.

From CH2M HILL, 1984

leak in the underground sprinkler main beneath the plating building, when they observed discoloration in the soils. GE and USAF personnel expressed concern that heavy metal contaminants might be present and that these contaminants could migrate to the groundwater. The influx of water from the leaking sprinkler main could accelerate the migration of these potential contaminants.

A. Background

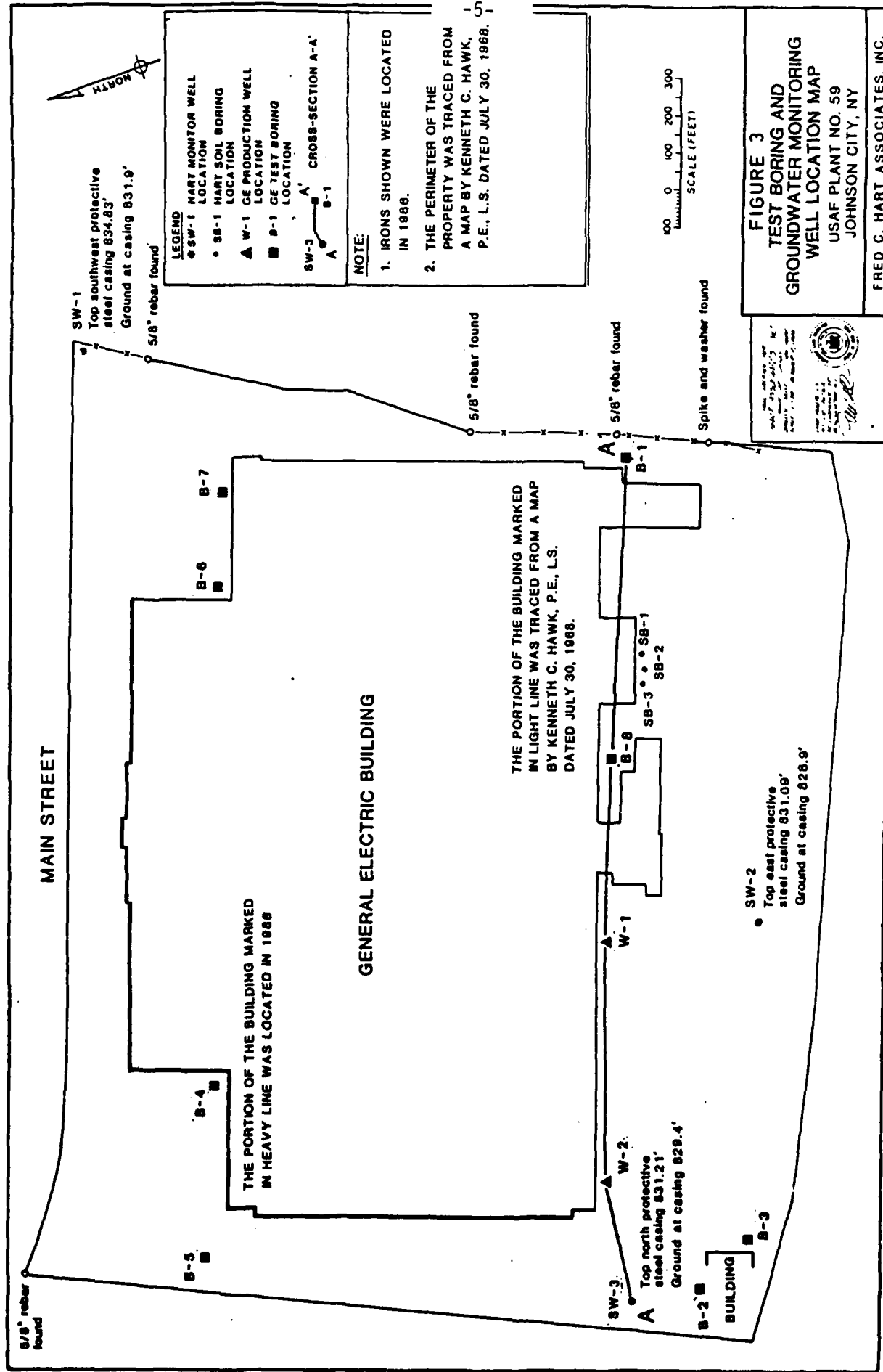
AFP 59 is located in Johnson City, New York, in an urban area with significant industrial activity (Figure 1). The current occupant of the plant is General Electric (GE), whose operations at the plant include the manufacture of flight control, laser, weapons control, internal navigation, and guidance systems. These systems are used in various military and commercial aircraft. Between 1942 and 1945, the plant was occupied by Remington Rand for the manufacture of airplane propellers. From 1945 to 1949, the plant was idle; the United States Air Force has occupied the site since 1949.

B. Field Program

Between September 8 and September 24, 1986, Fred C. Hart Associates, Inc. conducted a Phase II, Stage 1 field investigation at AFP 59 in accordance with the procedures outlined in the Technical Operations Plan (Appendix K).

Monitoring Well Program. A test boring and monitoring well installation program was conducted at AFP 59 to gather information regarding the local geology, soil grain size distribution, shallow subsurface permeability and contaminant distribution. Three shallow groundwater monitoring wells were installed in the uppermost water-bearing zone ranging in depth from 26 to 29 feet. Locations of the monitoring wells are shown in Figure 3.

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Soil samples were collected from the monitoring well borings and were field screened with an Organic Vapor Analyzer (OVA) to ascertain the relative presence of volatile organic compounds. Six soil samples with generally higher OVA readings were selected and sent to the laboratory for analysis of volatile organics and EP toxicity metals. Grain size distribution analyses were performed on two samples taken from each test boring.

Test Borings - Plating Building. In response to a request by the USAFOEHL, a test boring investigation was conducted in the vicinity of the plating building. The borings were advanced to a depth of ten feet. Two samples from each boring were analyzed for EP Toxicity metals and total chromium. In addition to these samples, one sample from SW-1 was submitted to establish background concentrations of the heavy metals. One soil sample from beneath the plating building (collected by GE personnel) was tested for the above-mentioned parameters to assess if the underlying soil was contaminated with heavy metals.

Groundwater Sampling Program. Groundwater samples were collected from the three wells installed by HART and from the existing on-site production well. The samples were analyzed for total petroleum hydrocarbons, primary metals, volatile organics and cyanide.

Groundwater level measurements were obtained during a 12-hour period following the installation of the wells. This information was used to construct a piezometric surface contour map to ascertain the direction of groundwater flow at the site.

C. Environmental Setting

The site geology is characterized by unconsolidated sand, silt, gravel, and clay. These are valley fill sediments deposited by Pleistocene glaciers during the last ice age. The valley fill sediment is

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located in the trough-shaped valleys cut into the bedrock as a result of glacial action. AFP 59 is located in the flood plain of the post-glacial Susquehanna River.

The results from test borings indicate that silty sands underlie the site with occasional layers of gravel, sand, silt, and clay. Results of grain size analyses indicate that the shallow subsurface sediments are predominantly gravel and silty sand. The bedrock underlying these glacial deposits is the Devonian Sonyea Group consisting of shales and siltstones. Bedrock was encountered at a depth of approximately 94 feet below AFP 59.

The Clinton Street-Ballpark Valley aquifer underlies the AFP 59 site. This aquifer extends from the western part of Binghamton through the central part of Johnson City, New York (NYSDEC, 1977). The Clinton Street-Ballpark Valley aquifer has been designated as a "sole source" aquifer by EPA under the Safe Drinking Water Act and is the major groundwater resource in the area. Water level measurements collected at the site (from HART wells) indicate that the direction of groundwater flow is to the northwest. Groundwater is found at a depth of approximately 20 feet below ground level at AFP 59.

D. Significance of Findings

A total of 42 subsurface soil samples were collected during this investigation. Using the OVA headspace screening process, 15 samples were selected and sent for laboratory analysis. Four groundwater samples were collected, all of which were submitted to the laboratory for analysis. Soil samples were collected from the well borings and test borings, and groundwater samples were collected from the on-site monitoring wells and the existing on-site production well. Proper QA/QC procedures were maintained through the use of chain-of-custody records, proper analytical procedures, duplicate samples and field blanks. Confirmatory analyses were performed on samples indicating the presence of volatile organic constituents.

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Subsurface Soil Samples. Laboratory analyses detected arsenic, barium, cadmium, chromium, lead, silver, selenium and total petroleum hydrocarbons in subsurface soils at AFP 59. These EP Toxicity metals were detected at concentrations below established maximum EP Toxicity concentrations. The range in concentration of total petroleum hydrocarbons was below the method detection limit except for one sample.

Total chromium was analyzed for and detected in all soil samples taken from the Area No. 2 plating room boreholes. The concentrations of total chromium for all samples was above the background sample; however, none was more than an order of magnitude higher. EP Toxicity values for chromium for the same samples were all below maximum EP Toxicity concentrations. Chromium was not detected in any of the groundwater samples that were collected.

Groundwater. The results of all inorganic and total petroleum hydrocarbon analyses for groundwater samples are presented in Table 1. Test results for volatile organics in groundwater, including confirmatory analyses, are summarized in Table 2. Table 3 documents the substances of concern, and the concentration range of primary metals, volatile organics and total petroleum hydrocarbons in the groundwater samples. These three categories are compared with five relevant types of water quality standards, criteria, or guidance values. Substances of concern in groundwater that could potentially endanger human health, welfare or the environment include four metals: arsenic, barium, cadmium and lead. Volatile organics were found only in samples collected at SW-3 and the production well. Volatile organic compounds detected on-site include 1,1-dichloroethane, trans-1,2-dichloroethene, 1,1,1-trichloroethane and trichloroethene. Total petroleum hydrocarbons were detected only in the production well.

Among the nine potentially hazardous substances detected in the groundwater at AFP 59, four constituents (cadmium, lead, trichloroethene

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TABLE 1

ANALYTICAL RESULTS FOR INORGANICS AND
PETROLEUM HYDROCARBONS IN GROUNDWATER
USAF PLANT NO. 59
JOHNSON CITY, NY

Parameters

Sample Date: 9/23/86										
Analysis Date: 9/25/86(a)										
Sample Identification	Barium	Cadmium	Lead	Arsenic	Silver	Chromium	Mercury	Selenium	Cyanide	Total Petroleum Hydrocarbons
Detection Limit (mg/L)	0.01	0.005	0.02	0.005	0.01	0.02	0.001	0.005	0.01	0.5
Analytical Method	E200.7	E200.7	E200.7	E206.2	E200.7	E200.7	E245.1	E270.2	A412b/SW9010	E418.1
AFP59, SW1, Water, Hart 001	0.21	0.007	0.30	0.02	<0.01	<0.02	<0.001	<0.005	<0.01	<0.5
AFP59, SW2, Water, Hart 002	<0.01	0.01	0.03	<0.005	<0.01	<0.02	<0.001	<0.005	<0.01	<0.5
AFP59, SW3, Water, Hart 003	0.05	<0.005	0.14	0.01	<0.01	<0.02	<0.001	<0.005	<0.01	<0.5
AFP59, SW4, Water, Hart 004(b)	<0.01	<0.005	0.07	0.01	<0.01	<0.02	<0.001	<0.005	<0.01	<0.5
AFP59, Production Well, Hart 007	0.14	<0.005	0.13	0.01	<0.01	<0.02	<0.001	<0.005	<0.01	0.6
Field Blank, Hart 005	NA(c)	NA	NA	NA	NA	NA	NA	NA	NA	<0.5

(a) Arsenic and Petroleum Hydrocarbons analyzed on 9/29/86 and 10/15/86 respectively.
 (b) Duplicate Sample of AFP 59, SW-2, WATER, HART 002.
 (c) NA - Parameter Not Analyzed
 (CL5120A)

TABLE 2

ANALYTICAL RESULTS FOR ORGANICS IN GROUNDWATER

USAF PLANT NO. 59
JOHNSON CITY, NY

Detection Limit (ug/L) Analytical Method	1,1-dichloroethane		trans-1,2-dichloroethane		1,1,1-trichloroethane		trichloroethene	
	First Column	Confirmatory Analysis	First Column	Confirmatory Analysis	First Column	Confirmatory Analysis	First Column	Confirmatory Analysis
AFP 59 SW-1, Water, HART 001	1 E601/602	1 E624	1 E601/602	1 E624	2 E601/602	2 E624	2 E601/602	2 E624
AFP 59 SW-2, Water, HART 002	<1	NA (a)	<1	NA	<2	NA	<2	NA
AFP 59 SW-3, Water, HART 003	<1	NA	<1	NA	<2	NA	<2	NA
AFP 59 SW-4, Water, HART 004(b)	<1	NA	<1	NA	<2	NA	<2	NA
AFP 59, Production Well, HART 007	16	15	66	73	9	3	11	8
Field Blank, HART 005	<1	NA	<1	NA	<2	NA	<2	NA

(a) NA Second column confirmatory analysis not performed.

(b) Duplicate Sample of AFP 59, SW-2, WATER, HART 002.

(CL5120A)

TABLE 3

COMPARISON OF SUBSTANCES OF CONCERN IN GROUNDWATER
WITH RELEVANT CRITERIA, STANDARDS AND GUIDANCE VALUES

USAF PLANT NO. 59
JOHNSON CITY, NY

Parameter	Range of Concentrations (mg/L)	Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (mg/L)(a)	Preliminary Protective Concen- tration Limits (PPCLs) (mg/L)(b)	EPA Drinking Water Health Advisories (mg/L)(c)	Proposed Maximum Contaminant Level Goals (MCLGs) (mg/L)(d)	New York State Ambient Water Quality Standards & Guidance Values (NYSAMQSGVs) (mg/L)(e)
Barium	<0.01 - 0.21	1.0	1.0 (MCL)	1.8 (adult, lifetime)	1.5	1.0(S)
Cadmium	<0.005 - 0.01	0.010	0.01 (MCL) or 0.00000449 (UCR)	0.043 (infant, 1-day)	0.005	0.010(S)
				0.008 (infant, 10-day)		
				0.005 (infant, longer term)		
				0.018 (adult, longer term)		
Lead	0.03 - 0.30	0.05	0.155 (ADI) or 0.05 (MCL)	0.020 mg/day (infant, longer term)	0.020	0.025(S)
				0.020 mg/day (adult, longer term)		
				0.020 mg/day (adult, lifetime)		
Arsenic	<0.005 - 0.02	0.05	0.05 (MCL) or 0.0000025 (UCR)	0.050 (infant, 1- and 10-day)	0.05	0.025(S)
				0.050 (infant & adult, longer term)		
				0.050 (adult, lifetime)		

(CL5120A)

TABLE 3 - (CONTINUED)

COMPARISON OF SUBSTANCES OF CONCERN IN GROUNDWATER
WITH RELEVANT CRITERIA, STANDARDS AND GUIDANCE VALUES

USAF PLANT NO. 59
JOHNSON CITY, NY

Parameter	Range of Concentrations (mg/L)	Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (mg/L)(a)	Preliminary Protective Concentration Limits (PPCLs) (mg/L)(b)	EPA Drinking Water Health Advisories (mg/L)(c)	Proposed Maximum Contaminant Level Goals (MCLGs) (mg/L)(d)	New York State Ambient Water Quality Standards & Guidance Values (NYSAMQSVs) (mg/L)(e)
Total Petroleum Hydrocarbons	<0.5 - 0.6	NA ^(f)	NA	NA	NA	1.0(g)
1,1-Dichloroethane	<0.001 - 0.016	NA	4.05	NA	NA	0.050(gv)
trans-1,2-Dichloroethene	<0.001 - 0.066	NA	NA	2.72 (infant, 1-day) 1.0 (infant, 10-day) 1.0 (infant, longer term) 3.5 (adult, longer term) 0.35 (adult, lifetime)	0.07	0.050(gv)
1,1,1-Trichloroethane	<0.002 - 0.009	0.200	19.0 (ADI)	140.0 (infant, 1-day) 35.0 (infant, 10-day) 35.0 (infant, longer term) 125.0 (adult, longer term) 1.0 (adult, lifetime)	NA	0.050(gv)
Trichloroethene	<0.002 - 0.011	0.00	.00184 (UCR)	NA	NA	0.010(s)

(CL5120A)

TABLE 3 - (CONTINUED)

COMPARISON OF SUBSTANCES OF CONCERN IN GROUNDWATER
WITH RELEVANT CRITERIA, STANDARDS AND GUIDANCE VALUES

USAF PLANT NO. 59
JOHNSON CITY, NY

- (a) USEPA 40 CFR 141 (National Primary Drinking Water Standards); 52 Federal Register 25712, July 8, 1987.
- (b) USEPA Compilation of Agency reviewed health effects data for 40 CFR 261, Appendix VIII "Hazardous Constituents". UCR or unit cancer risk indicates a chemical with carcinogenic potential. Recommended level for protection of human health is zero based on a non-threshold assumption for this chemical. Level indicated corresponds to a 10^{-6} risk from lifetime exposure (70 years) for a 70 kg adult.
- (c) Superfund Public Health Evaluation Manual, October 1986, USEPA Office of Emergency and Remedial Response, Office of Solid Waste and Emergency Response. EPA Drinking Water Health Advisories are based upon exposures for a 10 kg infant or a 70 kg adult. Longer term health advisories are for exposures ranging from several months to several years and should generally be compared only to estimated short-term concentrations.
- (d) Proposed MCLGs, Federal Register, Vol. 50, No. 219, Wednesday, November 13, 1985, pp. 46935-47022.
- (e) Quality standards for Class GA are the most stringent of (1) maximum contaminant levels (MCLs) for drinking water established in 10 NYCRR subpart 5-1, (2) MCLs established under the Safe Drinking Water Act, (3) Standards for raw water quality established under 10 NYCRR Part 170, or (4) the standards listed below. S = Standard; GV = Guidance Value
- (f) NA - Not applicable. No standard or guidance established.
- (g) Recommended Cleanup Standard for Groundwater, New Jersey Department of Environmental Protection.

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and trans-1,2-dichloroethene) have been detected at concentration levels equal to or in excess of current:

- o applicable Safe Drinking Water Act Maximum Contamination Levels (MCLs)
- o Preliminary Protective Concentration Limits (PPCLs) for protection of human health from ingestion of water containing contaminants
- o proposed Maximum Contaminant Level Goals (MCLGs)
- o New York State Ambient Water Quality Standards and Guidance Values for groundwater (NYSAWQSGVs)

The EPA Drinking Water Health Advisories and PPCLs Unit Cancer Risks (UCR) were included for purposes of comparison only. The Advisories are based on short- and long-term exposures. The PPCL UCR values indicate that the compound is a potential carcinogen and therefore a health concern. These UCR values correspond to an incremental increase in cancer risk of 10^{-6} .

Lead exceeded the NYSAWQSGV and the MCL in all wells. Cadmium was detected in SW-2 at the MCL and NYSAWQSGV for groundwater. Cadmium was also detected in SW-1 above the MCLG but below the MCL and NYSAWQSGV.

Of the volatile organic contaminants detected, trichloroethene was present in concentrations which exceed the MCL and PPCL in two wells (SW-3 and the production well) and the NYSAWQSGV in the production well. Trans-1,2-dichloroethene was detected in only one well and exceeded the NYSAWQSGW (production well).

Conclusions Regarding Contaminant Distribution. Contaminants of concern in the deeper portion of the Clinton Street-Ballpark Valley (CL5121A)

aquifer include some organic compounds and lead. Historical analytical results of deep groundwater production wells in the vicinity of AFP 59 indicate that in the past there has been organic contamination both upgradient and downgradient of AFP 59. Several of the same parameters found in the deep production well were observed in these off-site production wells (1,1-dichloroethane and trans-1,2-dichloroethene). These results are given in Appendix H.6. The results of the preliminary assessment indicate that there may be a source of off-site volatile organic contamination. The off-site metal analysis data from the deeper zone of the Clinton Street-Ballpark Valley aquifer are insufficient to determine the source of lead.

Three groundwater monitoring wells (SW-1, SW-2 and SW-3) screened in the shallow zone of the Clinton Street-Ballpark Valley aquifer identified contamination by one volatile organic and two metals. Trichloroethene was found only in well SW-3, downgradient and cross-gradient of the groundwater flow direction at AFP 59. A definitive source of this contaminant is difficult to ascertain; it could be from river or creek water recharging the aquifer, or from some other potential source at AFP 59. Source determination is hampered by the limited number of sample locations and sampling events from which data have been collected. Lead was observed in all on-site groundwater monitoring wells in concentrations exceeding applicable standards. The highest concentration of lead in groundwater was found in the upgradient shallow well (SW-1). Cadmium was found in two wells (SW-1 and SW-2, upgradient and downgradient respectively) indicating that this contamination could be originating from an off-site source.

The sampling data collected during this study indicate minor contamination in both the shallow wells and the deeper production well. There is a clay layer which provides a barrier between the upper and lower groundwater zones. Clay layers are very dense and act as barriers to vertical contaminant migration, but examination of the other deep borehole logs indicates that this clay layer does not appear to be continuous (CL5121A)

across the site. This would allow contaminants to flow more freely between the upper and lower groundwater zones. The volatile organic contamination is limited to the shallow well SW-3 and the production well. Based on a single sampling of the shallow wells, and the limited distribution of this volatile organic contamination, verification of these results is recommended.

The primary receptor of concern for contaminated groundwater is the public supply wells in the "sole source" Clinton Street-Ballpark Valley aquifer.

Metal concentrations found in the soil analyses were all below applicable EP Toxicity maximum contaminant levels. No volatile organic contamination was observed in soils.

E. Recommendations

The site has been classified (as per USAF catagories) as a Category II site, which is defined as a site requiring additional Phase II efforts. The following recommendations are based on the results of this Phase II study, and are proposed in order to more fully develop and understand existing groundwater conditions at the AFP 59 site (Table 4).

TABLE 4
RECOMMENDATIONS FOR POTENTIAL PROBLEM AREAS

<u>Location</u>	<u>Recommended Action</u>	<u>Rationale</u>
All Monitoring Wells	Sample existing wells for priority pollutants; based on the results, continue to monitor groundwater VOCs, petroleum hydrocarbons and primary metals or priority pollutants. Assess groundwater flow patterns.	To assess if other contaminants are present. Contaminant concentrations in groundwater are trace levels and monitoring is necessary to quantify contaminants in groundwater.
Areas No. 1 & 2	Install shallow well near plating building.	To monitor for potential migration of contaminants from underneath building (Area No. 2), and to detect possible contaminant releases from Area No. 1.
Plant Site	Install three deep wells near the existing shallow wells. Install a well nest consisting of one deep well and one shallow well in the northwest corner of the site.	To verify the existence/extent of any contaminants in the zone utilized for potable water; monitor groundwater quality down-gradient of the site.
	Perform a pumping test with the production well to assess the interconnection between upper and lower water-bearing zones.	To evaluate site-specific hydrologic conditions, and establish extent of hydrologic connection between upper and lower water-bearing zones. This will help to determine whether downward migration of contaminants from the site are the source of the contaminants in the lower zone.
	Sample the surface water and sediment in Little Choconut Creek upstream and downstream of OUTFALL 001, and analyze for priority pollutants.	To establish the contribution, if any, of contaminants in Little Choconut Creek as it recharges the underlying aquifer.

(CL5119A)
(01071-00-86007-00)

I. INTRODUCTION

A. Mission of Air Force Installation Restoration Program (IRP)

The United States Air Force has long been engaged in a wide variety of operations that require the storage, use and disposal of toxic and hazardous materials. Federal, state and local governments have developed strict regulations requiring disposers to identify the location and contents of past hazardous waste disposal sites and, when necessary, act to eliminate any hazards to the environment or human health. The primary federal legislation governing disposal of hazardous waste is the amended Resource Conservation and Recovery Act (RCRA). Under Section 6003 of RCRA, federal agencies are directed to assist the Environmental Protection Agency (EPA). Under Section 3012, state agencies are required to inventory past disposal sites and make the information available to the requesting regulatory agencies. To assure compliance with these hazardous waste regulations, the Department of Defense (DOD) developed the Installation Restoration Program (IRP). The current DOD IRP policy is Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and implemented by Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the Installation Restoration Program. DOD policy is to identify and evaluate suspected problems associated with the past handling of hazardous materials and to remediate environmental contamination that has resulted from these past operations. The IRP will be the basis for response actions at Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and clarified by Executive Order 12316. CERCLA is the primary federal legislation governing remedial actions at past hazardous waste disposal sites.

B. Purpose of Program

The purpose of this study is to conduct a contaminant source investigation at Air Force Plant No. 59 (AFP 59) located in Johnson City, (CL5119A/2)

New York. The study assesses: 1) the presence, or absence, of contamination within the specified areas of the field survey; 2) the potential for migration within the specified areas of the field survey; 3) the extent and magnitude of contamination on the AFP 59 property if present; and 4) potential environmental consequences and health risks of migrating contaminants (if found) based on state and federal standards for these contaminants. This report evaluates the results of the field investigation conducted by HART and incorporates all available historic data. This report also identifies contaminants which may have originated from off-site property adjacent to the AFP 59 facility.

The Installation Restoration Program consists of the following four phases:

- Phase I - Initial Assessment/Records Search
- Phase II - Confirmation and Quantification
- Phase III - Technology Base Development
- Phase IV - Operations/Remedial Actions

As requested by the U.S. Air Force Occupational and Environmental Health Laboratory (USAFOEHL), Fred C. Hart Associates, Inc. (HART) has prepared the following IRP Report for Phase II confirmation work at AFP 59 in Johnson City, New York. The work performance is based on the Phase II Technical Operations Plan prepared by HART in September 1986, the Phase I Initial Assessment/Records Search prepared by CH₂M Hill in October 1984, the HART Presurvey Report for the USAFOEHL prepared in 1986, and the Air Force Phase II Confirmation Study Scope of Work. The field investigation and results discussed in this document fulfill requirements of the USAF Phase II, Stage 1.

C. Duration of Program

This report contains information obtained during a field investigation conducted in accordance with procedures described in the HART Technical Operations Plan for the Phase II (Confirmation and Quantification) portion of the USAF Installation Restoration Program. The Technical Operations

(CL5119A/2)

Plan provided a detailed operations and sampling protocol for field activities of the current investigation. In compliance with this plan, HART completed the following tasks:

C.1 Test Boring and Monitoring Well Installation

- Provide an upgradient/downgradient understanding of groundwater flow at the plant
- Characterize the hydrogeologic conditions at the site
- Establish whether the plant, as a whole, is contributing contamination to the regional groundwater flow regime and ascertain if there are any upgradient sources of contamination
- Establish the vertical distribution of potential soil contamination by test borings

C.2 Site-Specific Investigation of Identified Hazardous Waste Storage Areas

- Based on results in the Phase I report, investigate specific sites for potential contamination on the site
- Evaluate water quality in the shallow aquifer both upgradient and downgradient of the plant

C.3 Groundwater Sampling

- Measure groundwater elevations
- Measure the background levels of natural constituents
- Assess the types and concentrations of potential contaminants

C.4 Test Boring Program - Plating Building

- Assess the potential for contaminant migration from beneath the Plating Building
- Assess the vertical distribution of potential contamination at the site

C.5 Surveying

- Permanently establish the horizontal location and vertical elevation of each monitoring well to assess groundwater elevations and flow direction

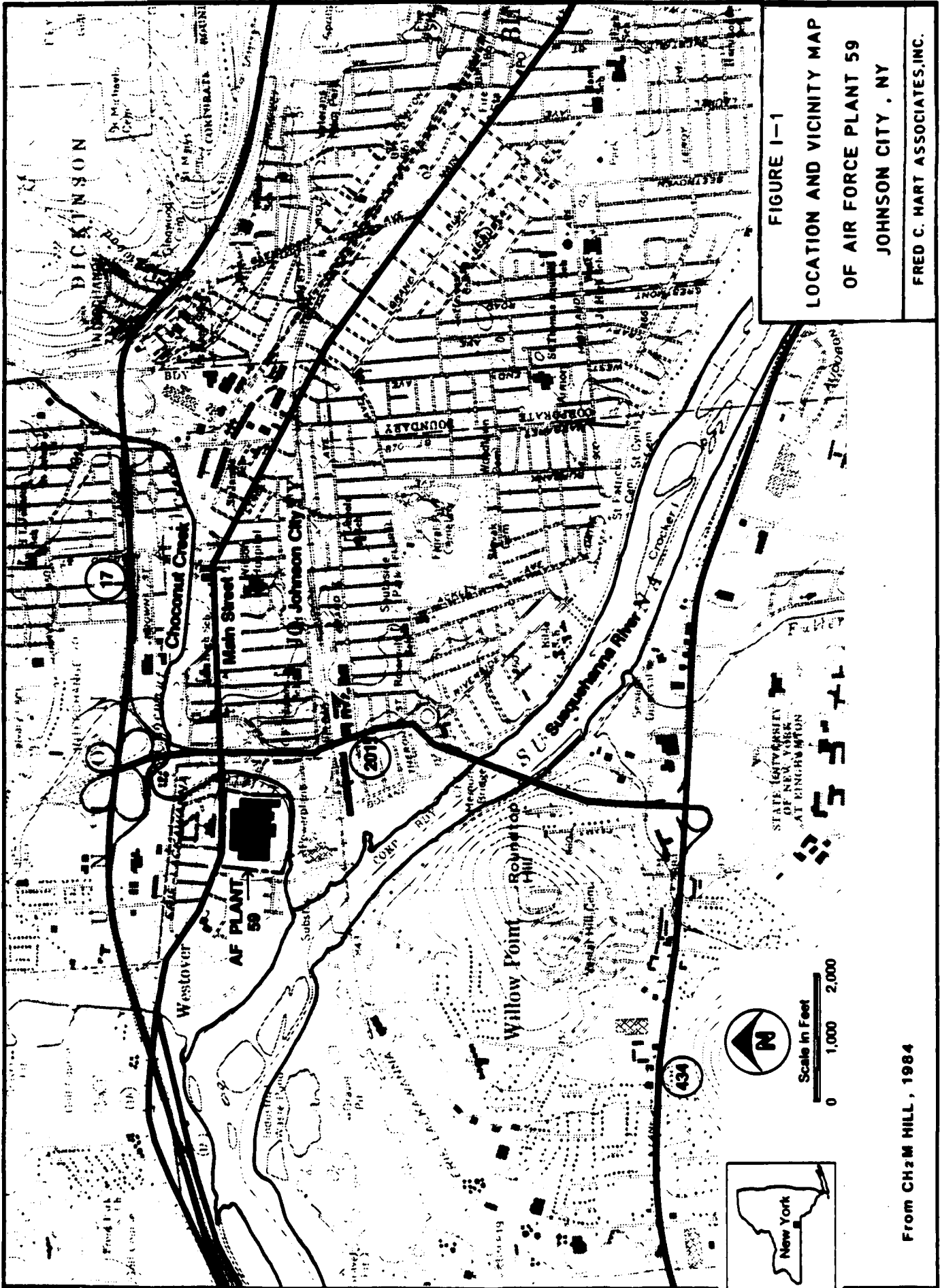
HART completed these field tasks within the three-week period of August 8, 1986, to August 24, 1986.

D. History of Industrial Operations at the Site
and Description of Potential Sources of Environmental Contamination

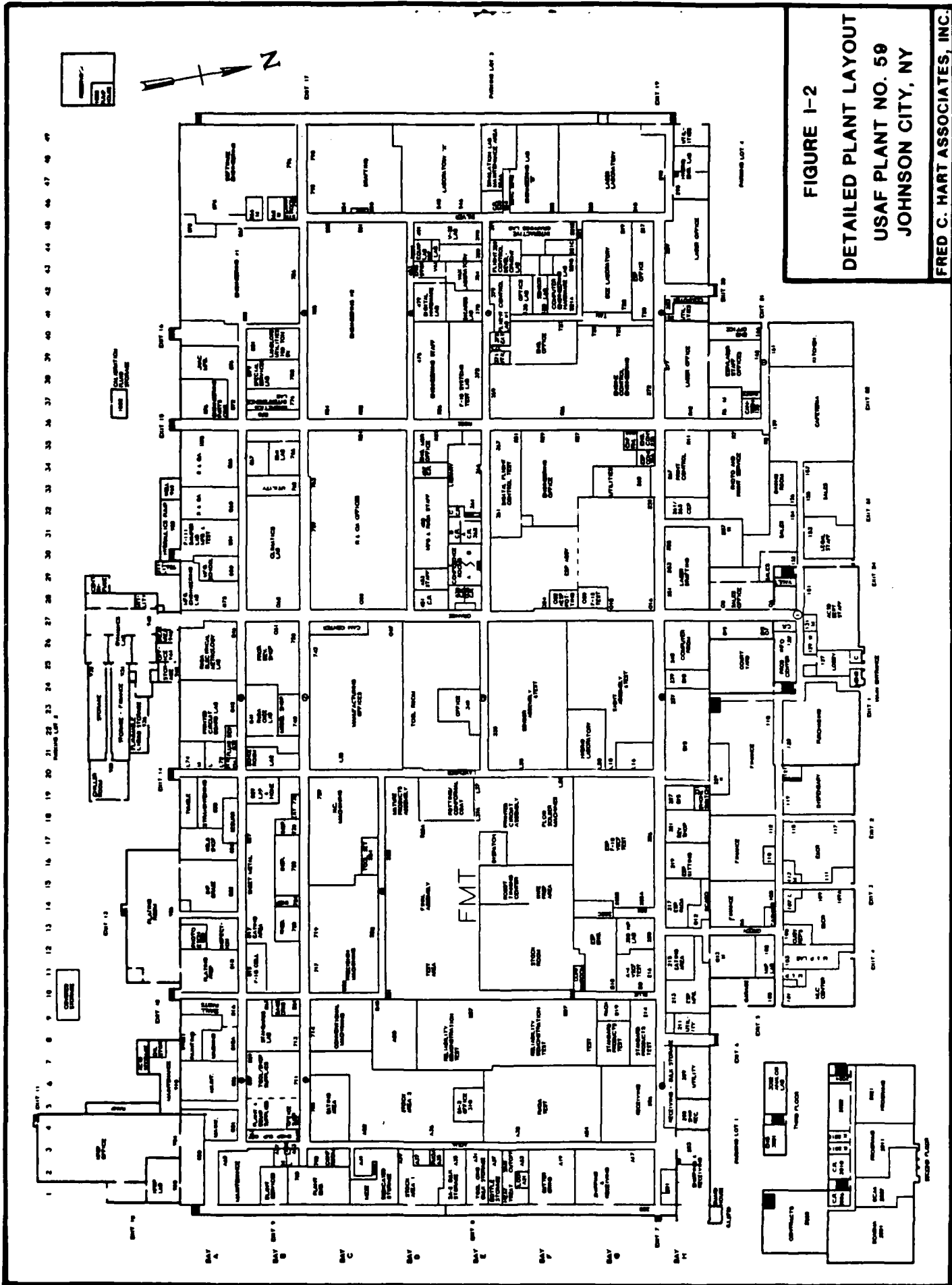
D.1 History of Industrial Operations

AFP 59, located in Johnson City, New York (Figure I-1), was designed and built in 1942 by PLANCOR, the Defense Plant Corporation. The original building contained 621,500 square feet of floor space and has remained essentially unchanged (Figure I-2).

Remington Rand, Inc. was the first manufacturer to occupy the plant. Remington Rand manufactured aluminum aircraft propellers at the plant from 1942 to 1945. The plant closed at the end of World War II. In April 1949, AFP 59 was reopened as an aircraft controls manufacturing facility. General Electric Company was contracted to operate the facility and the manufacturing process. The major process at that time was the



From CH2M HILL, 1984



manufacture of parts for electro-mechanical aircraft control systems. Plant activity peaked in 1967 at the height of the Vietnam War.

During the 1970s, technological advances in electronic control systems caused a decreasing demand for electro-mechanical control systems, resulting in a decline in machine shop activity. Currently, manufacturing at AFP 59 operates on a three-shift schedule, employing 2,300 people.

General Electric Company currently manufactures flight control, laser, weapons control, internal navigation, and guidance systems at AFP 59. These systems are used in various military aircraft including the F-18, F-15, F-111, and B-1. Control systems for Boeing 757 and 767 commercial jets also are manufactured at the plant.

D.1.a Site Improvements. Several improvements have been made to the outdoor facilities at AFP 59 over the years. In 1959, the gravel and dirt parking lots surrounding the manufacturing building were paved. In the mid-1960s the State of New York built an earthen containment dike along the banks of Little Choconut Creek behind the facility as part of a flood control project. In 1974 a water supply well was drilled immediately south of the manufacturing building to reduce the plant's demand on municipal water supplies. A water recharge well for non-contact cooling water was also drilled at this time; however, it was abandoned shortly after installation due to failure of geologic strata (CH₂M Hill, 1984). General Electric Company discontinued use of the railroad spur in the early 1950s. The spur was paved over, and in 1980 the trestle over Little Choconut Creek was removed.

D.2 Materials Handled and Waste Disposal Practices

Operations at AFP 59 have generated a variety of waste products, such as: waste oils, including cutting oils, lubricating oils, and coolants; spent solvents, including degreasing agents; spent process chemicals,

including plating acids, caustics, chromium and cyanide solutions; and paint residues. The manufacturing operations currently generate about 50,000 gallons per year of these wastes. The quantity of wastes generated in the past varied proportionally to the manufacturing activity at the plant.

The following summarizes past and present waste disposal practices used at AFP 59:

- o concentrated plating baths have been neutralized in an above-ground holding tank and removed by a contractor (1952 to present);
- o plating rinsewater was treated in a settling tank to precipitate metals prior to discharge to Outfall 001 (1952 to 1969); plating rinsewater was treated in a settling tank for chromium reduction and metal precipitation prior to discharge to Outfall 001 (1969 to July 1984); plating rinsewater is currently treated using an anion and cation exchange column and reused (July 1984 to present);
- o waste oils were primarily recovered, with some waste oils being discharged to an oil/water separator upstream of Outfall 002 (1942 to 1953); waste oils were discharged to two underground waste oil storage tanks and removed by a contractor for disposal (1953 to 1985); waste oils are discharged to one aboveground storage tank and oils are removed monthly by a private contractor (1985 to present); and
- o kerosene-based degreasing solvents were disposed of with the waste oils (1942 to 1969); spent solvents are drummed and removed by a contractor (1969 to present).

D.3 Potential Sources of Environmental Concern

D.3.a Area No. 1 - Former Underground Waste Oil Storage Tanks. Area No. 1 has been identified as a potential concern due to spillage associated with several underground oil storage tanks and the close proximity of municipal water supply wells. The Clinton Street-Ballpark aquifer, the aquifer underlying the site, has been designated as a "sole source" aquifer in the Johnson City area. Historical data indicate that waste oils were routinely spilled in this area and could have caused underground contamination.

In the past, Area No. 1 has been used for the temporary storage of waste oils. Two interconnected 1,000-gallon underground storage tanks were installed in 1953 and used until their removal in 1985 (Figure I-3). The underground waste oil tanks were inspected daily to prevent overtopping; however, waste oil spills have occurred during the monthly removal of oils from the tank. Interviews with employees indicate that the spills resulted from releasing of the residual waste oil in the vacuum truck suction hose. The area surrounding the tanks was backfilled with gravel during their installation. During tank removal operations, the gravel surrounding both tanks was found to be heavily stained. In the past, stained gravel had been removed and replaced with fresh gravel for aesthetic reasons. When the tanks were removed, soil was excavated to a depth of 12 feet (approximately 6 feet below the bottom of both tanks). The two underground tanks have been replaced by one double-walled aboveground tank.

Prior to 1969, non-chlorinated, kerosene-based degreasers were stored in the underground tanks along with waste oils. A comprehensive list of waste oils generated at AFP 59 is given in Appendix C-4.

D.3.b Area No. 2 - Plating Building. General Electric identified Area No. 2 as an area of concern at the beginning of the Phase II investigation. The potential contamination source in this area is plating

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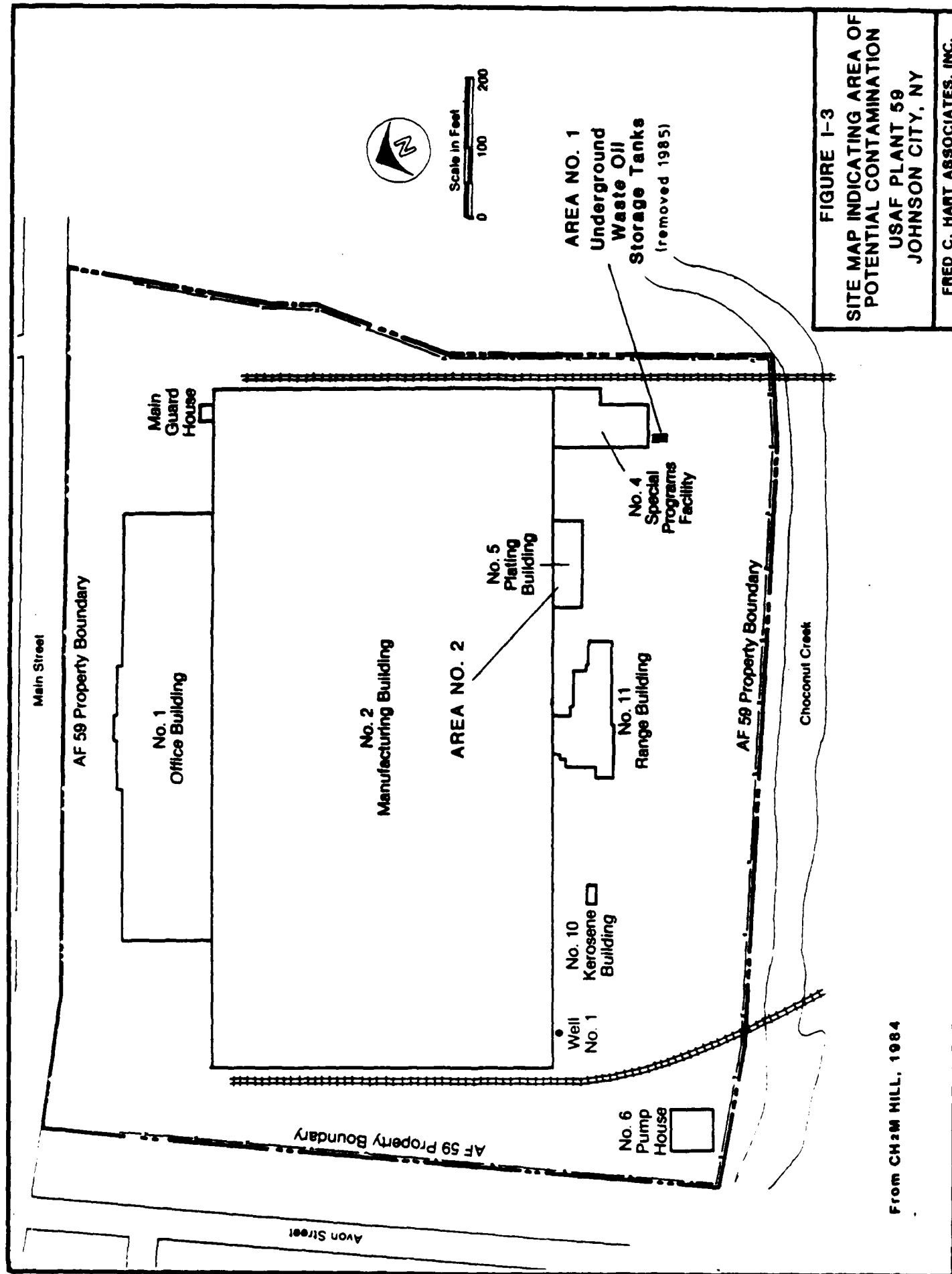


FIGURE I-3
SITE MAP INDICATING AREA OF
POTENTIAL CONTAMINATION
USAF PLANT 59
JOHNSON CITY, NY
FRED C. HART ASSOCIATES, INC.

From CH2M HILL, 1984

wastes, and is a concern because of the toxicity and persistence of heavy metals in plating wastes. GE personnel identified this area while repairing a leak in the underground sprinkler main beneath the plating building, where they observed discoloration in the soils. GE and USAF personnel expressed concern that heavy metal contaminants might be present and that these contaminants could migrate to the groundwater. The influx of water from the leaking sprinkler main could accelerate the migration of these potential contaminants.

E. Identification of Pollutants Sampled

A variety of analytical techniques were used to evaluate the quality of the soil and groundwater samples collected. An Organic Vapor Analyzer (OVA) was used to screen soil samples to assess which samples should be submitted for laboratory analysis. In addition, pH and conductivity were measured in the field to provide a preliminary assessment of groundwater quality. Soil and groundwater samples were analyzed for total petroleum hydrocarbons, primary metals, volatile organics, cyanide, EP Toxicity metals (soil only), and total chromium (soil only).

E.1 Use of the Organic Vapor Analyzer

An OVA was used to screen each subsurface soil sample in the field. For this screening, portions of each soil sample were placed in 40-ml glass vials with Teflon caps. The vials were immersed in a 40°C hot water bath for 20 minutes. A sample of the headspace within each vial was taken with a syringe and injected into the OVA to determine the relative concentrations of volatile organic contaminants in each soil sample. The two samples from each well boring generally showing the highest concentrations were sent to the laboratory for more detailed analyses.

Of the 42 subsurface soil samples collected, 16 were selected for laboratory analysis.

(CL5119A/2)

E.2 Analytical Testing

The 16 soil samples selected for detailed laboratory evaluation were analyzed for total petroleum hydrocarbons (TPH), EP Toxicity metals, VOCs and cyanide. Soil samples from test borings located near the plating building were analyzed for total chromium and EP Toxicity metals. Princeton Testing Laboratory in Princeton, New Jersey, performed the analyses.

Groundwater samples from monitoring wells were also submitted for laboratory analyses. These analyses included TPH, primary metals, VOCs and cyanide. These samples were also analyzed by Princeton Testing Laboratories. A total of five groundwater samples were collected: one from the on-site production well, three from the groundwater monitoring wells, a duplicate sample from one of the monitoring wells, and a field blank analyzed as a part of the QA/QC protocol.

E.3 Additional Testing

In addition to the analyses discussed in Sections E.1 and E.2, spilt samples for one soil and one water sample were sent to USAFOEHL to be analyzed for the same parameters listed above. Finally, a sample of drill cuttings from the boreholes was also sent to Princeton Testing Laboratories for EP Toxicity metals and total chromium analyses.

F. Participants in the Field Investigation

Personnel involved in the field investigation consisted of HART field team members, an Air Force technical monitor, General Electric coordinators, and HART-supervised subcontractors.

F.1 Fred C. Hart Personnel

Members of the HART field team are:

Robert Goldman - Project Manager

Vanessa DeVillez - Field Team Leader

John Garrison - Field Technician

F.2 Air Force Personnel

Air Force technical monitors and observers are:

James W. Better - Technical Program Manager

F.3 General Electric Personnel

General Electric personnel who assisted in coordinating various field activities are:

Patrick Gilligan - Plant Engineer

Mike Lichtenberger - Plant Engineer

F.4 Subcontractors

Subcontractors who participated in the field investigation under this contract include:

Drilling and Well Installation: Empire Soils Investigations, Inc.
105 Corona Avenue
Groton, New York 13073

Surveyor: Lynn Pullis
32 La Grange Street
Binghamton, New York 13905

Geochemical Laboratory: Princeton Testing Laboratory
Princeton Service Center
U.S. Route 1
Princeton, New Jersey 08540

Geotechnical Laboratory:

J&L Testing Company
113 Kimber Drive
Bridgeville, PA 15017

G. Other Pertinent Information

AFP 59 is underlain by an aquifer that acts as the major source of drinking water for Broome and Tioga counties. In 1985, the U.S. Environmental Protection Agency (USEPA) gave the Clinton Street-Ballpark Valley aquifer system sole-source status under Section 1424(e) of the Safe Drinking Water Act, which requires 1) the aquifer to be the sole or principal drinking water source in the area, and 2) that contamination of the aquifer would create a significant public health hazard (50 Federal Register 2026, January 14, 1985). The Clinton Street-Ballpark Valley aquifer is the sole source of drinking water for the communities of Vestal, Johnson City, Endicott, Nichols, Waverly and Owego. Contamination of this aquifer would affect approximately 128,000 people, creating a significant hazard to public health.

The Clinton Street-Ballpark Valley aquifer is overlain by unconsolidated, highly permeable deposits. As such, the aquifer is highly vulnerable to contamination by infiltration of impure surface waters. Furthermore, existing alternate drinking water sources could not meet 50 percent of the water demand in the area.

Johnson City public supply wells are located approximately 1,000 feet southwest of AFP 59. The proximity of these wells necessitates an effective groundwater monitoring system at AFP 59 to prevent degradation of the quality of groundwater within the Clinton Street-Ballpark Valley aquifer.

II. ENVIRONMENTAL SETTING

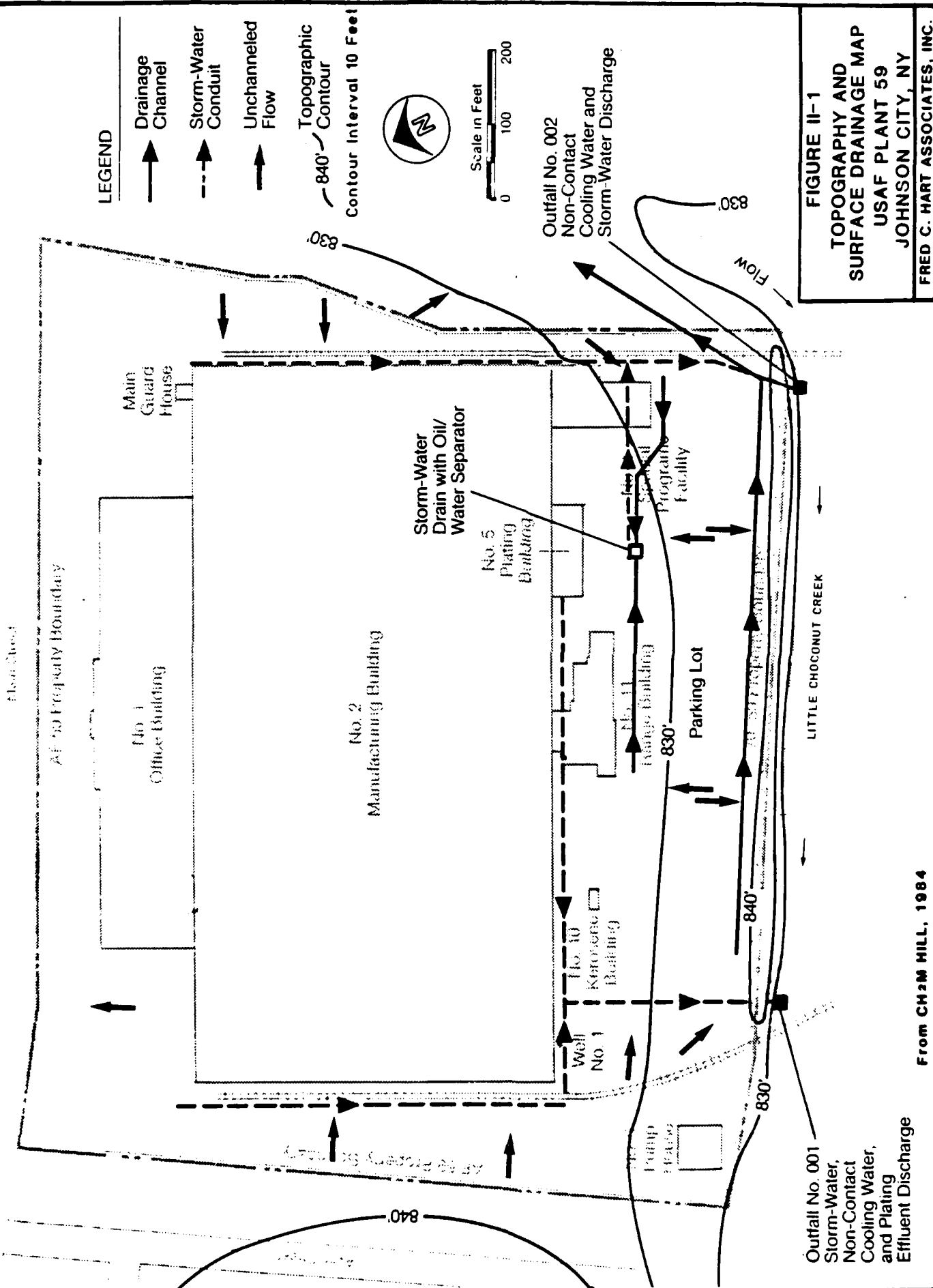
A. Physical Geography

AFP 59 is located in Broome County, New York, in the town of Johnson City (Figure I-1). The plant is approximately 3 miles west-northwest of downtown Binghamton, and about 4 miles east of Endicott. Other nearby towns (within 5 miles) include Maine, Chenango, Dickinson, Union, and Vestal.

The plant is bordered on the north side by Main Street, and on the east and south by Little Choconut Creek. A residential area is located immediately west of the site. The topography of the site is fairly flat and varies in elevation from 830 to 840 feet above mean sea level (msl). Land use surrounding the plant includes transportation, commercial, forest land/recreation, residential, and industrial use.

AFP 59 is located on the floodplain of the Susquehanna River within the Appalachian Plateau physiographic province. The geography of the Appalachian Plateau is characterized by relatively undisturbed, nearly horizontal sedimentary rocks bisected by streams. Surface runoff from the plant drains to Little Choconut Creek, which discharges to the Susquehanna River. The topography and surface water drainage of the site are presented in Figure II-1.

Surface materials at the site consist of cut and fill soils (Figure II-2). These include silty soils (Cy) of alluvial origin that do not support heavy loads well, and are subject to erosion. The western edge of the site is covered by loamy materials (Cw) of glacial origin that have been disturbed, or reworked, by man.



LEGEND

Cw Cut and Fill Soils,
Loamy Material
(Glacial Till
Material)

Cy Cut and Fill Soils,
Silty Material
(Alluvial Material)

Soil Boundary



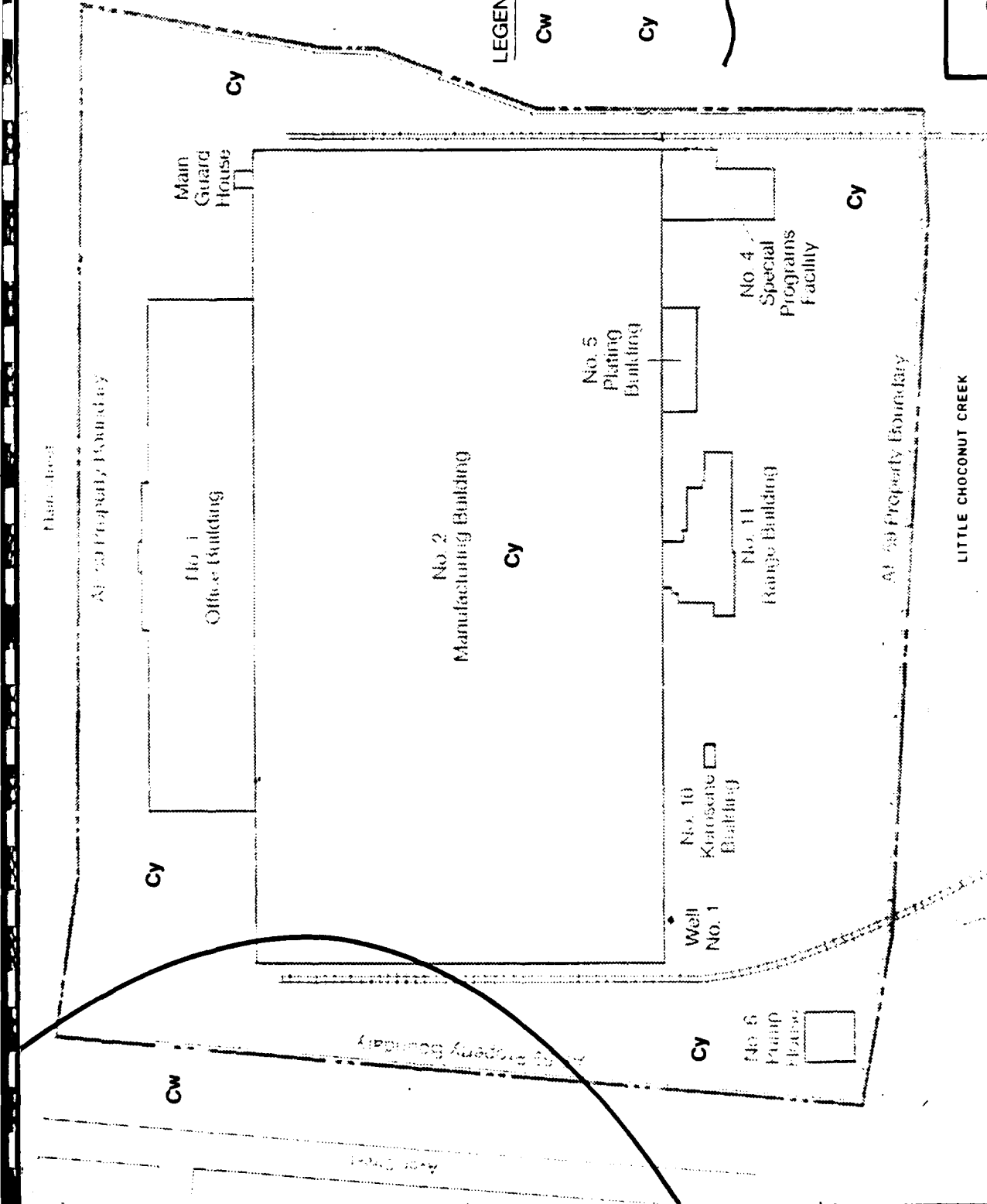
Scale in Feet
0 100 200

FIGURE II-2

DISTRIBUTION OF
SOIL TYPES

USAF PLANT 59
JOHNSON CITY, NY

FRED C. HART ASSOCIATES, INC.



From CHAM HILL, 1984

B. Regional Geology and Hydrogeology

B.1 Regional Geology

The geology of the Susquehanna River Basin and vicinity consists of glacial valley fill sediments of Pleistocene age. The deep valleys were originally formed by streams, and were subsequently widened and shaped by glacial ice (Coates, 1966). As the glaciers retreated, mounds of till spanning the valley floors were left behind. These till deposits, or terminal moraines, dammed meltwater streams, causing lakes to form as the glaciers retreated. Sediment-laden meltwater rivers formed deltas composed of sand and gravel where they entered the lakes. Silt, clay, and fine sand settled on the lake bottoms. The glacial deposits of the Susquehanna River basin consist of clay, silt, sand and gravel. The general distribution of subsurface geologic units in the study area is shown on Figure II-3. Table II-1 describes the geologic and hydrologic significance of the units depicted in Figure II-3.

The bedrock underlying the glacial deposits throughout southern New York consists of shales, siltstones, and sandstones. The Sonyea Group, consisting of shales and minor siltstones, underlies the Johnson City area (Randall, 1988). These units were deposited 345 to 410 million years ago as the result of an episode of mountain building, or orogeny, that uplifted a large area east of the present location of Johnson City. A large volume of sediment eroded from the uplifted area, was transported west and deposited in a shallow sea environment. In time, a thick sequence of fine-grained material known as the Catskill Clastic Wedge accumulated in what is now northeastern Pennsylvania and southern New York. Another episode of orogeny, exposed rocks of the Catskill Clastic Wedge to the forces of erosion. Streams eroded valleys in the Johnson City area that would eventually influence the flow of glacial ice during the Pleistocene.

LEGEND

- Fill Material (8)
- Recent Alluvium (5, 6, 7)
- Lake Bed Deposit (3b, 4)
- Bright Gravel (3c)
- Drab Gravel (3a)
- Shale and Siltstone Bedrock (1)
- Till (2)

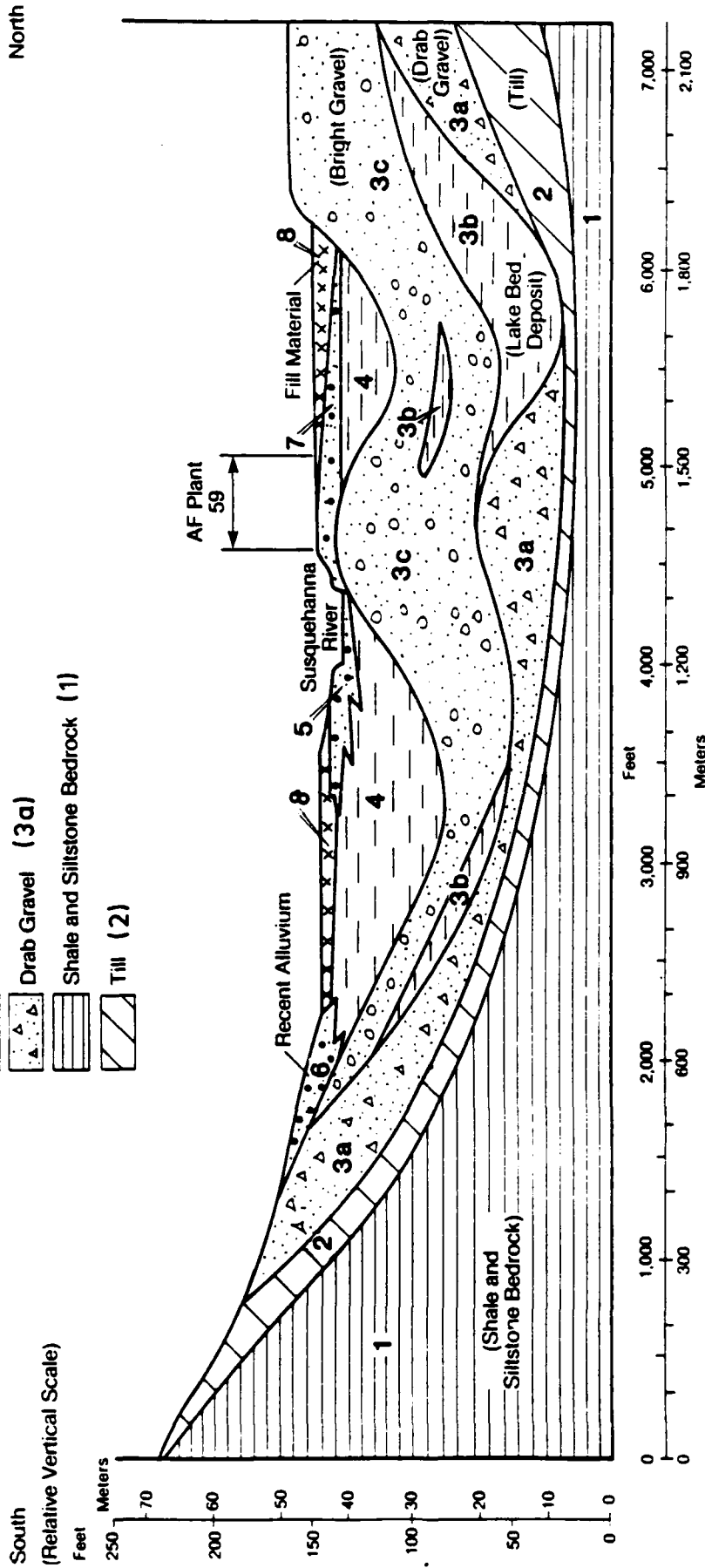


FIGURE II-3
IDEALIZED GEOLOGIC
CROSS SECTION
AF PLANT 59
JOHNSON CITY, NY

FRED C. HART ASSOCIATES, INC.

From: New York State
Dept. of Environmental Conservation
Bulletin 73

TABLE II-1
GEOLOGIC UNITS IN AND NEAR THE CLINTON STREET - BALLPARK AQUIFER

<u>Geologic unit (youngest to oldest)</u>	<u>Number in Figure II-3</u>	<u>Lithology (materials composing unit)</u>	<u>Distribution, thickness, and position</u>	<u>Hydrologic significance</u>
Fill	8	Chiefly trash and ashes; some sand, gravel, and other materials	Most natural depressions in Binghamton and Johnson City have been raised 5 to 20 feet by fill; some are now unrecog- sizable.	Not tapped by wells. Increases dissolved-solids concentration and acidity of infiltrating water, but effect decreases as age of fill increases.
Flood-plain silt	7	Brown silt and very fine sand with roots and a little fine organic matter.	Mantles lowlands inundated during major floods; typically 5 to 15 feet thick. May rest on all older units (1-5).	Not tapped by wells. Poor permeability limits recharge of underlying aquifers from floodwater and possibly from heavy rainfall.
Alluvial fan	6	Gravel, moderately sand and in general moderately silty. Most stones are flat pieces of local shale or siltstone.	Deposited by small streams where they enter the Susquehanna valley. May rest on all older units (1-5).	Permeable, but too thin to supply large-capacity wells. Water from small streams infiltrates through alluvial fan deposits to stratified glacial deposits.
Older river alluvium	5	Sand and gravel, bright but leached partially to completely free of limestone.	Interfingers with and overlies late-glacial lake beds near Chenango River as much as 35 feet thick. Relation to other units uncertain. May cap stratified glacial deposits beneath flood-plain silt elsewhere, but is not recognized or mapped.	High permeability and in good hydraulic contact with Chenango River. Could be tapped by large-capacity wells.

(CL5120A)

TABLE II-1 (CONTINUED)
GEOLOGIC UNITS IN AND NEAR THE CLINTON STREET - BALLPARK AQUIFER

Geologic unit (youngest to oldest)	Number in Figure II-3	Lithology (materials composing unit)	Distribution, thickness, and position	Hydrologic significance
Late-glacial	4	Silt and very fine sand with some clay and scattered tiny plant fragments; commonly grades into peat or highly organic silt at top.	Fills irregular depressions left when ice blocks melted, chiefly in a narrow east-west zone near deepest part of bedrock valley; as much as 80 feet thick. Generally overlies bright gravel.	A significant barrier to infiltration and groundwater flow in many places.
Stratified glacial deposits	3			
Bright gravel	3c	Sandy gravel and pebbly sand containing variable amounts of silt; highly calcareous. Upper part very bright (35 to 75 percent of the pebbles are limestone and other rock types not derived from local bedrock). Lower part moderately bright (15 to 30 percent exotic pebbles).	Present over much of the valley as broad terraces or underlying younger units; thickness varies widely, locally exceeds 100 feet.	High permeability, tapped by several large-capacity wells, but locally above water table. The abundant limestone in this unit causes water that migrates through it to have high hardness (250-400 milligrams per liter).
Lake beds	3b	Silt to fine sand, some clay, no plant fragments.	Lenses may occur anywhere within unit 3, but seem to be most common between the bright and drab gravels.	A significant barrier to infiltration and groundwater flow in places.

(CL5120A)

TABLE II-1 (CONTINUED)
GEOLOGIC UNITS IN AND NEAR THE CLINTON STREET - BALLPARK AQUIFER

Ceologic unit (youngest to oldest)	Number in Figure II-3	Lithology (materials composing unit)	Distribution, thickness, and position	Hydrologic significance
Drab gravel	3a	Sandy gravel and pebbly sand with variable amounts of silt; weakly calcareous. Pebbles are almost entirely local shale and siltstone, with 10 percent or less exotic rock types.	Present at land surface along north and south sides of valley; commonly underlies bright gravel (directly or with intervening lake beds) in central part of valley; varies widely in thickness.	High permeability; tapped by several large-capacity wells.
Glacial till	2	Mixture of silt, clay, gravel, and sand, tough and compact; commonly called hardpan. May contain minor sand and gravel lenses.	Immediately overlies bedrock. Only about 1 foot thick in places, but forms low hills in southern part of Susquehanna valley.	Very poor permeability. Low hills of till prevent movement of water between aquifer and Susquehanna River for 3 miles west from Chenango River.
Bedrock	1	Interbedded shale and siltstone	Present everywhere beneath other units.	Poor permeability; serves as north, and part of south, aquifer boundary, but yields 100 to 300 gallons per minute of salty water to wells several hundred feet deep.

From: New York State Dept. of Environmental Conservation, Bulletin No. 73, 1977.

(CL5120A)

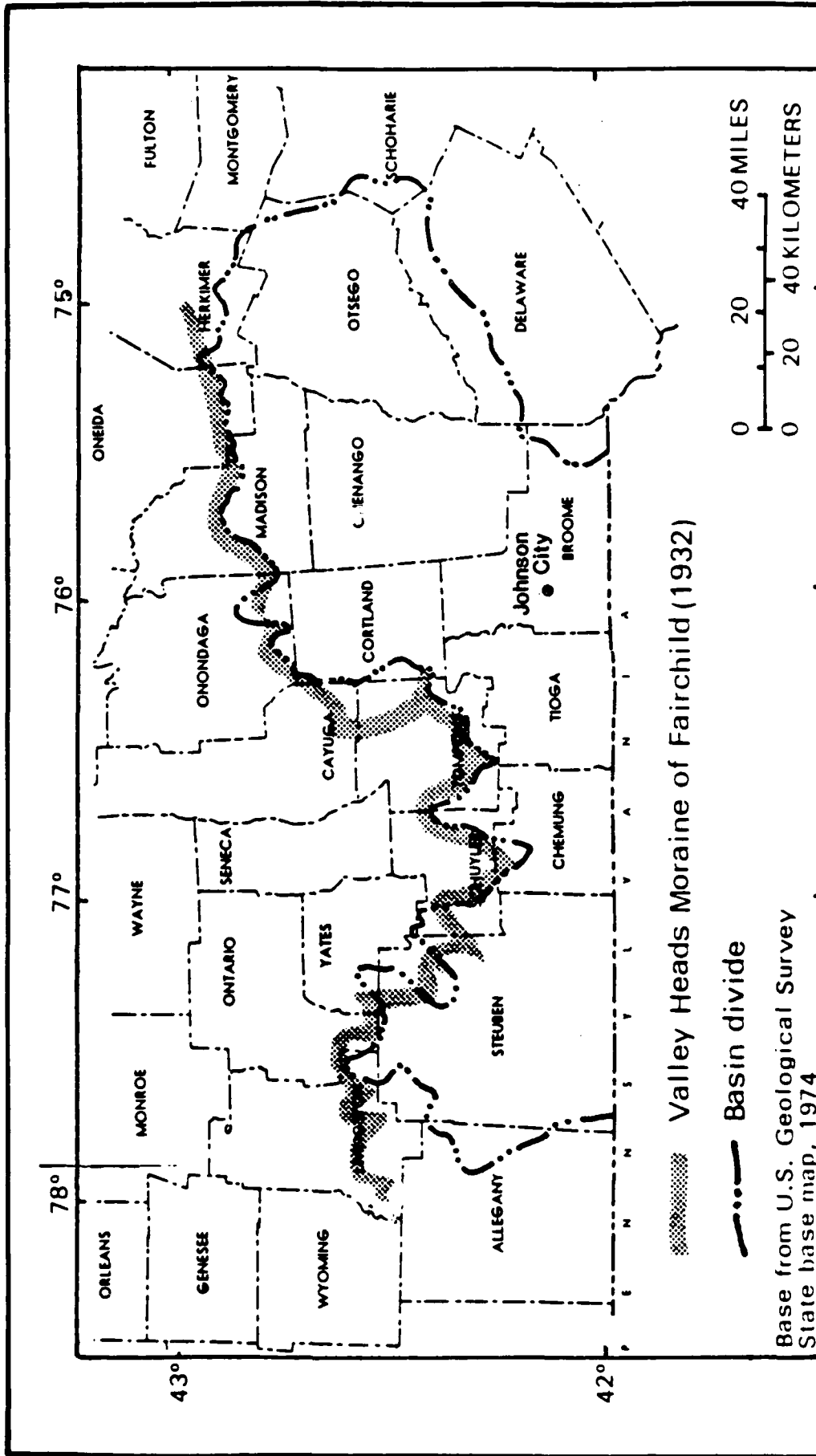
B.2 Regional Hydrogeology

B.2.a Susquehanna River Basin. AFP 59 is located within the Susquehanna River Basin (Figure II-4). The groundwater supplies in the basin are dependent on the local geology. Eighty-five percent of the basin area is characterized by bedrock uplands dissected by narrow valleys and covered with a thin layer of glacial till. In upland areas, low-yield groundwater supplies can be obtained from the till layer. Larger yielding supplies are obtained from the bedrock in areas where faulting or fracturing has increased the water-bearing capacity.

Broad, sediment-filled valleys comprise the remaining 15 percent of the Susquehanna River basin. These valleys consist of 70 to 500 feet of stratified glacial drift atop bedrock. Sand and gravel units within this drift provide municipal supply wells with yields averaging over 400 gallons per minute (NYSDEC, 1982). The Clinton Street-Ballpark Valley aquifer, which supplies groundwater to Johnson City residents, is one of these "stratified aquifers" (Figure II-5).

The location and areal extent of stratified-drift aquifers is a function of conditions during deposition. All such aquifers were deposited toward the end of the Wisconsin glacialiation as glaciers were retreating to the north. Lakes that commonly formed in the wake of retreating glaciers were laden with sediment from meltwater streams. When the rates of ice flow and melting were nearly equal, the toe of the glaciers remained more or less stationary. As a result, large deltas of sand and gravel covering the width of the valleys developed where the meltwater streams entered the proglacial lakes. These extensive deposits serve as good sources of high-yielding groundwater supplies.

If ice melted at the toe of the glacier slightly faster than the flow of ice, the toe retreated slowly up the valley and smaller deltas, limited to the edges of the valley floor, developed. Deposits that accumulated under these conditions yield moderate groundwater supplies.

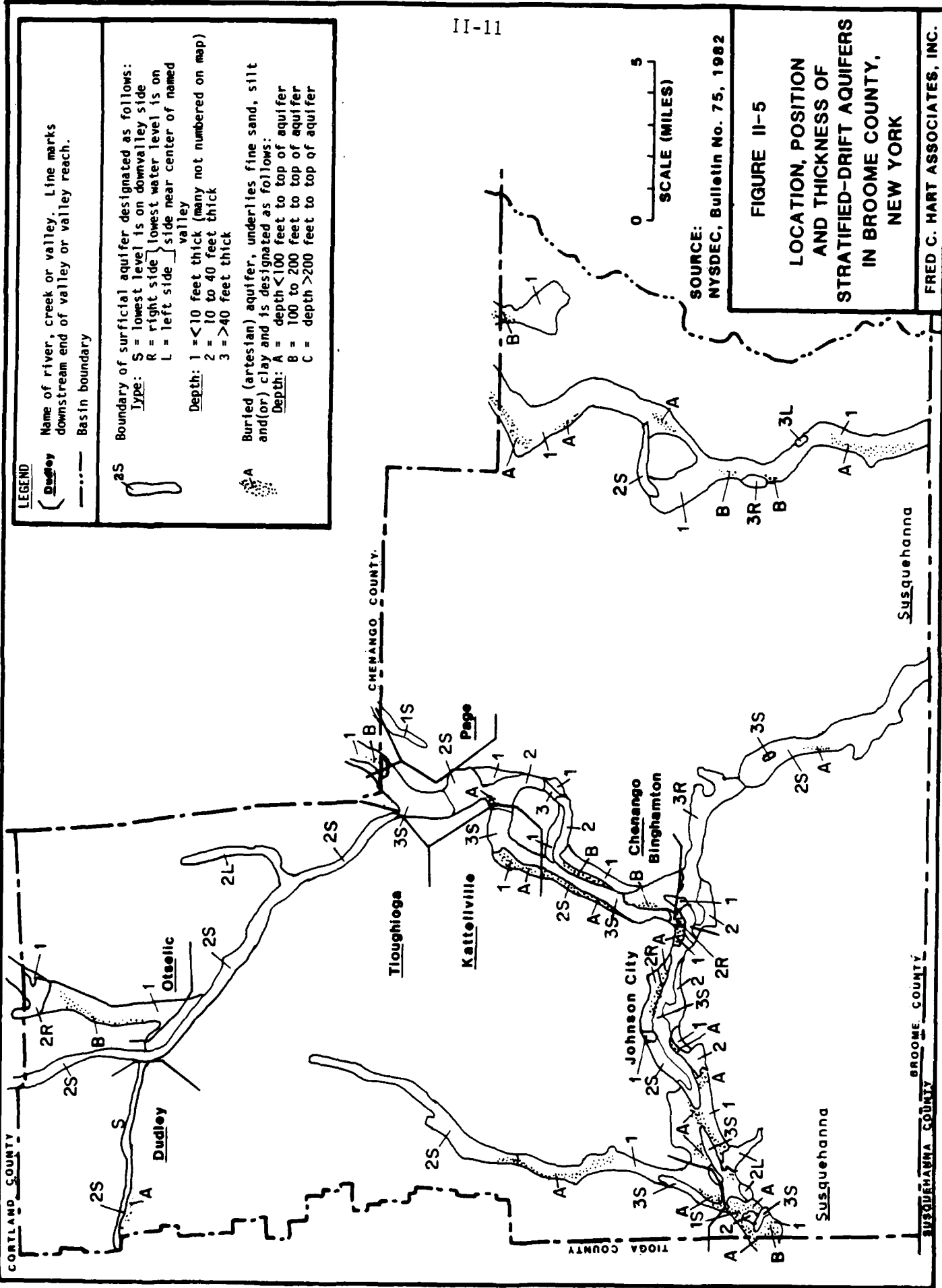


SOURCE: NYSDEC, BULLETIN 75, 1982.

FIGURE II-4

LOCATION OF
NEW YORK COUNTIES
IN SUSQUEHANNA RIVER BASIN

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Where the ice retreated rapidly, there was not enough time for coarse sediment to reach the lake surface and a thin layer of sediment was deposited at the mouths of meltwater streams. In all of the scenarios presented above, fine sediments were carried in suspension to distant areas of the lake where they were deposited.

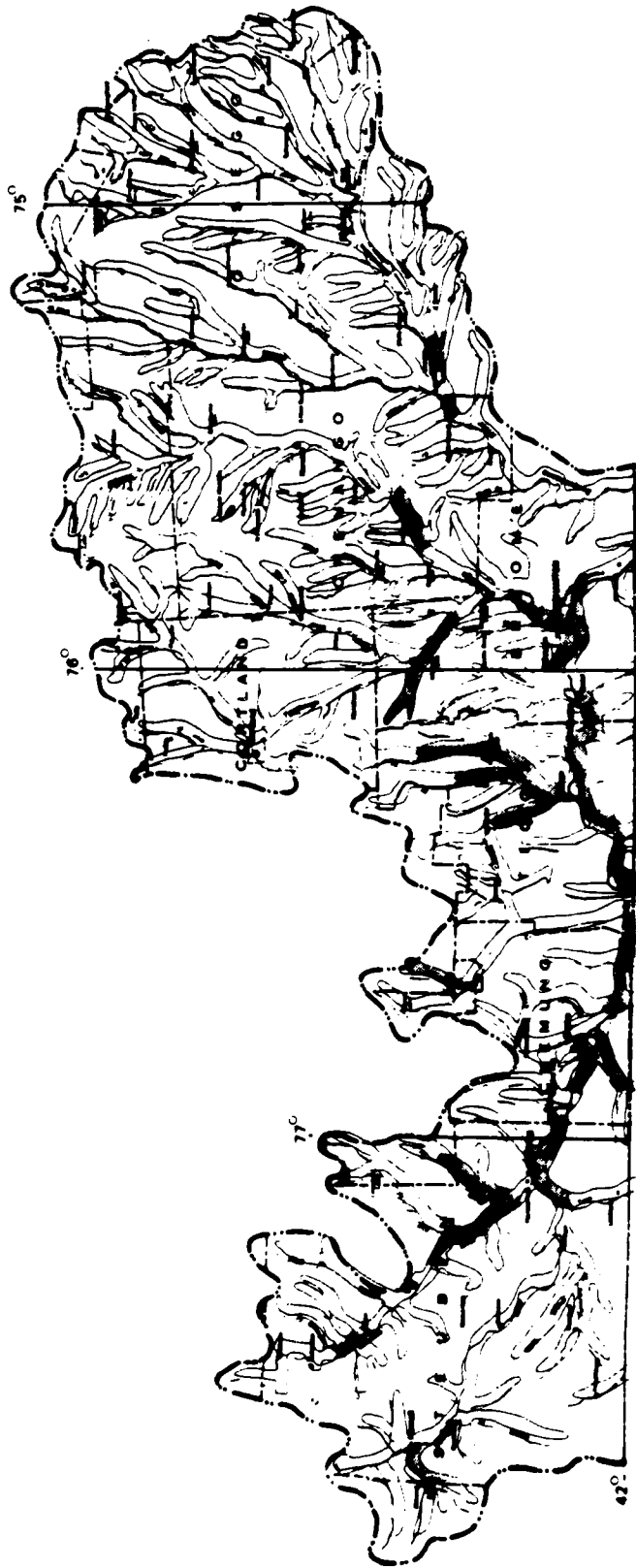
In broad valleys along the northern basin divide, ice advanced repeatedly into adjacent lakes and produced thick layers of glacial till interbedded with fine-grained lake sediment and minor amounts of sand and gravel. These deposits are collectively known as the Valley Heads Moraine.

Johnson City is located in a broad valley where the toe of the glacier occupied one position for a relatively long period of time (Figure II-6a). The deposits are primarily silty to clean sand and gravel with numerous lenses of fine-grained lake sediment. A generalized illustration of the geology and hydrology typical of this valley type is shown in Figure II-6b.

B.2.b Clinton Street-Ballpark Valley Aquifer. The Clinton Street-Ballpark Valley aquifer extends from the western part of Binghamton through the central part of Johnson City (NYSDEC, Bull. 73, 1977). The aquifer underlies three square miles of urban land in the Susquehanna River Valley. The geologic zone that contains the aquifer is composed mainly of permeable sand and gravel, with occasional silt lenses. Geologic units within and adjacent to the aquifer are included in Table II-1.

In 1985, the Clinton Street-Ballpark Valley aquifer was designated as a sole source aquifer by the USEPA under the Safe Drinking Water Act (50 Federal Register 2026, January 14, 1985). This classification was made because the aquifer is the principal source of drinking water for residents of Broome and Tioga counties. If this aquifer were to become contaminated, it would impact approximately 128,000 residents. Since the aquifer is overlain by permeable, unconsolidated glacial and alluvial deposits, it is highly susceptible to contamination through surface

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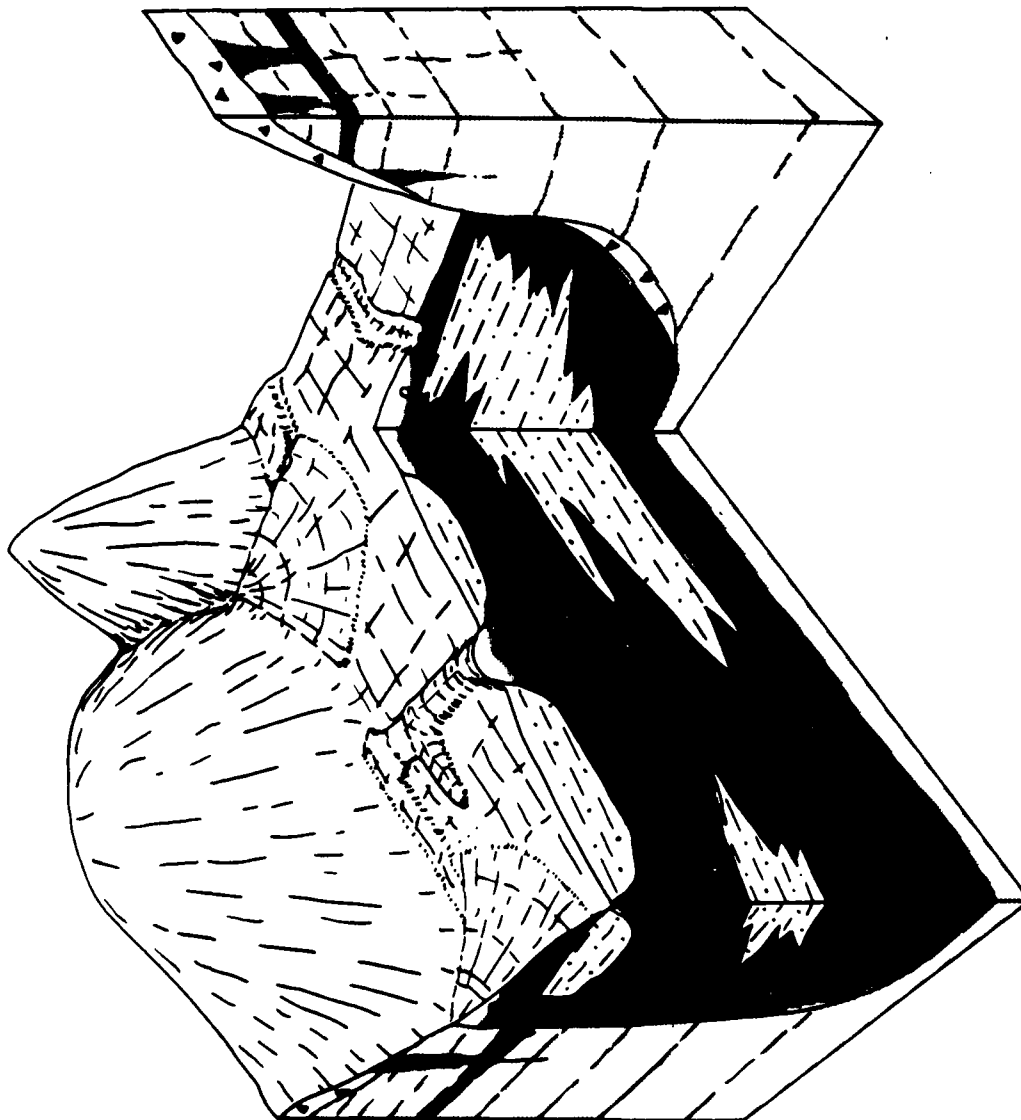
Base from U.S. Geological Survey
State base map, 1974



FIGURE II-6a

INDEX MAP SHOWING
LOCATION OF VALLEYS
TYPIFIED IN FIGURE II-6b

FRED C. HART ASSOCIATES, INC.



LEGEND

SAND AND GRAVEL

LACUSTRINE SILTS, CLAY
AND VERY FINE SAND

TILL

BEDROCK, WITH FRACTURES

HIGH-YIELDING AQUIFER MATERIAL

LOW-YIELDING AQUIFER MATERIAL

FIGURE II-6b

GEOLOGY AND HYDROLOGY
TYPICAL OF VALLEYS WHERE
ICE STAGNATED AND WASTED

NOTE: Valleys are commonly oriented east-west, bedrock
is typically less than 100 feet below stream grade.

SOURCE: USGS, Bulletin 75, 1982.

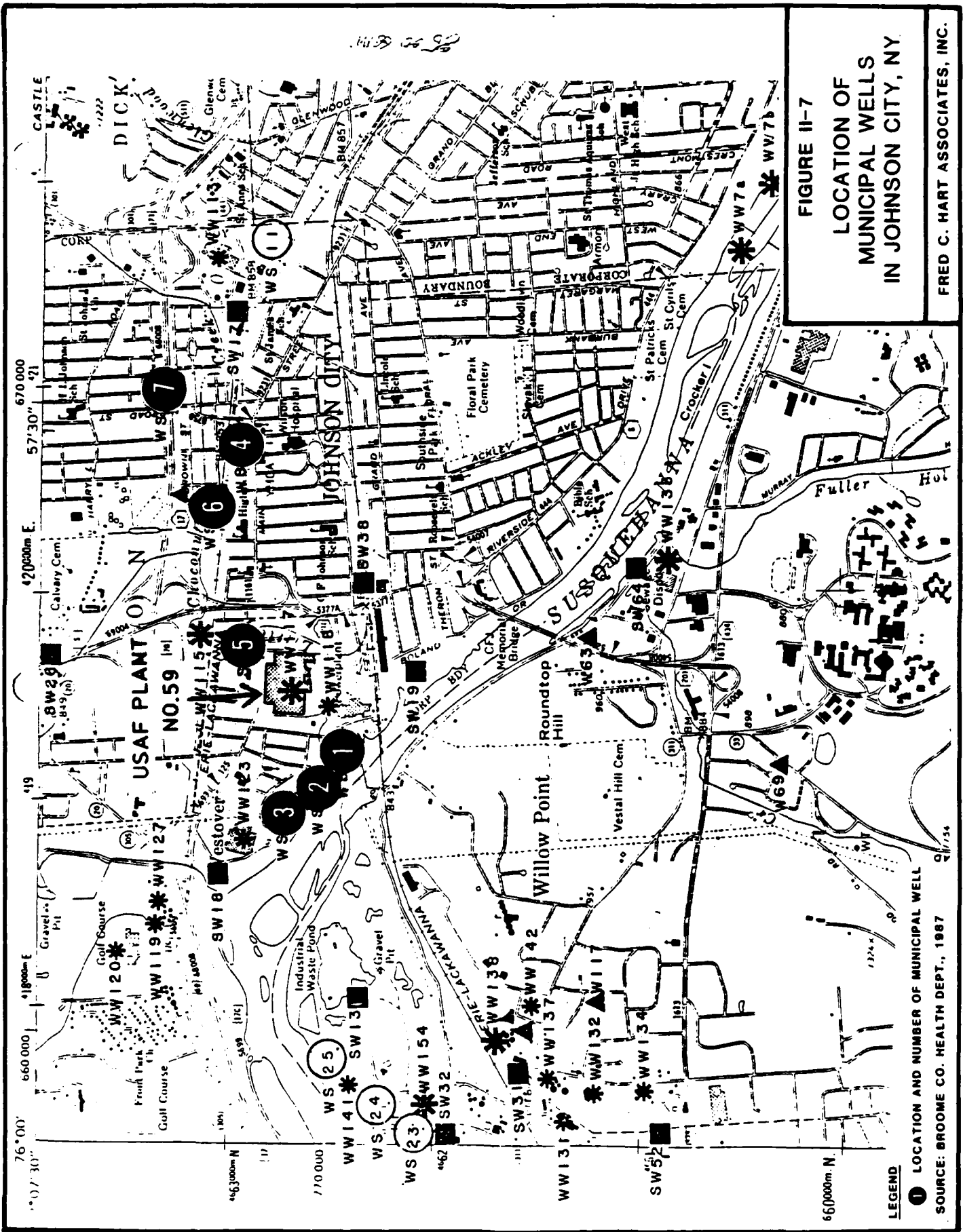
FRED C. HART ASSOCIATES, INC.

recharge. Additionally, there are no feasible existing alternative drinking water sources that could meet 50 percent or more of the drinking water demand of the area.

The aquifer transmissivity, or flux of water through the aquifer, ranges from 10,000 square feet per day to 50,000 square feet per day (ft^2/day). The natural pattern of groundwater flow in the aquifer has been altered due to development and large-scale use of the aquifer. During the 1960s, the pattern of groundwater flow within the Clinton Street-Ballpark Valley aquifer changed significantly. Previously, precipitation infiltrating into the aquifer flowed east and west, discharging to the Chenango and Susquehanna rivers, respectively. Today, these rivers and their tributaries lose a portion of their total flow to the groundwater system. In other words, the natural pattern of groundwater recharging streams and rivers has been reversed and now streams and rivers recharge the aquifer. As a result, discharge from the Clinton Street-Ballpark Valley aquifer is almost exclusively via pumping.

Two factors contributed to this shift in groundwater flow patterns. First, a change in the pumping schedule of six Johnson City supply wells affected the local groundwater system. Pumping of wells 4, 5, and 6, drilled in the central portion of the aquifer (Figure II-7), was increased at this time. Concurrently, discharge from wells 1, 2 and 3, near the Susquehanna River, was cut back.

Water levels were also affected by drought conditions which prevailed in the northeastern United States from 1962 to 1967 (Barksdale et al., 1966). Precipitation in the Binghamton area was 10 to 20 percent below average rates during this six-year period. In spite of the decrease in recharge to the aquifer, pumping demands remained unchanged until 1965.



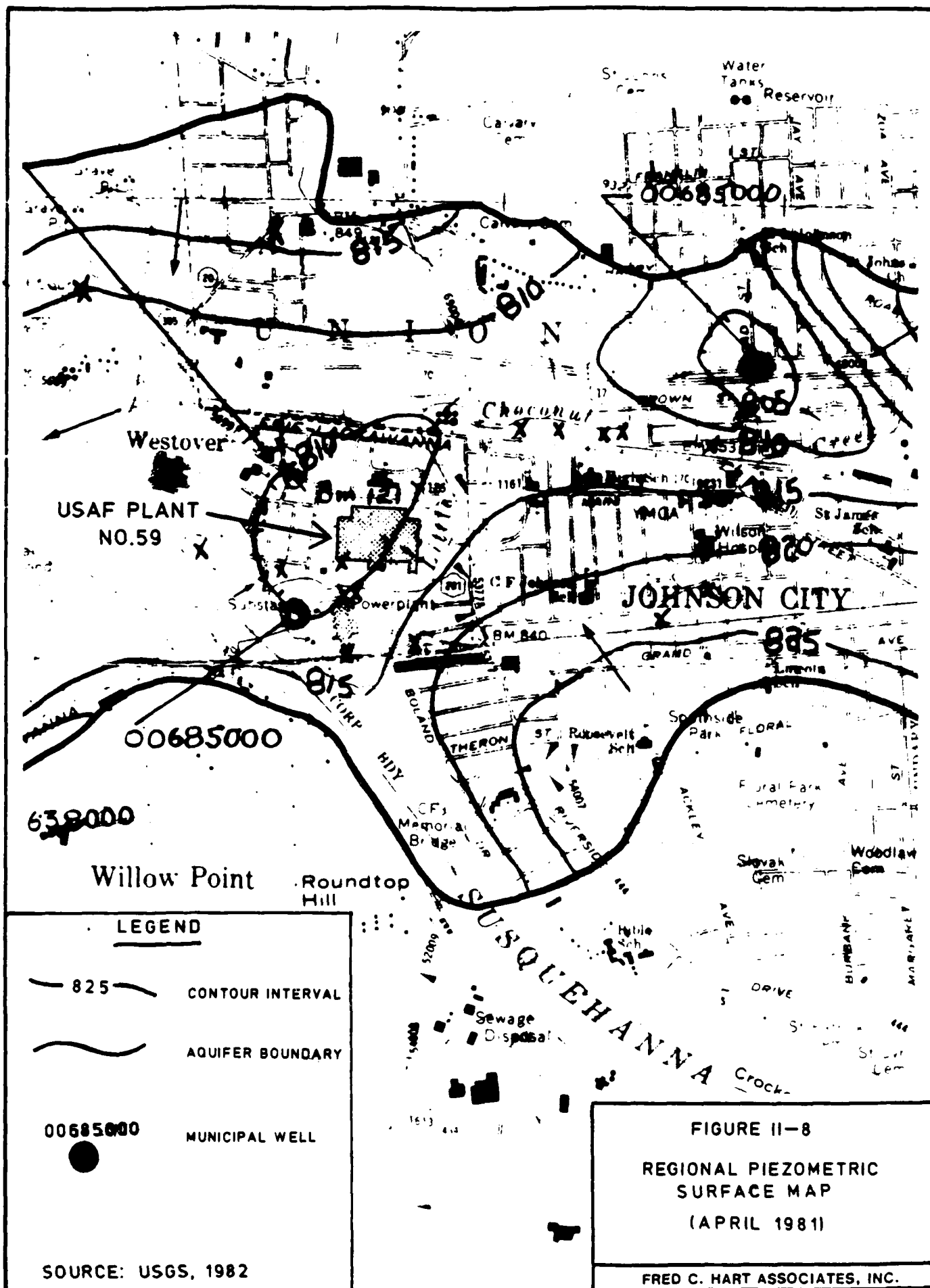
The altered pumping schedule coupled with the natural reduction in recharge to the aquifer combined to cause a significant drop in water levels in the central portion of the aquifer and the change in the natural pattern of groundwater flow.

A comparison of water levels in September 1958 to those in October 1967 indicates that the groundwater elevations decreased by approximately 10 feet in Binghamton and as much as 23 feet in Johnson City. This resulted in a decrease in aquifer storage of approximately 1 billion gallons between 1958 and 1967. The usable storage capacity of the aquifer was estimated to be 1,320 million gallons based on conditions in 1967.

Randall (1970) documented the hydraulic communication between the Clinton Street-Ballpark Valley aquifer and surface streams. He cited the presence of coliform bacteria in a municipal supply well in nearby Endicott, New York, as evidence to support his conclusion. In western Binghamton and Johnson City, however, lenses of glacial till restrict groundwater flow between the Susquehanna River and the aquifer along a three-mile stretch of the river valley.

The water table for the entire Clinton Street-Ballpark Valley aquifer (Figure II-8) was mapped in 1981 (USGS, 1982). The USGS map indicates a small groundwater depression to the west of AFP 59. Groundwater flowing beneath AFP 59 flows from southeast to northwest into this depression.

Although the groundwater temperature in the deeper portion of the aquifer is approximately 11°C, with little seasonal variation, one USGS well near the Chenango River has shown temperature fluctuations ranging from 1 to 22°C as a result of infiltrating river water (NYSDEC, 1977). Evidence of surface water recharge to the aquifer can also be found in the chemistry of the local groundwater. Generally, water in the central part of the aquifer is more mineralized than near the edges, where dilution by infiltrating river water occurs.



C. Site Geology and Hydrogeology

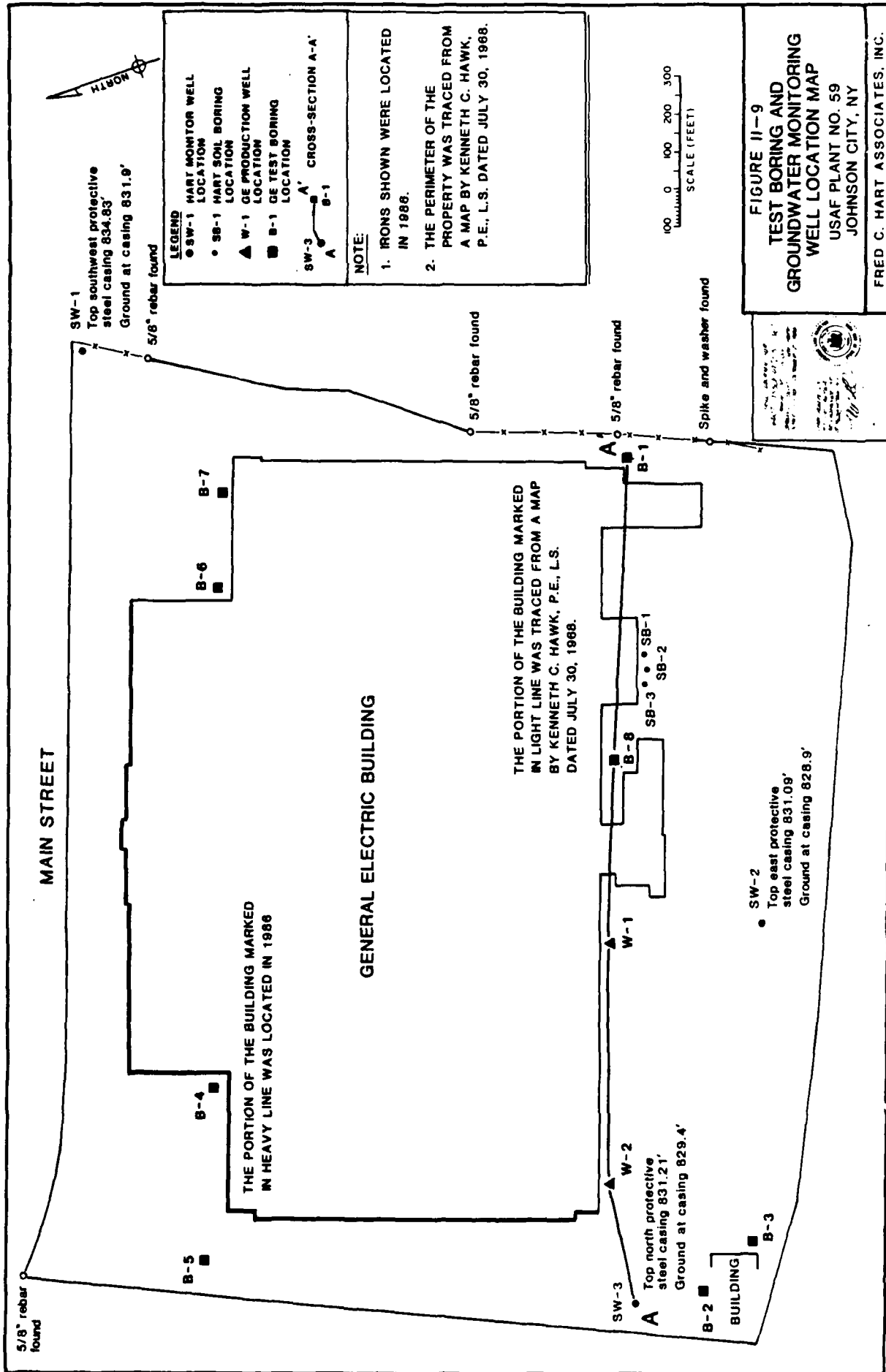
To date, HART has drilled a total of six test borings at AFP 59. Three of these borings were completed as monitoring wells. The locations of test borings and wells are presented in Figure II-9. The three well borings, SW-1, SW-2, and SW-3, were completed at depths of 36, 26, and 30 feet respectively. The three test borings, SB-1, SB-2, and SB-3, were drilled to a depth of 10 feet each.

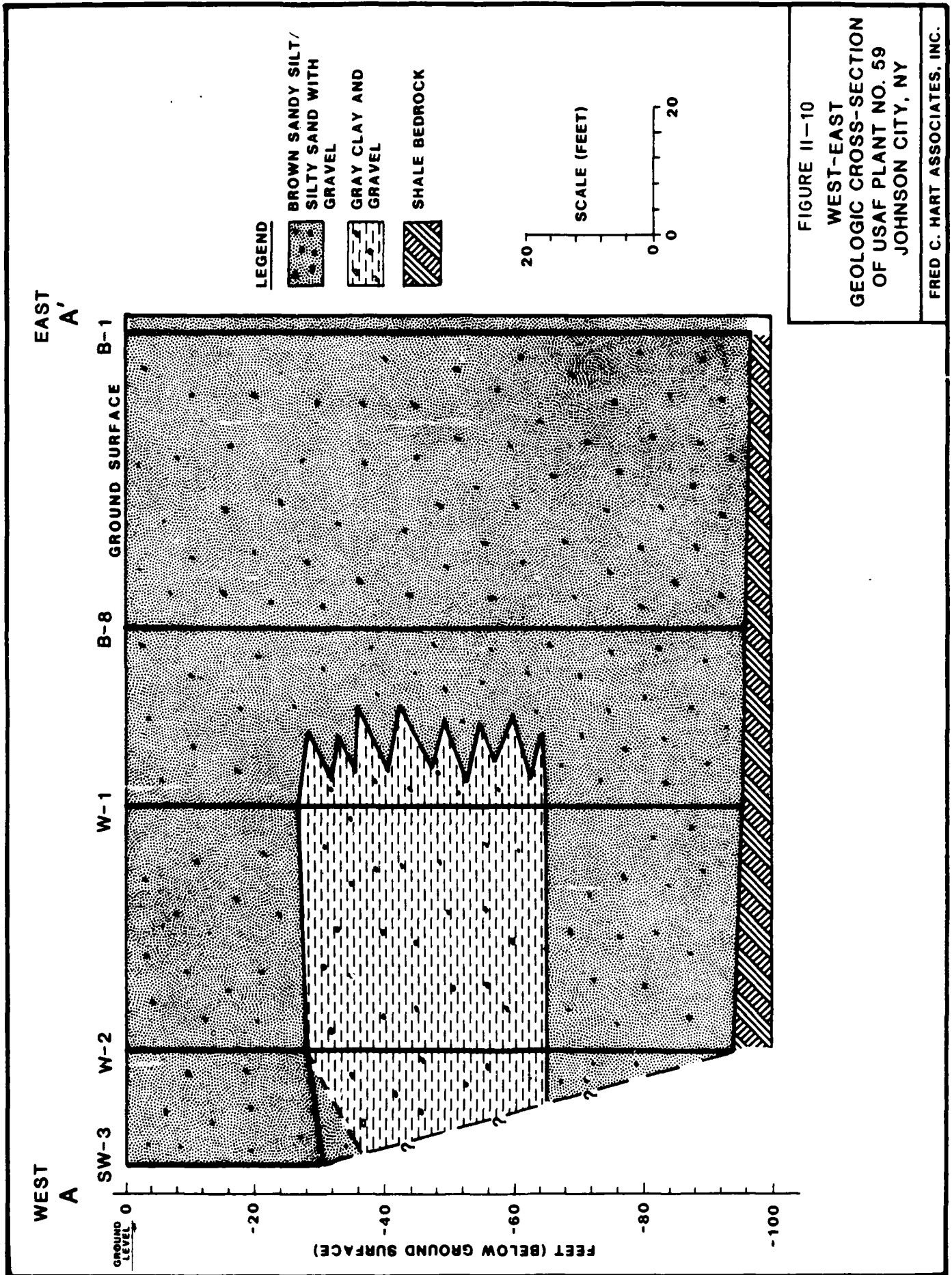
C.1 Site Geology

Data collected during this investigation indicate that the plant site is underlain by unconsolidated alluvial and glacial sediments. These sediments consist of brown sand and silt, with occasional lenses of gravel and trace amounts of clay. On the basis of new and existing boring data (Appendix E), a geologic cross-section depicting the subsurface geology at AFP 59 was constructed (Figure II-10).

At one time, Little Choconut Creek flowed across the southeastern portion of the site. The stream channel has since been rerouted to its present location. The abandoned stream channel was backfilled consistent with the surrounding grade. The majority of the site is covered by soils and flood plain deposits of Little Choconut Creek or the Susquehanna River (Figure II-2). Lateral variations in sediment type in the vicinity of the abandoned stream channel were produced by the natural meandering of the stream channel.

During installation of the existing production well, data regarding the subsurface geology were collected (Figure II-11). In the vicinity of the production well, clay and gravel are found from 27 to 58 feet below ground surface. Gravel with lesser amounts of clay was identified to a depth of 65 feet. Sand and gravel are found between 65 feet and 94 feet below ground surface. Bedrock is encountered at a depth of 94 feet.





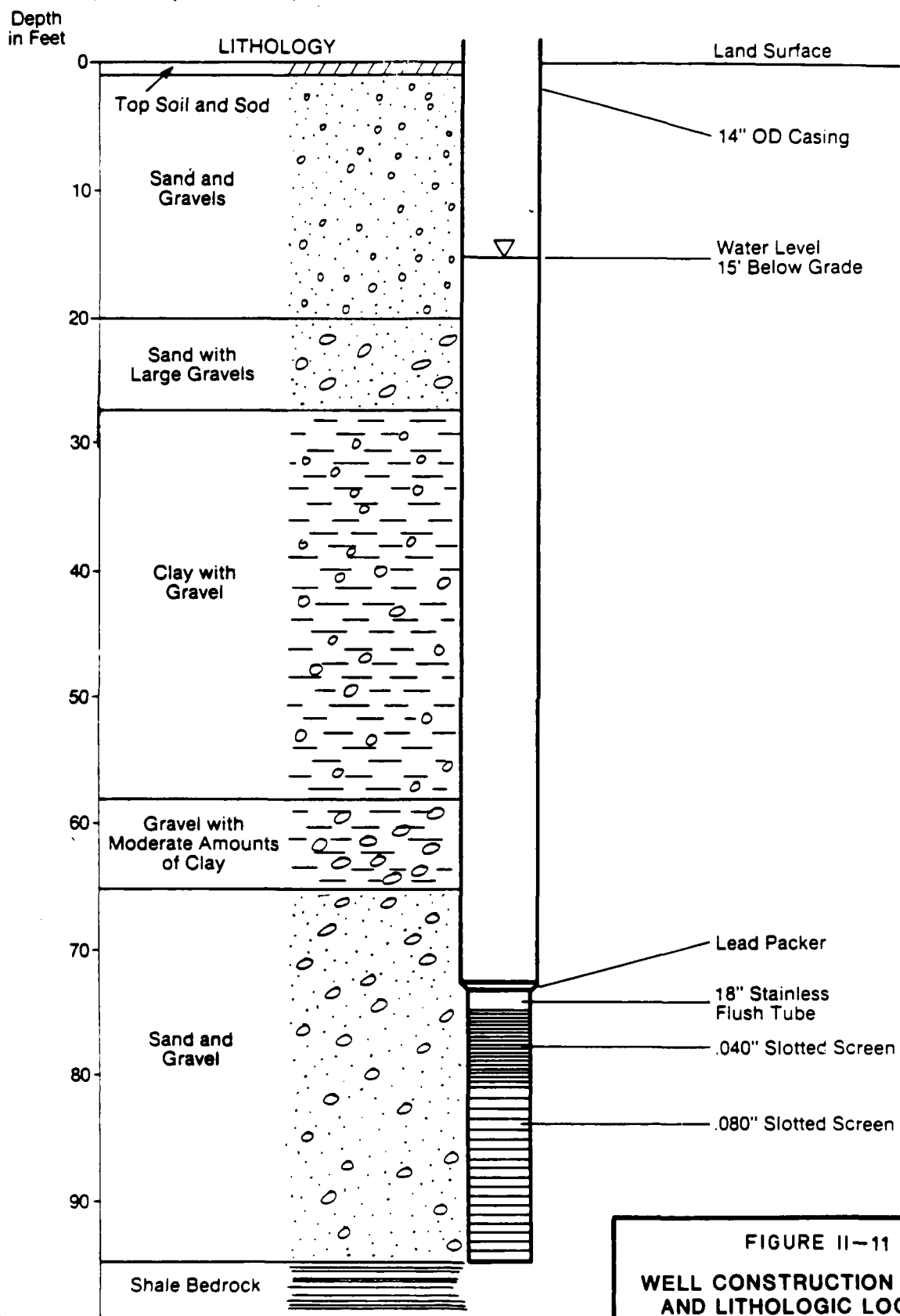


FIGURE II-11
 WELL CONSTRUCTION DETAIL
 AND LITHOLOGIC LOG FOR
 WELL NO. 1-MAY 16, 1974
 USAF PLANT 58
 JOHNSON CITY, NY

FRED C. HART ASSOCIATES, INC.

Grain size analyses based on the Unified Soil Classification System and visual classification were conducted on subsurface soil samples (Appendix E.4). The majority of the samples analyzed were predominantly either gravel, silty sand, or both.

Descriptive results of grain size analyses and visual classifications are presented in Table II-2. From these data, estimates of soil hydraulic conductivity were made using the method of Powers (1981). This method uses grain size uniformity and blow count data to estimate in-situ density. Based on an established empirical relationship, hydraulic conductivity can be estimated.

Due to method limitations, it was only possible to estimate the hydraulic conductivity of one sample (Table II-3). The estimated hydraulic conductivity of this sample is 5.50×10^{-2} cm/sec. All other points fell beyond the limits of the curves. From these data, it can be concluded that hydraulic conductivity values are significantly lower than 2.0×10^{-3} cm/sec.

C.2 Site Hydrogeology

The hydrogeologic investigation conducted by HART concentrated on the shallow water-bearing zone of the Clinton Street-Ballpark Valley aquifer. Beneath the site, water table evaluations range from 808 to 812 feet above mean sea level (Table II-4). The direction of groundwater flow was initially believed to be southwest toward three municipal supply wells and the Susquehanna River (CH₂M Hill, 1984). Data from monitoring wells installed by HART, however, indicate that the direction of groundwater flow is toward the northwest (Figure II-12). This conclusion is consistent with the flow direction determined in 1981 (USGS, 1982; Figure II-8).

Approximately 3.3 million gallons per day (2290 gpm) of groundwater are pumped at the Johnson City well field. This pumping creates a groundwater gradient of 0.0044 (2 feet/450 feet) across the southern
(CL5126A/1)
(01071-00-86007-00)

TABLE II-2

SUMMARY OF GRAIN SIZE TESTS-USAF PLANT NO. 59

<u>Boring and Sample Number</u>	<u>Depth Below Surface (Feet)</u>	<u>Classification Based on Grain Size Curve</u>	<u>Visual Classification</u>
SW-1:SS-3	10-12	C-F Silty <u>Sand</u> w/some F Gravel	Brown F Sandy <u>Silt</u> w/sand lens
SW-1:SS-12	28-30	C-F <u>Sand</u> w/ some Gravel and trace of clay	M-C <u>Sand</u>
SW-2:SS-4	12-14	M-F Silty <u>Sand</u>	Brown M-F <u>Sand</u> w/some silt
SW-2:SS-9	22-24	F Gravel w/ C-F sand and some silt	<u>Gravel</u>
SW-3:SS-2	5-7	F Gravel and C-F silty <u>Sand</u>	Brown silty M <u>Sand</u> with pebbles
SW-3:SS-12	28-30	C-F Sandy F <u>Gravel</u> w/some silt	M-C <u>Sand</u> w/ trace of Gravel

(CL5120A)

TABLE II-3
PERMEABILITY ESTIMATES OF GRAIN SIZE SAMPLES

Boring and Sample No.	Uniformity Coefficient ($C_u = D_{60}/D_{10}$)(a)	Medium No. of Blows(b)	Relative Density(c)	Estimated Hydraulic Conductivity ($\times 10^{-2} \text{ cm/s}$)(d)
SW-1:S-3	6 = .18/.03e	8	Loose	NC(f)
SW-1:S-12	4.5 = 1.3/.29	12	Medium dense	5.50 ($\times 10^{-2} \text{ cm/sec}$)
SW-2:S-4	12 = .36/.03e	13	Medium dense	NC
SW-2:S-9	80 = 16/.20	27	Medium dense	NC
SW-3:S-2	400 = 8/.02e	43	Dense	NC
SW-3:S-12	180 = 9/.05e	31	Dense	NC

- (a) Based on grain size analysis; See Appendix E.4.
 (b) See field logs, Appendix E.1.
 (c) For 12" distance. Based on blow counts, Unified Soil Classification System.
 (d) Estimates based on Figures 3.4a through 3.4c (Powers, 1981, pp.46-48).
 (e) Graph does not extend to D_{10} , so value is extrapolated.
 (f) NC - Not computable; outside the range of verified relationships.

(CL5120A)

TABLE II-4

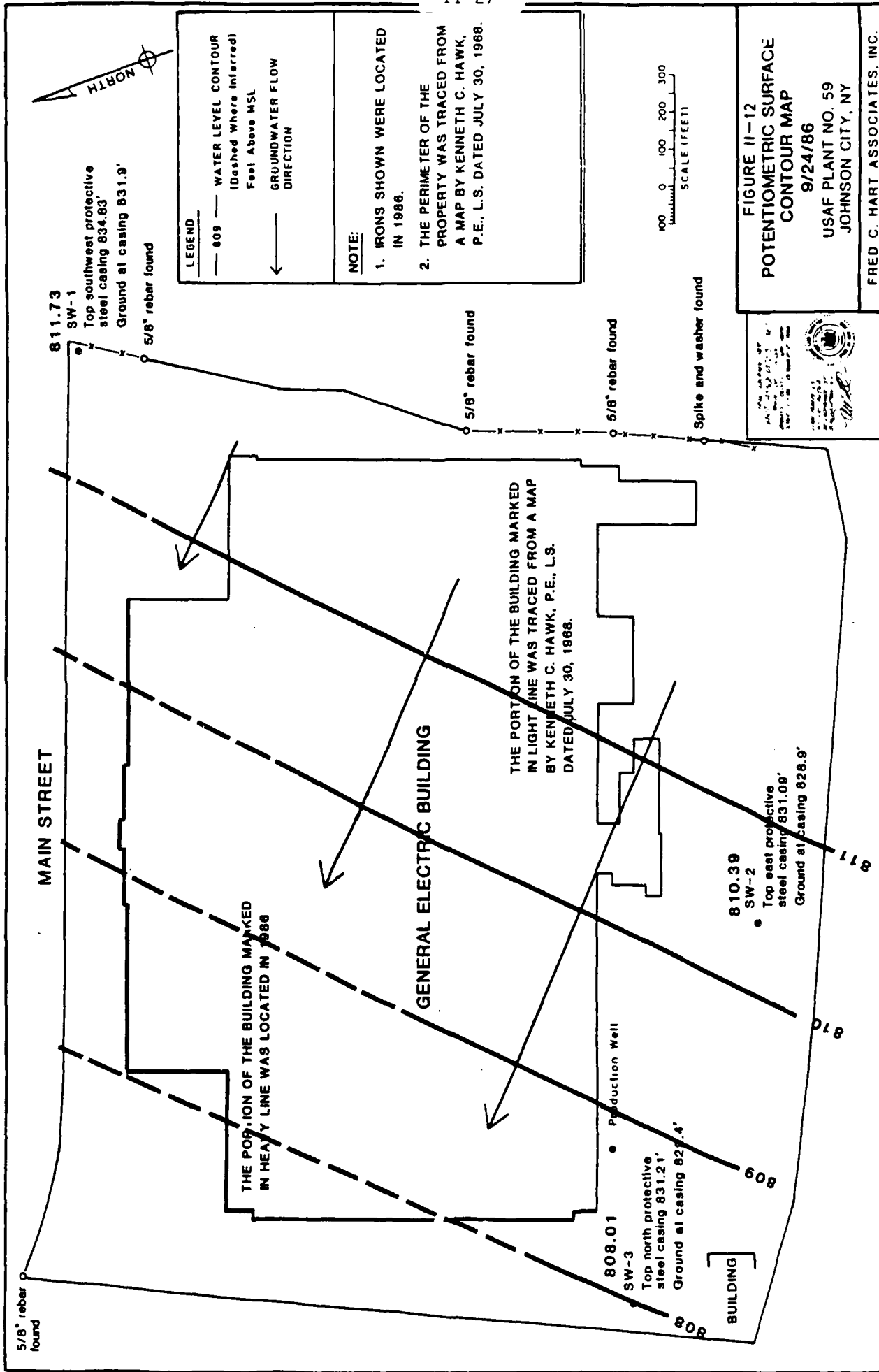
WATER LEVEL MEASUREMENTS 9/24/86

USAF PLANT NO. 59
JOHNSON CITY, NY

Well Number	Depth to Water From Top of Steel Casing (ft)	Ground Elevation (ft - MSL)	Elevation of Top of Casing (TOC) (ft - MSL)	Water Level Elevation (ft - MSL)
SW-1	23.10	831.90	834.83 (southwest side)	811.73
SW-2	20.70	828.90	831.09 (east side)	810.39
SW-3	23.20	829.40	831.21 (north side)	808.01

MSL - Elevation above mean sea level (ft)

(CL5120A)



portion of AFP 59. Pumping the on-site production well (Well No. 1) at a normal rate of 350 gpm causes the groundwater gradient to decrease to about 0.0022 (1 foot/450 feet).

The transmissivity of the aquifer in the vicinity of AFP 59 generally ranges from 10,000 ft²/day to 50,000 ft²/day. The combination of high transmissivity values, recharge from streams, and infiltration of precipitation permit average well yields of 400 gallons per minute (gpm) to be sustained for long periods.

In order to assess the groundwater flow rates at the site, hydraulic conductivity was estimated based on descriptions of the subsurface material. These descriptions were correlated with published descriptions and hydraulic conductivities for the Clinton Street-Ballpark Valley aquifer (NYSDEC, 1977). The hydraulic conductivity was estimated to be 1,000 ft/day. Based on a measured gradient of 1 ft/450 ft or 0.0022, the specific discharge in the area of the site was calculated to be approximately 2.2 ft/day.

D. Meteorology

AFP 59 is located near 42° north latitude, in south-central New York near the Pennsylvania border. The climate is humid, maritime with mild summers and long, cold winters. The prevailing wind direction is west-southwest. Weather is usually warm and humid when the air flow is from the south or southwest, and cold and less humid when the air flow is from the north or northwest.

The average annual temperature for nearby Binghamton is 46°F. Monthly mean temperatures vary from 20°F in January to 69°F in July. The average daily minimum temperature in January is 13°F and the lowest recorded temperature is -20°F. The average daily maximum temperature in July is 78°F and the highest temperature recorded at Binghamton is 96°F in the month of September. Freezing temperatures occur at Binghamton on the average of 147 days per year.

Mean annual precipitation recorded in the vicinity of AFP 59 is about 37 inches per year. The greatest precipitation occurs in June and the least in February. For the most part, precipitation is evenly distributed throughout the year. Snowfall accounts for a large proportion of the total precipitation during the winter months, with an annual average of about 85 inches at the Broome County airport. Snowfall greater than 1.0 inch occurs approximately 24 days per year. Mean annual lake evaporation, commonly used to estimate the mean annual evapotranspiration rate, is estimated to be 28 inches per year. Evapotranspiration over land areas may be greater or lesser than lake evaporation depending on the amount and type of vegetation and the availability of moisture. Mean annual net precipitation (mean annual precipitation minus mean annual evapotranspiration) is approximately nine inches per year (CH₂M Hill, 1984). Additional meteorologic information can be found in Appendix C.3.

III. FIELD PROGRAM

A. Introduction

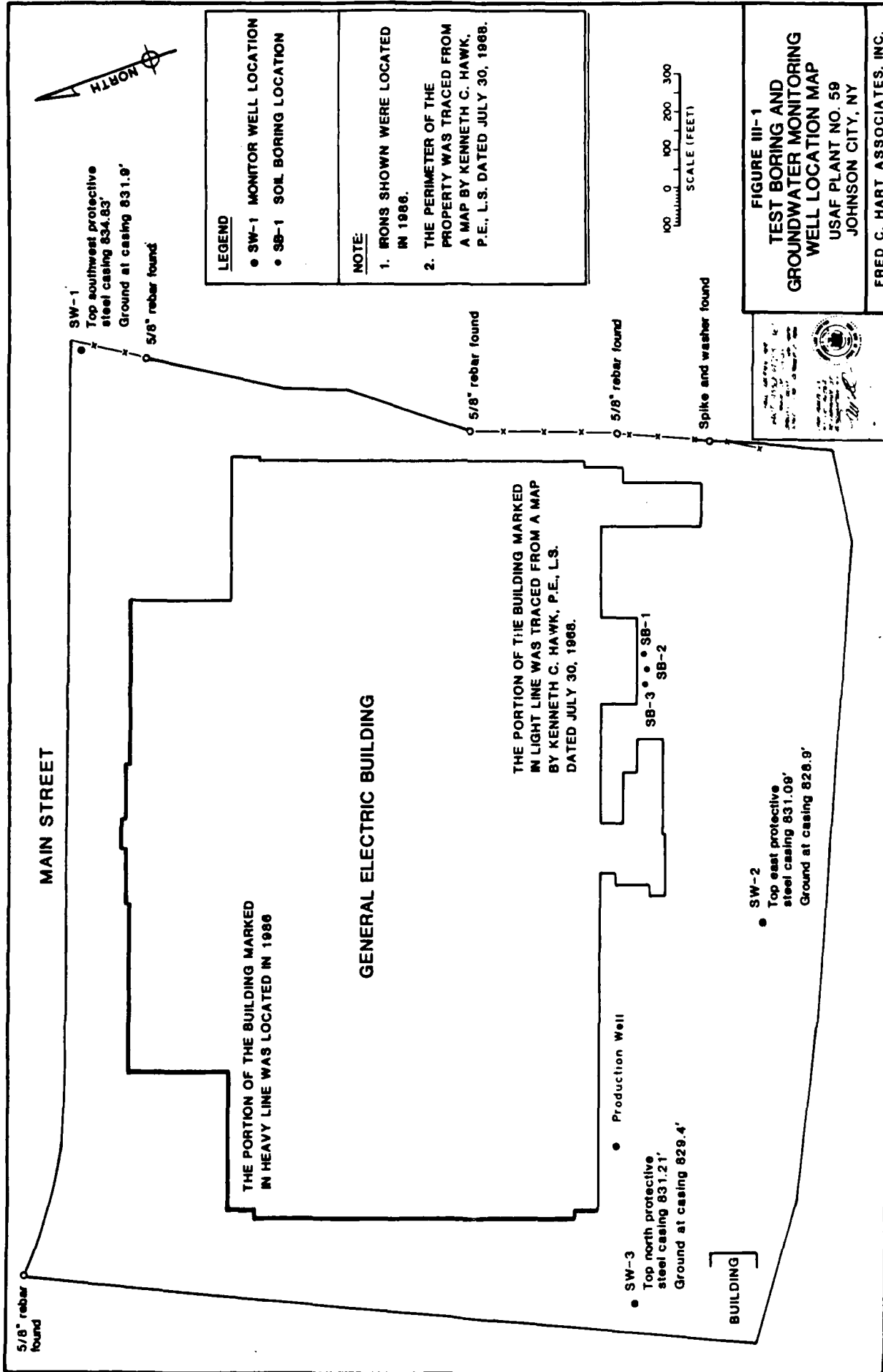
This chapter provides a detailed summary of field investigations conducted at AFP 59 from September 8 to September 24, 1986. These investigations include a test boring and monitoring well installation program, soil and groundwater sampling, water level measurements, and an elevation survey. This chapter describes procedures and applications of the field program. Details of sampling and analytical procedures are included in Appendix F.

B. Test Boring Program

A test boring program was conducted at the site to characterize the local geology and gather information on grain size distribution, hydraulic conductivity and contaminant distribution in the subsurface. Two sets of test borings were completed at the site. Three deep borings (approximately 30 ft) were drilled and had monitoring wells installed in them. The deep boreholes and associated wells were located to assess whether the historical oil spills have had an impact on the groundwater. Three shallow test borings (10 ft) were drilled adjacent to the plating building to assess potential near-surface contamination of heavy metals from the plating operations.

B.1 Locations

Figure III-1 shows the test boring locations. All boring locations were proposed in the Technical Operations Plan (Appendix K) and were approved by USAF and GE personnel. Monitoring wells were installed in the "SW" series borings. These deep borings are designated as SW-1 (36 feet deep), SW-2 (26 feet deep) and SW-3 (30 feet deep). These three borings were sampled at 5-foot intervals for the first 10 feet, and continuously sampled thereafter.



The "SB" series of borings serve to characterize the chemical quality of soil adjacent to the plating building. Each of these three borings were sampled continuously to a depth of 10 feet, and were drilled at the request of USAF personnel.

B.2 Drilling and Sampling Methodology

Empire Soils Investigations, Inc. of Groton, New York, drilled all of the test borings under the supervision and direction of a HART hydrogeologist. The well borings were augered with a CME 55 mobile truck-mounted drill rig using 4.25-inch inside diameter (ID) hollow stem augers. The only exception is SW-3 where 2.25-inch ID hollow stem augers were used. Using hollow stem augers permits the advancement of the boreholes while providing access for sampling and shallow well installation. The "SB" series borings were augered with 2.25-inch ID augers.

Soil samples were collected by 2.0-inch ID split-spoon samplers driven through a two-foot interval, using a standard 140-pound hammer falling 30 inches. Soil was collected ahead of the auger to obtain an undisturbed sample. A HART hydrogeologist logged all borings in the field. Lithologic logs of all borings are included in Appendix E.1.

The "SW" series soil samples were transferred immediately to air-tight 8-oz glass jars and 40-ml teflon-lined septum vials, and the containers were put on ice. For the "SB" series samples, only 8-oz glass sample jars were filled.

Additional samples were collected from the "SW" series borings for grain size analysis. These samples were also collected using split-spoon sampling techniques. The technicians attempted to collect Shelby tube samples for permeability analysis, but samples could not be obtained due to the loose consistency of the subsurface soil. All cuttings produced during drilling were immediately drummed and removed.

B.3 Sample Description

Soil samples were collected during the test boring program to determine:

- o The presence of volatile organics, primary metals, total petroleum hydrocarbons, and cyanide in the "SW" series
- o The grain size range in the "SW" series
- o The presence of EP Toxicity metals and total chromium in the "SB" series

A discussion of each sampling phase and the analytical techniques follows.

B.3.a Analytical Requirements for the Test Boreholes Completed as Wells ("SW" Series). Samples collected using the split-spoon sampling technique were screened with the organic vapor analyzer (OVA) to measure the concentration of total volatile organic compounds. This procedure involved placing the 40-ml sample vials in a 40°C hot water bath for 20 minutes. Using a syringe, an aliquot of air from the headspace within the vial, was then withdrawn and injected directly into the OVA. The relative concentration of volatile organic compounds detected in each sample were then used to delineate zones of potential contamination by volatile organic compounds.

Of the 33 well boring samples screened, six samples with highest relative values were selected for laboratory analysis (Table III-1). The two samples from each of the three boreholes with the generally higher total volatile concentrations were sent to the laboratory for detailed analysis. In addition to these six samples, one duplicate sample was sent to the laboratory as a quality control check. Table III-2 lists these samples. One sample was split with the USAFOEHL and sent to Brooks AFB (CL5126A/4)
(01071-00-86007-00)

TABLE III-1

OVA FIELD SCREENING RESULTS - SOIL

<u>Boring Number</u>	<u>Sample Depth (ft)</u>	<u>Total Volatiles Concentration (ppm)</u>	<u>Laboratory Sample Identification No. (a)</u>
SW-1	0.5-2	NA(b)	
	5-7	NA	
	10-12	0	
	12-14	2	
	14-16	1	
	16-18	NA	
	18-20	2	AFP 59, SW-1, 18'-20', HART 004
	20-22	0.6	AFP 59, SW-1, 20'-22', HART 005
	22-24	1.2	
	24-26	8	AFP 59, SW-1, 24'-26', HART 007
	26-28	1.8	
	28-30	1.1	
	30-32	0.2	
	32-34	0	
	34-36	1.0	
SW-2	0.5-2	0	
	5-7	0	
	10-12	0	
	12-14	0	
	14-16	0	
	16-18	4.8	
	18-20	6.0	
	20-22	7.5	
	22-24	9.7	AFP 59, SW-2, 22'-24', HART 009
	24-26	10.0	AFP 59, SW-2, 24'-26', HART 010
SW-3	0-2	0.1	
	5-7	0	
	10-12	0	
	12-14	0.6	
	14-16	7.4	
	16-18	0.7	
	18-20	1.3	
	20-22	12.0	
	22-24	7.2	AFP 59, SW-3, 22'-24', HART 009
	24-26	12.0	AFP 59, SW-3, 24'-26', HART 010
	26-28	5.2	
	28-30	9.0	

(a) Samples selected for laboratory analysis.

(b) No sample obtained.

(CL5120A)

TABLE III-2
SUBSURFACE SOIL SAMPLES FROM THE WELL BORINGS
SELECTED FOR LABORATORY ANALYSIS

<u>Sample Identifier</u>	<u>Depth (ft)</u>	<u>Field Sample Number</u>
AFP 59, SW-1	18-20	HART 004
AFP 59, SW-1(a)	20-22	HART 005
AFP 59, SW-1	24-26	HART 007
AFP 59, SW-2	22-24	HART 009
AFP 59, SW-2	24-26	HART 010
AFP 59, SW-3	22-24	HART 009
AFPS 59, SW-3	24-26	HART 010
AFP 59, SW-4(b)	22-24	HART 001
AFP 59, Drum Sample	Composite	HART 013

(a) Sample used for background purposes for comparison to "SB" series borings.

(b) Duplicate of Sample AFP 59, SW-3, 22'-24', HART 009.

for analysis. The remaining samples, including a duplicate of the split sample, were sent to Princeton Testing Laboratory in Princeton, New Jersey, to be analyzed for volatile organic compounds, total petroleum hydrocarbons, primary metals, and cyanide.

Because OVA headspace analyses yield qualitative results, this technique is only useful for identifying borehole samples with the highest relative concentrations of volatile organic compounds. To obtain accurate, quantitative results for the concentrations of individual organic compounds, select samples were subject to more detailed laboratory analysis. Concentrations given by OVA measurements are not useful quantitatively because they can yield results which are up to several orders of magnitude larger than those obtained by laboratory analysis. This variation in accuracy between the two methods is largely due to the difference in the ratio of sample amount to gas volume. For example, laboratory methods of finding the actual soil content include using three to four grams of sample soil from which the organics volatilize into a one-liter chamber. OVA analysis of a sample employs approximately 10 grams of sample with 10 mls of headspace volume over the soil. Therefore, the large difference in the measurements from the two methods is a result of the concentrating effect of the headspace in the septum vials during OVA analysis.

Two split-spoon samples from each well borehole ("SW" series) were analyzed for grain size distribution: one sample from the unsaturated zone, and one sample from the screened interval. Samples were selected with the intent of establishing a representative data base for deposits at various depths. Table III-3 gives a list of the analyzed samples. This information assisted in the lithologic classification of the subsurface materials and provided information on relative hydraulic conductivities. J & L Testing of Bridgeville, Pennsylvania, was contracted to perform the grain size analyses. Results of grain size distribution analyses are given in Appendix E.4.

TABLE III-3
SPLIT SPOON SAMPLES
SELECTED FOR GRAIN SIZE ANALYSIS

<u>Boring Number</u>	<u>Split Spoon Number</u>	<u>Depth Interval (ft)</u>
SW-1	SS-3	10-12
SW-1	SS-12	28-30
SW-2	SS-4	12-14
SW-2	SS-9	22-24
SW-3	SS-2	5-7
SW-3	SS-12	28-30

(CL5120A)

Drill cuttings were analyzed using the EP Toxicity method to determine if the subsurface material was hazardous and required special disposal considerations. All soil samples and the drum composite sample (HART 013) were found to be nonhazardous. The results of these EP Toxicity analyses are presented in Appendix H.1.

B.3.b. Analytical Requirements for the Test Boreholes at the Plating Building ("SB" Series). Six soil samples were collected from the three test borings ("SB" series) at the plating building. Samples sent to the laboratory were analyzed for EP Toxicity metals and total chromium. The samples were selected from the 0 to 2 and 8 to 10-foot intervals when sufficient recovery was obtained at these depths. If there was insufficient recovery at these depths, samples were selected from the next deepest zone in which an adequate sample volume could be collected. Two additional soil samples were collected for laboratory analysis: one sample from SW-1 to be used as a background sample, and one sample from beneath the plating building. The latter sample was collected from the wall of an excavated hole dug beneath the floor of the plating building. GE personnel collected this sample using a clean laboratory container. A list of samples sent to the laboratory is presented in Table III-4.

B.4 Decontamination Procedures

Decontamination procedures followed by HART personnel during the test boring and soil sampling program were used to:

- o Limit the introduction of contaminated materials to "clean areas," such as other test borings
- o Limit the transmittal of contaminated materials between samples, which would yield false analytical results

TABLE III-4

SOIL SAMPLES FROM THE PLATING BUILDING
BORINGS SELECTED FOR LABORATORY ANALYSIS

<u>Sample Identifier</u>	<u>Depth (ft)</u>	<u>Field Sample Number</u>
SB-1	2-4 4-6	HART 002 HART 003
SB-2	0.5-2 6-8	HART 001 HART 004
SB-3	2-4 8-10	HART 001 HART 004
Plating Room East - Sample 2(a)	Beneath plating building floor	GE 002

(a) GE personnel obtained this sample from beneath plating building floor

The decontamination procedure followed for all sampling apparatus (split-spoons and spatulas) required washing the equipment with Liquinox and water, followed by a distilled water rinse, a methanol rinse and a final distilled water rinse.

All drilling equipment, including augers, rods, bits and the rig, was decontaminated by steam cleaning. The steam cleaning equipment used a mild soap and water mixture to remove the bulk solids. All steam cleaning was conducted in an open area equipped with a drain behind the plant.

C. Monitoring Well Installation Program

Monitoring wells were installed at the site to monitor groundwater quality in the shallow aquifer and assess the hydraulic properties of the aquifer. The three wells installed at AFP 59 were screened in the uppermost water-bearing zone. This zone is separated from the lower portion of the aquifer by approximately 37 feet of clay and gravel. The presence of this clay unit has only been confirmed beneath part of the site. The geology and hydraulic properties of subsurface materials are expected to vary throughout the site.

C.1 Locations

The monitoring well locations are presented in Figure III-1. These locations correspond to the "SW" series boring locations described above. Well locations were chosen to provide the most effective monitoring points for detection of possible contaminant releases and migration from hazardous material and waste storage areas. One well is located upgradient (SW-1) at the site to provide background groundwater quality data. All wells are less than 30 feet deep and are in the shallow water-bearing zone.

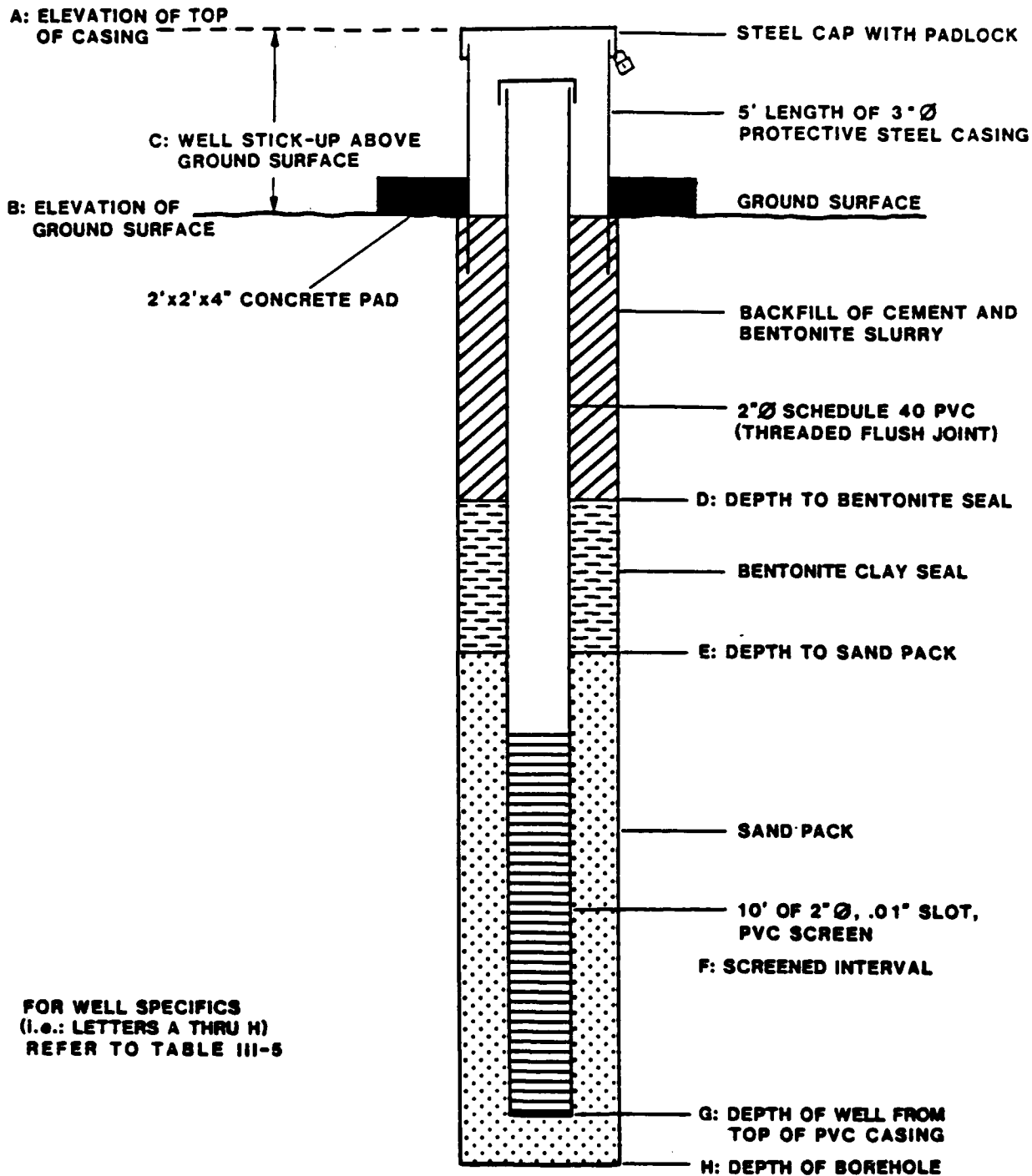
C.2 Shallow Well Construction Methodology and Procedures

A generalized well construction diagram is presented in Figure III-2. Table III-5 gives specific well construction details. The shallow wells were installed using hollow-stem augers. Well SW-1 was drilled using 4.25-inch ID augers. Wells SW-2 and SW-3 were drilled with 2.25-inch ID hollow-stem augers using 4-inch flush joint casing. Empire Soils Investigations of Groton, New York, drilled and installed the wells under the supervision of a HART hydrogeologist. Upon completion of the SW-1 well boring, the borehole was backfilled with clean silica sand to the desired depth and capped with a six-inch bentonite pellet seal.

Generally, placement of the wells is such that the screened interval extends from seven feet below the water table to three feet above the water table. This compensates for seasonal fluctuations in the water table. The wells were constructed of two-inch schedule 40 PVC casing and 0.010 inch machine-slot PVC well screens with end caps. The wells were installed in the borehole through the hollow-stem augers. The sand pack that surrounds the screen was added as the augers were retracted from the borehole. The sand pack was added from the bottom of the borehole to a height of two feet above the well screen, followed by a two-foot thick bentonite pellet seal. The boreholes were then grouted with a cement/bentonite slurry to the ground surface. Each well was fitted with a locking steel protective casing and a concrete pad.

C.3 Decontamination Procedures

All drilling equipment (augers, rods, bits and the rig itself), was decontaminated between borings to prevent cross-contamination. Well screens, riser pipe and temporary casing were also decontaminated prior to installation in the boreholes. The decontamination procedures for all equipment and well materials consisted of steam cleaning. The steam cleaner utilized a mild soap and water wash to remove the bulk solids. All steam cleaning was conducted in a designated area equipped with a drain.



FOR WELL SPECIFICS
(I.e.: LETTERS A THRU H)
REFER TO TABLE III-5

NOT TO SCALE

FIGURE III-2

WELL CONSTRUCTION DIAGRAM

TABLE III-5
WELL CONSTRUCTION DATA

Well #	A(a) Elev. TOC (ft - MSL)	B Elev. Ground Surface (ft - MSL)	C Stick-Up (ft)	D Depth To Bentonite (Seal (ft)	E Depth To Sand Pack (ft)	F Screened Interval (ft)	G Depth Of Well From TOC (ft)	H Depth Of Borehole (ft)(b)
SW-1	834.83	831.90	2.93	13	15	17-27	29.93	27
SW-2	831.09	828.90	2.19	12	14	16-26	28.19	26
SW-3	831.21	829.40	1.81	15	17	19-29	30.81	29

(a) NOTE: The values in columns C,D,E,F and H are measurements taken during well construction relative to the ground surface.

(b) Borings were advanced (for soil sampling purposes) to a total depth of 36, 26, and 30 feet below ground surface for SW-1, SW-2 and SW-3 respectively.

(CL5120A)

C.4 Well Development

Following installation, well development was performed to remove fine grained materials around the well screen in order to increase hydraulic connection between the sand pack and the well screen. The well development was performed with a one-inch diameter PVC pipe fitted with a check valve. The pipe was used to agitate and evacuate water in the well. Development continued until the water was free of sediment. Prior to development, the wells were sampled and analyzed with an OVA to determine if the evacuated water contained any volatile contaminants at levels requiring special disposal considerations. Also, during development, all wells were analyzed for specific conductivity, pH, and temperature. These measurements were taken periodically during development to assess when conditions had stabilized. Results of these measurements are provided in Table III-6.

D. Groundwater Sampling Program

Monitoring wells were sampled two weeks after well development was complete. This passage of time permitted stabilization of the groundwater conditions to allow a more representative sampling of the aquifer. Following development, groundwater samples were collected using a bottom-loading, stainless steel bailer that had been decontaminated, and fitted with a Teflon check-valve and new nylon rope. Before sampling, at least five well volumes were bailed to obtain a representative sample. The first three bailer volumes were discarded to rinse the bailer prior to collecting the sample. Well evacuation data is presented in Table III-6.

The recharge characteristics of each well were noted during well evacuation. All monitoring wells recharged rapidly and none of the wells could be bailed dry.

TABLE III-6

WELL VOLUME DATA
AT THE TIME OF SAMPLING
9/23/86

<u>Well Number</u>	<u>Depth to Water (ft)</u>	<u>Height of Water Column (ft)</u>	<u>Standing Volume of Water in Well (gal)</u>	<u>Volume Removed (gal)</u>
SW-1	20.55	5.6	0.90	30
SW-2	18.75	7.5	1.2	25
SW-3	21.75	6.7	1.1	25

D.1 pH, Specific Conductivity, and Temperature Measurement Procedures

Samples were immediately transferred to 8-oz glass jars. Specific conductivity, pH and temperature measurements were taken from glass sample jars during groundwater sampling for field analysis. Results of these analyses are provided in Table III-7.

D.2 Analytical Sampling Procedures

Following purging of each well, a groundwater sample was collected with the stainless steel bailer. The first three bailer volumes were discarded to rinse the bailer prior to collecting the sample. Samples were poured directly into the appropriate laboratory containers for volatile organic, total petroleum hydrocarbons, primary metals and cyanide analyses. Samples to be analyzed for metals were filtered in the field using a Geotech suction filter and 0.45 micron filter paper. All groundwater samples and blanks were preserved and handled as summarized in Table III-8. Upon collection, all samples were stored in ice-filled coolers pending shipment. Samples were sent via overnight courier to Princeton Testing Laboratories in Princeton, New Jersey. One sample was split with USAFOEHL and sent to their laboratory at Brooks AFB in Texas for independent analysis.

A total of six groundwater samples were collected for laboratory analysis. Table III-9 lists these samples by field identification number. Samples were obtained from the three monitoring wells installed by HART and the existing production well. A blind duplicate, called sample SW-4, was collected from well SW-2 and a split sample was collected from the production well for USAFOEHL. Finally, a field blank was collected to provide a check on the integrity of decontamination procedures.

TABLE III-7
FIELD TEST DATA

<u>Parameter</u>	<u>SW-1</u>	<u>SW-2</u>	<u>SW-3</u>	<u>Production Well</u>
pH (standard pH units)	6.5/6.9(a)	6.3/6.6	6.6/6.8	(b)-/7.6
Specific Conductivity (umhos/cm)	1716/2300	353/380	840/730	-/710
Temperature (°C)	20.0/21.5	20.0/21.5	20.0/21.5	-/19.0
OVA Headspace analysis (ppm)	4.8/-	0/-	1.0/-	-/-

(a) Well Development / Groundwater Sampling
9/12/86 9/23/86

(b) - No measurement taken

(CL5120A)

TABLE III-8
SAMPLE CONTAINERS AND PRESERVATION

Parameter	Volume Required	Container	Preservative	Holding Time
Total Petroleum Hydrocarbons	1 liter	glass	H ₂ SO ₄ to pH <2	28 Days
Primary Metals	1 liter	HDPE	Filter on-site HNO ₃ to pH <2	6 months
Volatile Organics	2 bottles (40 ml each)	VOA vials	2-3 crystals Na ₂ S ₂ O ₃	14 days
Cyanide	500 ml	glass	NaOH to pH >12	14 days

TABLE III-9
GROUNDWATER SAMPLES
SELECTED FOR LABORATORY ANALYSIS

Sample Number

AFP 59, SW-1, Water, HART 001
AFP 59, SW-2, Water, HART 002(a)
AFP 59, SW-3, Water, HART 003
AFP 59, SW-4, Water, HART 004(b)
AFP 59, Production Well, Water, HART 007

- (a) Split Sample sent to USAFOEHL,
(same sample as AFP 59, SW-2, Water, USAFOEHL 002)
- (b) Blind Duplicate of AFP 59, SW-2, Water, HART 002

D.3 Decontamination Procedures

Sampling equipment was decontaminated between wells to prevent cross-contamination of the samples. The decontamination procedure consisted of washing the bailer with a mild soap (Liquinox) and water, followed by a tap water rinse, a methanol rinse, and a distilled water rinse.

E. Surveying Program

Lynn Pullis Surveying of Binghamton, New York, surveyed the well evaluations and horizontal locations on September 24, 1986. Elevations were surveyed to 0.01 ft accuracy and horizontal locations to within one foot. The results of the elevation survey are presented in Table II-4. At each well location, the top of the protective steel casing and ground surface elevations were determined.

F. Groundwater Level Measurement Program

Following installation of the monitoring wells, groundwater level measurements were obtained. All measurements were made within a 12-hour period. Water level measurements were obtained using a Slope Indicator Co., Model 51453 water level indicator. Water level measurements are reported in Table II-4.

G. Quality Assurance/Quality Control (QA/QC) Field Procedures

To ensure collection of technically defensible data, QA/QC procedures were followed. Details of field sampling, QA/QC samples and analytical methods can be found in Appendix F. Appendix F also contains details on sample numbering, preservation of samples and field equipment utilization. Chain-of-custody methodology and equipment calibration are discussed in Appendix K.

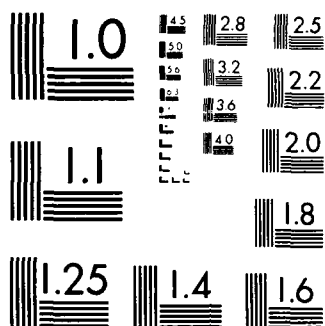
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INSTALLATION RESTORATION PROGRAM PHASE 2
CONFIRMATION/QUANTIFICATION STAG. (U) HART (FRED C)
ASSOCIATES INC NEW YORK MAR 88 F33615-84-D-4404

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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

IV. DISCUSSION OF RESULTS AND SIGNIFICANCE OF FINDINGS

A. Introduction

This chapter presents and summarizes the analytical results for the soil and groundwater samples collected during this investigation. Discussions primarily concern the laboratory analysis of soil samples taken from the monitoring wells and test borings, and groundwater samples collected from the on-site wells. Analytical results are compared with federal and state standards, criteria, limits and guidelines. The reliability of the results are discussed by comparing duplicates, spikes, and blanks, and evaluating the laboratory quality assurance/quality control (QA/QC) and HART's field procedures. The significance of the findings is discussed in terms of the extent of contamination and the overall risk posed by the site.

B. Results of Testing

B.1 Summary of Results

This section presents the analytical testing results for subsurface soil and groundwater samples collected during September 1986. Sampling methodology is consistent with current EPA protocol and is described in Section III. Complete results of sampling are discussed later in this section (D.1 - Evaluation of Laboratory QA/QC and Reliability of Results).

The types and numbers of samples analyzed are as follows:

<u>Media</u>	<u>Number of Samples</u>	<u>Number of Duplicates, *Background Samples and Field Blanks</u>
Soil (SB series)	7	1*
Soil (SW series)	7	2
Groundwater	<u>4</u>	<u>2</u>
	18	5

(CL5124A)

A total of 42 subsurface soil samples were collected during this investigation. Of these 42 samples, 17 (including QA/QC samples) were selected for laboratory analysis. Generally, samples with the highest relative total volatile organic compounds (VOCs) levels as measured with an OVA were sent for laboratory analysis. The drum composite sample (HART 013) and the samples retained from soil borings (SB-1, SB-2 and SB-3) were not screened with the OVA because these samples were not analyzed for VOCs. A total of six groundwater samples (including QA/QC samples) were also collected during the HART investigation and sent to the laboratory for analysis. Soil samples were collected from well borings (SW series) and test borings (SB series) while groundwater samples were collected from the on-site monitoring wells and the production well. Laboratory analytical results for the inorganic and organic analyses can be found in Appendices H.1 and H.3, respectively.

Princeton Testing Laboratory (PTL), in Princeton, New Jersey, provided the laboratory analysis for this investigation at AFP 59. PTL was required to analyze for volatile organics, total petroleum hydrocarbons (TPH), metals, EP Toxicity metals, and other compounds. Analysis of all samples has been completed. Proper QA/QC procedures were maintained through the use of duplicate samples and field blanks. Second column confirmation analyses (EPA Method 624) were performed on groundwater samples containing concentrations of constituents above PTL's method detection limit in order to verify the presence of these contaminants (chemical concentration below PTL's method detection limit could not be accurately measured on a quantitative basis). Samples reported to contain values less than the PTL quantification limit but above the method detection limit were classified as not detected. This is discussed in Section D.1 - Evaluation of Laboratory QA/QC and Reliability of Results.

The concentrations of contaminants detected in the soil borings near the plating building and the soil borings from the groundwater monitoring wells are presented in Tables IV-1 and IV-2, respectively. Analytical results for inorganics and total petroleum hydrocarbons in groundwater are presented in Table IV-3, while the results of analysis for organics in (CL5124A)

TABLE IV-1

ANALYTICAL RESULTS - SOIL FROM BOREHOLE PROGRAM

USAF PLANT NO. 59

JOHNSON CITY, N.Y.

Parameters (a)

Sample Identification	Arsenic EP Tox.	Barium EP Tox.	Cadmium EP Tox.	Chromium EP Tox.	Lead EP Tox.	Selenium EP Tox.	Silver EP Tox.	Total Chromium (c)
Sample Date: 9/9-12/86								
Extraction Date: 10/1-2/86								
Analysis Date: 10/8/86 (b)	0.01	0.05	0.01	0.02	0.02	0.01	0.01	1.0 (mg/kg)
Limit (mg/L)								
AFP 59, SB-1, 2'-4', HART 002	<0.01	<0.05	<0.01	<0.02	<0.02	<0.01	<0.01	7.70
AFP 59, SB-1, 4'-6', HART 003	<0.01	<0.05	<0.01	<0.02	0.08	<0.01	<0.01	12.4
AFP 59, SB-2, 0.5'-2', HART 001	0.01	<0.05	<0.01	<0.02	0.06	<0.01	<0.01	12.6
AFP 59, SB-2, 6'-8', HART 004	0.01	0.06	<0.01	<0.02	0.10	<0.01	<0.01	16.1
AFP 59, SB-3, 2'-4', HART 001	0.01	<0.05	<0.01	<0.02	0.04	<0.01	<0.01	18.0
AFP 59, SB-3, 8'-10', HART 004	<0.01	<0.05	<0.01	<0.02	0.07	<0.01	<0.01	67.4
AFP 59, Plating Room East, S2, GE 002	0.02	0.19	<0.01	<0.02	0.31	<0.01	<0.01	43.6
AFP 59, SW-1, 20'-22', HART 005(d)	0.01	0.51	0.02	0.02	0.78	0.01	0.01	5.43

(a) EP Tox. mercury (Detection Limit is 0.001 mg/L) was analyzed for but not detected.

(b) Selenium analyzed 10/7/86

(c) Digestion of total chromium 9/25-26/86; Atomic absorption conducted 9/30/86

(d) Background sample taken from monitoring well borehole

(CL5120A)

TABLE IV-2

ANALYTICAL RESULTS - SOIL FROM MONITORING WELL PROGRAM
USAF PLANT NO. 59
JOHNSON CITY, N.Y.

Sample Identification	Parameters (a)							
	<u>Arsenic</u> EP Tox.	<u>Barium</u> EP Tox.	<u>Cadmium</u> EP Tox.	<u>Chromium</u> EP Tox.	<u>Lead</u> EP Tox.	<u>Selenium</u> EP Tox.	<u>Silver</u> EP Tox.	<u>Petroleum</u> <u>Hydrocarbons</u>
Sample Date: 9/9-12/86 Extraction Date: 9/22-23/86 Analysis Date: 9/30/86 ^a	Detection Limit (mg/L)	0.01	0.05	0.01	0.02	0.02	0.01	10.0 (mg/kg)
AFP 59, SW-1, 18'-20', HART 004	0.02	0.52	0.04	<0.02	0.16	<0.01	0.01	<10.0
AFP 59, SW-1, 24'-26', HART 007	0.02	0.44	0.02	<0.02	0.15	0.01	<0.01	11.4
AFP 59, SW-2, 22'-24', HART 009	0.01	0.35	0.02	<0.02	0.03	<0.01	<0.01	<10.0
AFP 59, SW-2, 24'-26', HART 010	0.01	0.20	0.01	<0.02	0.03	<0.01	<0.01	<10.0
AFP 59, SW-3, 22'-24', HART 009	<0.01	0.14	0.02	<0.02	0.05	<0.01	<0.01	<10.0
AFP 59, SW-3, 24'-26', HART 010	0.03	0.50	0.06	<0.02	0.18	0.01	0.01	<10.0
AFP 59, SW-4, 22'-24', HART 001(c)	<0.01	0.10	0.02	<0.02	0.06	<0.01	<0.01	<10.0
AFP 59, Field Blank, Water, Hart 001	NA(e)	NA	NA	NA	NA	NA	NA	<0.05
AFP 59, SW-3, Drum Composite, HART 013(f)	0.02	0.39	0.04	<0.02	0.71	<0.01	0.01	NA

(a) Cyanide (DL(g) is 0.35 mg/l) and EP Tox. Mercury (DL is 0.001 mg/l) were analyzed for, but were not detected. The Drum Composite sample (HART 013) and the Field Blank sample (Hart 001) were not analyzed for cyanide content.

(b) Selenium and Silver analyzed 9/29/86; Petroleum Hydrocarbons analyzed 10/2/86.

(c) Duplicate sample of AFP 59, SW-3, 22'-24', HART 009.

(d) Water sample, mg/L.

(e) NA - Parameter not analyzed.

(f) Sample analyzed 9/25/85 except for mercury which was analyzed on 9/28/87.

(g) DL - Detection limit.

(CL5120A)

TABLE IV-3

ANALYTICAL RESULTS FOR INORGANICS AND
PETROLEUM HYDROCARBONS IN GROUNDWATER

USAF PLANT NO. 59

JOHNSON CITY, NY

Parameters

Sample Date: 9/23/86

Analysis Date: 9/25/86(a)

Sample Identification	Barium	Cadmium	Lead	Arsenic	Silver	Chromium	Mercury	Selenium	Cyanide	Total Petroleum Hydrocarbons
Detection Limit (mg/L)	0.01	0.005	0.02	0.005	0.01	0.02	0.001	0.005	0.01	0.5
Analytical Method	E200.7	E200.7	E200.7	E206.2	E200.7	E200.7	E245.1	E270.2	A412D/SW9010	E418.1
AFP59, SW1, Water, Hart 001	0.21	0.007	0.30	0.02	<0.01	<0.02	<0.001	<0.005	<0.01	<0.5
AFP59, SW2, Water, Hart 002	<0.01	0.01	0.03	<0.005	<0.01	<0.02	<0.001	<0.005	<0.01	<0.5
AFP59, SW3, Water, Hart 003	0.05	<0.005	0.14	0.01	<0.01	<0.02	<0.001	<0.005	<0.01	<0.5
AFP59, SW4, Water, Hart 004(b)	<0.01	<0.005	0.07	0.01	<0.01	<0.02	<0.001	<0.005	<0.01	<0.5
AFP59, Production Well, Hart 007	0.14	<0.005	0.13	0.01	<0.01	<0.02	<0.001	<0.005	<0.01	0.6
Field Blank, Hart 005	NA(c)	NA	NA	NA	NA	NA	NA	NA	NA	<0.5

(a) Arsenic and Petroleum Hydrocarbons analyzed on 9/29/86 and 10/15/86 respectively.

(b) Duplicate Sample of AFP 59, SW-2, WATER, HART 002.

(c) NA - Parameter Not Analyzed

(CL5120A)

groundwater is shown in Table IV-4. For reference purposes, each sample includes the borehole number, depth of sample (if appropriate), sample date, analysis date, method detection limit and the EPA analytical method. Samples are reported in concentrations of mg/L or ug/L. Detection limits are listed in Appendix F.2. Complete results of analytical testing are presented in Appendix H.

B.2 Discussion of Sample Results

B.2.a. Subsurface Soil. Based on the results of laboratory analysis, substances of concern detected in subsurface soils at AFP 59 include a number of metals and total petroleum hydrocarbons.

Metals were detected in all analyzed soil samples analyzed from the borehole and monitoring well program, including the duplicate sample. Table IV-5 presents the list of metals and the range of concentrations detected in both the borehole and monitoring well program. Any values identified in the following paragraphs are for comparison purposes only and do not represent water quality criteria or recommended cleanup criteria.

All concentrations of metals, with the exception of total chromium, were detected at levels below established maximum EP Toxicity concentrations. In the borehole program, concentrations of lead exceeded 0.05 mg/L in 75 percent (6/8) of the samples, while barium levels exceeded 0.05 mg/L (method detection limit) in 37.5 percent (3/8) of the samples. Total chromium was detected at levels exceeding 10 mg/kg and 20 mg/kg in 75 percent (6/8) and 25 percent (2/8) of the borehole samples, respectively.

In soil samples analyzed from the monitoring well program, barium concentrations equaled or exceeded 0.20 mg/L in 75 percent (6/8) of the

TABLE IV-4

ANALYTICAL RESULTS FOR ORGANICS IN GROUNDWATER

USAF PLANT NO. 59

JOHNSON CITY, NY

Detection Limit (ug/L) Analytical Method	1,1-dichloroethane		trans-1,2-dichloroethane		1,1,1-trichloroethane		trichloroethene	
	First Column	Confirmatory Analysis	First Column	Confirmatory Analysis	First Column	Confirmatory Analysis	First Column	Confirmatory Analysis
AFP 59 SW-1, Water, HART 001	1 E601/602	1 E624	1 E601/602	1 E624	2 E601/602	2 E624	2 E601/602	2 E624
AFP 59, SW-2, Water, HART 002	<1	NA (a)	<1	NA	<2	NA	<2	NA
AFP 59, SW-3, Water, HART 003	<1	NA	<1	NA	<2	NA	<2	NA
AFP 59, SW-4, Water, HART 004 (b)	<1	NA	<1	NA	<2	NA	<2	NA
AFP 59, Production Well, HART 007	16	15	66	73	9	3	11	8
Field Blank, HART 005	<1	NA	<1	NA	<2	NA	<2	NA

(a) NA Second column confirmatory analysis not performed.

(b) Duplicate Sample of AFP 59, SW-2, WATER, HART 002.

(CL5120A)

TABLE IV-5

SUBSTANCES OF CONCERN IN SUBSURFACE SOILS

USAF PLANT NO. 59

JOHNSON CITY, NY

Constituent	Maximum Allowable Concentration of Contaminants for EP Toxicity ^(a) (mg/L)	Borehole Program Concentration Range (mg/L)	# of Samples Above Method Detection Limit Total # of Samples		Monitoring Well Program Concentration Range (mg/L)	# of Samples Above Method Detection Limit Total # of Samples	
Arsenic (EP TOX)	5.0	<0.01-0.02	5/8		<0.01-0.03	6/8	
Barium (EP TOX)	100.0	<0.05-0.51	3/8		0.10-0.52	8/8	
Cadmium (EP TOX)	1.0	<0.01-0.02	1/8		0.01-0.06	8/8	
Chromium (EP TOX)	5.0	<0.02-0.02	1/8		<0.02	0/8	
Lead (EP TOX)	5.0	<0.02-0.78	7/8		0.03-0.71	8/8	
Selenium (EP TOX)	1.0	<0.01-0.01	1/8		<0.01-0.01	2/8	
Silver (EP TOX)	5.0	<0.01-0.01	1/8		<0.01-0.01	3/8	
Total Chromium (mg/kg)	*(b)	5.43-67.4	8/8		NA ^(c)	NA	
Petroleum	*	NA	NA				
Hydrocarbons (mg/kg)					<10.0-11.4	1/8	

(a) Concentrations contained in Appendix II, 40 CFR 261, Subpart D

(b) * Maximum concentration for soils not established for this parameter

(c) NA Sample was not analyzed for this parameter or not applicable

(CL5120A)

samples. Concentrations of lead equaled or exceeded 0.05 mg/L and 0.15 mg/L in 75 percent (6/8) and 50 percent (4/8) of the samples, respectively. More lead was detected at sites SW-1 and SW-3 than at SW-2. With the exception of one sample which had a concentration of 11.4 mg/kg (12.5 percent of samples or 1/8), the maximum concentration of total petroleum hydrocarbons was below the method detection limit of 10 mg/kg.

B.2.b. Groundwater. Table IV-6 documents the substances of concern, the total number of observations of each chemical, and the concentration range of groundwater samples tested for primary metals, volatile organics and total petroleum hydrocarbons (TPH). Substances of concern in groundwater that could potentially endanger human health, welfare or the environment include the following four metals: arsenic, barium, cadmium and lead. Lead was detected in all four wells (SW-1, SW-2, SW-3, Production Well). Lead concentrations ranged from 0.03 to 0.30 mg/L, and the highest levels were detected at groundwater sites SW-1 (0.30 mg/L) and SW-3 (0.14 mg/L). Barium and arsenic were detected at three groundwater sites and cadmium was detected at two sites. TPH was found above the detection limit in the production well only.

VOCs were only found in groundwater monitoring well SW-3 and the production well. VOCs detected on-site in 20 percent (1/5) of the groundwater samples include 1,1-dichloroethane, trans-1,2-dichloroethene and 1,1,1-trichloroethane. Trichloroethene was present in 40 percent (2/5) of samples. With the exception of one sample (Production Well) which had a concentration of 0.6 mg/L (1/5, or 20 percent of samples), the concentration of total petroleum hydrocarbons was below the method detection limit.

During February and May 1985, groundwater samples were collected at the on-site production well and analyzed for volatile organic compounds and metals. O'Brien & Gere Engineers, Inc. of Syracuse, New York, performed the laboratory analysis (Table IV-7). Levels of volatile organic compounds, such as 1,1-dichloroethane (11 ug/L), trans-1,2-dichloroethene (37-63 ug/L), 1,1,1-trichloroethane (2-3 ug/L) (CL5124A)

TABLE IV-6

SUBSTANCES OF CONCERN IN GROUNDWATER
USAF PLANT NO. 59
JOHNSON CITY, NEW YORK

<u>Constituent</u>	<u>Concentration Range (mg/L)</u>	<u>No. of Sample Constituent Detected/Total No. of Samples</u>
Inorganics		
Arsenic	<0.005-0.02	4/5
Barium	<0.01-0.21	3/5
Cadmium	<0.005-0.01	2/5
Lead	0.03-0.30	5/5
Petroleum Hydrocarbons	<0.5-0.6	1/5
Organics	<u>Concentration Range (ug/l)</u>	
1,1-Dichloroethane	<1-16	1/5
trans-1,2-Dichloroethene	<1-66	1/5
1,1,1-Trichloroethane	<2-9	1/5
Trichloroethene	<2-11	2/5

TABLE IV-7

HISTORICAL ANALYTICAL RESULTS FOR ORGANICS
AND INORGANICS IN GROUNDWATER
AT PRODUCTION WELL
USAF PLANT NO. 59
JOHNSON CITY, N.Y. (a)

<u>Sample Identification</u>	<u>84122</u>	<u>30861</u>	<u>27795(b)</u>
Date Collected	5/23/85	2/12/85	2/7/85
Date Received	5/24/85	2/12/85	2/7/85
Date Analyzed	6/5/85	2/13/85	4/29/85(c)
<u>Organics (ug/l)</u>			
1,1-Dichloroethane	11	11	NA(d)
trans-1,2-Dichloroethene	37	63	NA
1,1,1-Trichloroethane	2	3	NA
Trichloroethene	5	8	NA
Freon 113	2	5	NA
<u>Inorganics (mg/l)</u>			
Nickel	NA	NA	30

(a) Laboratory Analysis Performed by O'Brien & Gere Engineers, Inc., Syracuse, N.Y.

(b) Sample analyzed for Metals, Cyanide, Phenols, Pesticides/PCB's and Semi-Volatiles.

(c) Pesticides/PCB's analyzed 2/25/85 (none detected above method detection limit).

(d) NA - Not Analyzed

(GC1000B/30)

and trichloroethene (5-8 ug/L), were detected in groundwater samples from the production well in concentrations similar to those detected by HART (Table IV-4). However, analytical results for metals indicate the presence of nickel at a concentration of only 0.030 mg/L. Nickel was not analyzed during the September 1986 sampling program.

The predominant environmental processes thought to determine the aquatic fate of the above-mentioned compounds are presented in Table IV-8.

C. Comparison of Results With Available Federal,
State and Local Standards, Criteria, Limits and Guidelines

Among the nine potentially hazardous substances detected in the groundwater at AFP 59, four have been detected at concentrations equal to or exceeding current applicable Safe Drinking Water Act Maximum Contamination Levels (MCLs), Preliminary Protective Concentration Limits (PPCLs) for protection of human health from ingestion of water containing contaminants, Proposed Maximum Contaminant Level Goals (MCLGs) or New York State Ambient Water Quality Standards and Guidance Values for groundwater (NYSAWQSGVs). These substances include two volatile organic compounds (trans-1,2-dichloroethene and trichloroethene) and two metals (cadmium and lead). Table IV-9 lists the nine potentially hazardous substances of concern, documents the maximum concentration detected in groundwater at the site, and compares them with five relevant water quality criteria or standards.

For purposes of comparison only, the EPA Drinking Water Health Advisories and PPCL unit cancer risks (UCR) were identified. These relevant advisories are based on short- and long-term chronic exposures and were included to indicate that the compound is a potential carcinogen. These UCR values correspond to an incremental increase in cancer risk of 10^{-6} , or one in a million for a 70 kg adult consuming 2 liters of water per day over a 70-year lifetime.

(CL5124A)

TABLE IV-8
ENVIRONMENTAL PROCESSES AND AQUATIC FATE

<u>Compound</u>	<u>Environmental Process</u>	<u>Comment</u>
1,1-Dichloroethane	Volatilization Photo-oxidation	Primary transport process Slow rate in aquatic environment.
Trans-1,2-Dichloroethene	Volatilization Photo-oxidation	Primary transport process Occurs in troposphere.
1,1,1-Trichloroethane	Volatilization Photo-oxidation	Primary aquatic transport process Occurs in troposphere
Trichloroethene	Volatilization Photo-oxidation	Primary transport process Slow rate in aquatic environment
Cadmium	Chemical speciation Sorption Bioaccumulation	Complexation with organic material Associates with organic material Concentration factor: 10^2 - 10^4
Chromium	Chemical speciation Bioaccumulation Sorption	Cr VI to Cr III By aquatic organisms Cr VI and organic materials
Lead	Sorption Bioaccumulation Chemical speciation	To inorganic solids and organic materials. Concentration factor: 10^2 - 10^3 Organic complexation
Arsenic	Sorption Bioaccumulation Bio-transformation Chemical speciation	Affinity for clays, iron oxides, organic matter In lower trophic levels Produces organic arsenicals Inter-conversions of +3 and +5 state

(CL5120A)

TABLE IV-8 (CONTINUED)
ENVIRONMENTAL PROCESSES AND AQUATIC FATE

<u>Compound</u>	<u>Environmental Process</u>	<u>Comment</u>
Silver	Sorption	Affinity for hydrous manganese, iron oxides, clay materials and organics. Plants and primary consumer organisms
	Bioaccumulation	
	Chemical speciation	
Selenium	Chemical speciation	Controls solubility By hydrous metal oxides
	Sorption	
Barium	Sorption	Affinity for organic matter
	Bioaccumulation	
	Chemical speciation	
Petroleum hydrocarbons	Volatilization	Important aquatic process

TABLE IV-9
COMPARISON OF SUBSTANCES OF CONCERN IN GROUNDWATER
WITH RELEVANT CRITERIA, STANDARDS AND GUIDANCE VALUES

USAF PLANT NO. 59 JOHNSON CITY, NY						
Parameter	Range of Concentrations (mg/L)	Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (mg/L)(a)	Preliminary Protective Concentration Limits (PPCLs) (mg/L)(b)	EPA Drinking Water Health Advisories (mg/L)(c)	Proposed Maximum Contaminant Level Goals (MCLGs) (mg/L)(d)	New York State Ambient Water Quality Standards & Guidance Values (NYSAMQSVs) (mg/L)(e)
Barium	<0.01 - 0.21	1.0	1.0 (MCL)	1.8 (adult, lifetime)	1.5	1.0(S)
Cadmium	<0.005 - 0.01	0.010	0.01 (MCL) or 0.00000449 (UCR)	0.043 (infant, 1-day) 0.008 (infant, 10-day) 0.005 (infant, longer term) 0.018 (adult, longer term) 0.018 (adult, lifetime)	0.005	0.010(S)
Lead	0.03 - 0.30	0.05	0.155 (ADI) or 0.05 (MCL)	0.020 mg/day (infant, longer term) 0.020 mg/day (adult, longer term) 0.020 mg/day (adult, lifetime)	0.020	0.025 (S)
Arsenic	<0.005 - 0.02	0.05	0.05 (MCL) or 0.0000025 (UCR)	0.050 (infant, 1- and 10-day) 0.050 (infant & adult, longer term) 0.050 (adult, lifetime)	0.05	0.025 (S)

(CL5120A)

TABLE IV-9 - (CONTINUED)

COMPARISON OF SUBSTANCES OF CONCERN IN GROUNDWATER
WITH RELEVANT CRITERIA, STANDARDS AND GUIDANCE VALUESUSAF PLANT NO. 59
JOHNSON CITY, NY

Parameter	Range of Concentrations (mg/L)	Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (mg/L)(a)	Preliminary Protective Concentration Limits (PPCLs) (mg/L)(b)	EPA Drinking Water Health Advisories (mg/L)(c)	Proposed Maximum Contaminant Level Goals (MCLGs) (mg/L)(d)	New York State Ambient Water Quality Standards & Guidance Values (NYSAMQSVs) (mg/L)(e)
Total Petroleum Hydrocarbons	<0.5 - 0.6	NA(f)	NA	NA	NA	1.0(g)
1,1-Dichloroethane	<0.001 - 0.016	NA	4.05	NA	NA	0.050(GV)
trans-1,2-Dichloroethene	<0.001 - 0.066	NA	NA	2.72 (infant, 1-day) 1.0 (infant, 10-day) 1.0 (infant, longer term) 3.5 (adult, longer term) 0.35 (adult, lifetime)	0.07	0.050(GV)
1,1,1-Trichloroethane	<0.002 - 0.009	0.200	19.0 (AD1)	140.0 (infant, 1-day) 35.0 (infant, 10-day) 35.0 (infant, longer term) 125.0 (adult, longer term) 1.0 (adult, lifetime)	NA	0.050(GV)
Trichloroethene	<0.002 - 0.011	0.005	.00184 (UCR)	NA	NA	0.010(S)

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TABLE IV-9 - (CONTINUED)

COMPARISON OF SUBSTANCES OF CONCERN IN GROUNDWATER
WITH RELEVANT CRITERIA, STANDARDS AND GUIDANCE VALUES

USAF PLANT NO. 59
JOHNSON CITY, NY

- (a) USEPA 40 CFR 141 (National Primary Drinking Water Standards); 52 Federal Register 25712, July 8, 1987.
- (b) USEPA Compilation of Agency reviewed health effects data for 40 CFR 261, Appendix VIII "Hazardous Constituents". UCR or unit cancer risk indicates a chemical with carcinogenic potential. Recommended level for protection of human health is zero based on a non-threshold assumption for this chemical. Level indicated corresponds to a 10^{-6} risk from lifetime exposure (70 years) for a 70 kg adult.
- (c) Superfund Public Health Evaluation Manual, October 1986, USEPA Office of Emergency and Remedial Response, Office of Solid Waste and Emergency Response. EPA Drinking Water Health Advisories are based upon exposures for a 10 kg infant or a 70 kg adult. Longer term health advisories are for exposures ranging from several months to several years and should generally be compared only to estimated short-term concentrations.
- (d) Proposed MCLGs, Federal Register, Vol. 50, No. 219, Wednesday, November 13, 1985, pp. 46935-47022.
- (e) Quality standards for Class GA are the most stringent of (1) maximum contaminant levels (MCLs) for drinking water established in 10 NYCRR subpart 5-1, (2) MCLS established under the Safe Drinking Water Act, (3) Standards for raw water quality established under 10 NYCRR Part 170, or (4) the standards listed below. S = Standard; GV = Guidance Value
- (f) NA - Not applicable. No standard or guidance established.
- (g) Recommended Cleanup Standard for Groundwater, New Jersey Department of Environmental Protection.

Five of the nine potential contaminants identified at the site have been detected at concentrations below applicable standards, criteria or guidance values. These constituents are barium, arsenic, TPH, 1,1-dichloroethane and 1,1,1-trichloroethane.

Four constituents were found at concentrations equal to or exceeding applicable standards, criteria or guidance values. These constituents are lead, cadmium, trichloroethene and trans-1,2-dichloroethene.

Lead exceeded the NYSAWQSGVs and the MCLs in all wells (100 percent of the samples). Cadmium was detected in SW-2 at the MCL and NYSAWQSGV for groundwater. Cadmium was also detected in SW-1 in excess of the MCLG but below the MCL and the NYSAWQSGV.

Of the volatile organic contaminants identified, trichloroethene was present in concentrations which exceed the MCL and PPCL in two wells (SW-3 and the Production Well) and the NYSAWQSGV in the production well. Trans-1,2-dichloroethene was found in only one well and exceeded the NYSAWQSGV (SW-3).

EP Toxicity analyses of metals did not yield any values exceeding established maximum EP Toxicity concentrations.

D. Reliability of Results

D.1 Evaluation of Laboratory QA/QC and Reliability of Results

Princeton Testing Laboratories (PTL), in Princeton, New Jersey, performed the laboratory analyses under the direction of Nancy Dunn, Manager, Organic Laboratory; Edna Alinea, Manager, Water, Wastewater and Microbiology Laboratory; and James E. Dennison, Ph.D., C.I.H., Technical Director. PTL was responsible for soil and groundwater sample analyses for volatile organics, EP Toxicity metals and total petroleum hydrocarbons, along with quality control/quality assurance (QA/QC)

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procedures. Analytical protocols used for soil and groundwater samples were in accordance with the USAF Scope of Work (Table IV-10). A modified EPA Method 601/602 (organics) was used to accommodate solid matrices.

Soil samples analyzed for characteristics of EP Toxicity were to be reported in milligrams per liter (mg/L), as were all aqueous samples. Soil samples analyzed for total chromium or petroleum hydrocarbons were to be reported in milligrams per kilogram (mg/kg).

Quality control procedures to monitor laboratory performance involve the use of spike, duplicate and field blank samples. Two field blanks were taken; one consisted of distilled water poured over the decontaminated split-spoon used at SW-1 and was labeled Hart 001; the second field blank consisted of distilled water poured into the decontaminated bailer and was labeled HART 005. Two blind duplicate samples (Sample Nos. AFP 59, SW-4, 22 feet-24 feet, HART 001; and AFP 59, SW-4, Water, HART 004) were submitted to PTL with samples collected in the field in September 1986. The purpose of the field QC samples is to provide additional data to monitor the repeatability and accuracy of PTL's analyses. Combined laboratory and field QC procedures usually will insure an adequate data base for the evaluation of analytical data. All PTL inorganic and organic QA/QC results can be found in Appendices H.2 and H.4, respectively.

PTL performed duplicate analysis by splitting a sample and analyzing equal amounts of it using the same method. Differences in results indicate the measure of overall precision of the test method under real operating conditions. Matrix spike analysis involves the addition of a known amount of pollutant to a sample and provides a measure of accuracy or recovery, depending on whether the sample is a blank or a real sample.

TABLE IV-10

ANALYTICAL PROTOCOLS FOR SOIL
AND GROUNDWATER SAMPLES

<u>Pollutant</u>	<u>Method</u>	<u>Matrix</u>
VOCs	EPA 601/602	Water
Halogenated VOCs	SW 5030/SW 8010	Soil
Aromatic VOCs	SW 5030/SW 8020	Soil
Metals		
Barium	E 200.7	Water
Cadmium	E 200.7	Water
Lead	E 200.7	Water
Arsenic	E 206.2	Water
Mercury	E 245.1	Water
Selenium	E 270.2	Water
Silver	E 200.7	Water
Chromium	E 200.7	Water
Petroleum Hydrocarbons	E 418.1	Water and Soil
Cyanide	A 4120/SW 9010	Water and Soil
Metals	EP Toxicity (from Appendix II, 40 CFR 261, Subpart D)	Soil

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According to standard procedures for sample preservation, it is best to keep holding times to a minimum and analyze samples as soon as possible after collection. Volatile organic and cyanide analyses should be performed within 14 days of the time of sample receipt for water samples, while dissolved and total metals generally must be analyzed within 6 months of receipt for water samples. According to extraction/preparation and run dates provided by PTL, these holding times followed for all samples with the exception of two soil samples analyzed for cyanide (Appendix H). The established holding time for cyanide is for aqueous samples and is suggested as a guideline for soil samples in the absence of statistical data regarding solid samples (EPA, 1985). Since the holding time is only a guideline and was exceeded by only one day, the reported cyanide results for these samples are considered acceptable. No cyanide was detected above detection limits in any of the soil or water samples.

Two groundwater samples (SW-3, HART 003 and Production Well, HART 007) indicating the presence of VOCs were confirmed with second column confirmation analyses (EPA 624). Results are presented in Table IV-4. Chromatograms from the gas chromatography/mass spectrometer (GC/MS) confirmation run can be found in Appendix H.4. Based on these VOC analytical results from the GC/MS confirmation run and discussions with PTL, the four volatile organic contaminants detected in groundwater samples SW-3 and the production well are valid and representative of conditions at these wells. The data are extremely consistent and concentrations detected in the second column confirmation are representative of first column results for volatile organic content. In accordance with EPA Method 601 (Purgeable Halocarbons), second column conditions are as follows: Porosil-C (100/120 mesh) coated with n-octane packed in a 6-foot x 0.1 inch ID stainless steel or glass column. The carrier gas is helium at a 40 ml/minute flow rate. The column temperature is maintained at 50°C for 3 minutes and then programmed at 6°C/minute to 170°C/minute, and held for 4 minutes. No retention data are available for dichlorodifluoromethane, trichlorofluoromethane, 2-chloroethylvinyl ether and 1,1,2,2-tetrachloroethane using this Porosil-C plus n-octane column.

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QC duplicate analyses performed by PTL produced consistent results for the relative percent difference (RPD) when samples were analyzed for VOC concentrations in subsurface soil and groundwater. The relative percent difference was 0 percent for methylene chloride, 1,1-dichloroethane, chloroform and 1,2-dichloroethane for subsurface soil sample SW-3, 22 ft - 24 ft, HART 009. Duplicate analysis of this sample indicates that none of these four compounds were detected during either analysis. Duplicate analyses were performed on the matrix spikes for vinyl chloride, 1,1-dichloroethene, trans-1,2-dichloroethene, carbon tetrachloride, bromoform, benzene, ethylbenzene and 1,2-dichlorobenzene. These results indicated a RPD range of 0.1 to 7.0 for soils and 8.4 to 44.1 for groundwater. There are no PTL duplicate analyses for the groundwater samples; however, the GC/MS confirmation runs for SW-3, HART 003 and Production Well, HART 007 are considered to be valid duplicate analyses. QC duplicate analyses are given in Appendix H.4.

Bromochloromethane is the most commonly used volatile organic compound in the matrix spike analysis. Total percent recovery was relatively consistent and ranged from 96.5 percent to 98.8 percent in groundwater and subsurface soil samples. Matrix spike analyses were also performed on soil boring sample SB-3, 8 ft - 10 ft, HART 004 and groundwater sample SW-1, HART 001. Percent recovery was consistent and ranged from 84 to 100 percent for the soil boring sample and 88 to 100 percent for the groundwater sample. Matrix spike analyses were performed on soil and groundwater sample blanks for vinyl chloride, 1,1-dichloroethene, trans-1,2-dichloroethene, carbon tetrachloride, bromoform, benzene, ethylbenzene and 1,2-dichlorobenzene. Results for soil matrix spike analyses ranged from 96 to 124 percent. Groundwater matrix spike analyses ranged from 67 to 124 percent.

Sample No. SW-4, 22 ft - 24 ft, HART 001 is a blind duplicate of Sample No. SW-3, 22 ft - 24 ft, HART 009; and Sample No. SW-4, Water, HART 004 is a blind duplicate of Sample No. SW-2, Water, HART 002. Analytical results for metals and total petroleum hydrocarbon

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concentrations in soil samples HART 001 and HART 009 are very consistent. The metals barium, cadmium and lead are present at similar levels in both samples. The groundwater sample duplicate, HART 004, did not indicate the presence of cadmium, as did HART 002. There was a minor amount of arsenic found in HART 004; none was found in HART 002.

Overall, the testing method appears to be accurate based on the results of the matrix spike analysis. The duplicate analysis results are generally reliable for both subsurface soil and groundwater. Analytical results for samples are satisfactory from a qualitative viewpoint, as the types of contaminants detected are considered consistent with previous activities at the facility. A more accurate quantitative perspective will be possible once additional wells are installed at the site and more sampling points can be obtained and analyzed.

D.2 HART Field Procedures and Reliability of Equipment

D.2.a. Equipment. All field equipment was decontaminated prior to use in order to eliminate cross-contamination (Section 3.0). Two field blanks were collected to check the thoroughness of this procedure. One blank (Hart 001) was collected by pouring distilled water over a decontaminated split-spoon. The other field blank (HART 005) was collected by pouring distilled water into a decontaminated bailer. The analytical results from these samples are presented in Tables IV-2, IV-3, and IV-4. No detectable level of the RCRA metals, total petroleum hydrocarbons, or volatile organics were found in the field blank (HART 005) from the decontaminated bailer. The field blank (Hart 001) from the split-spoon was analyzed only for total petroleum hydrocarbons and none was detected.

All sampling equipment was calibrated on a daily basis. The OVA was calibrated to account for background VOC levels. The pH and conductivity meters were calibrated to laboratory prepared standards.

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D.2.b. Samples. One soil sample and one groundwater sample were submitted to PTL as blind duplicates. Analytical results from these samples can be found in Tables IV-2, IV-3 and IV-4. Results of these analyses are discussed in detail in Section D.1. The field team leader reported that one soil sample (SW-1, 24 ft - 26 ft, HART 007) was possibly cross-contaminated from ice water in the cooler. Analysis of this sample indicated results fairly consistent with the other soil samples except for the presence of 11.4 mg/kg of total petroleum hydrocarbons. Owing to the fact that the total petroleum hydrocarbons were not found in any other samples, the presence of total petroleum hydrocarbons in this sample could be attributed to contamination from the ice water in the cooler.

E. Significance of Findings

E.1 Extent of Contamination

A discussion of contaminants found in groundwater and soil at the former underground waste oil storage tank area, the plating building, production well and shallow groundwater wells follows. The Phase I study provided an historical review of waste generation and waste management activities at the plant. HART analytical results of contaminants found in soils and groundwater indicate some correlation with chemicals reportedly stored and used in industrial processes at AFP 59 in the past.

E.1.a. Former Underground Waste Oil Storage Tanks. Well SW-2 was installed adjacent to the former location of the underground waste oil storage tanks. Excavation and removal of the underground waste oil storage tanks occurred in the summer of 1985. As shown in the analytical data (Tables IV-2, IV-3 and IV-4) no volatile organics or total petroleum hydrocarbons were detected in the soil or groundwater at SW-2. Furthermore, arsenic, barium, cadmium and lead were detected in soil (SW-2) at levels which were below the maximum concentration of contaminants for EP Toxicity. Groundwater from well SW-2 indicated the

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presence of two heavy metals. The cadmium concentration was equal to the MCL and NYSAWQSGV, while the lead concentration was below the applicable standard and criteria. A blind duplicate of groundwater from SW-2, however, did not indicate the presence of cadmium.

E.1.b. Plating Building. Test borings SB-1, SB-2 and SB-3 were drilled just south of the plating building. In addition to soil samples from the borings, a soil sample (S2, GE002) collected by GE employees from beneath the plating building was sent for laboratory analysis. Analytes detected in SB-1, SB-2, SB-3 and S2, GE002 (Plating Room East) include arsenic, barium, lead and total chromium. Concentrations of lead and total chromium were higher in the deeper of the two samples in each boring. Concentrations of metals did not exceed recommended limits for EP Toxicity. Compared to the three soil borings, the Plating Room East (S2, GE002) sample contained the highest concentration of metals, with the exception of total chromium. However, a background soil sample taken at SW-1 (HART 005, 20 ft - 22 ft), an upgradient location, contained higher levels of metals (except for total chromium) than in the soil borings. All concentrations of total chromium were higher in the test borings than in the SW-1 background soil sample.

E.1.c. Production Well. Volatile organics, total petroleum hydrocarbons and heavy metals were detected in the HART 007 sample taken from the production well. Arsenic, barium and lead were detected at levels similar to those found in the three shallow monitoring wells (SW-1, SW-2 and SW-3). The lead level detected in the production well exceeded the MCL. The highest concentrations (9-66 ug/L) and the greatest number of VOCs were found in this well, and the levels detected are consistent with previous analytical results (Table IV-7). The presence of total petroleum hydrocarbons in the production well at 0.6 mg/L may have been influenced by the method of sampling. The sample from the production well was collected with a pump through a metal gate valve, while a bailer was used to sample SW-1, SW-2 and SW-3.

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E.1.d. Shallow Groundwater Wells. Three monitoring wells, SW-1, SW-2 and SW-3, were installed at AFP 59 during this investigation. A blind duplicate sample of SW-2 was labeled SW-4. The extent of contamination in monitoring well SW-2 is discussed in Section E.1.a. SW-1, which is in an upgradient location, had the highest concentration of metals (arsenic, barium and lead) compared to SW-2 and SW-3. Levels of arsenic and barium, however, were below applicable standards. Lead concentrations detected at SW-1, SW-3 and in SW-4 exceeded the MCL, while lead concentrations in SW-1, SW-2, SW-3 and SW-4 exceeded the MCLG and NYSAWQSGV. No VOCs were detected at SW-1 and SW-2, but a low level (6 ug/L) of trichloroethene was found at SW-3. Trichloroethene contamination in this shallow monitoring well (SW-3) will have to be confirmed.

E.2 Distribution of Contaminants

The distribution of similar contaminants in groundwater and soil were inconsistent throughout the site. Groundwater contaminants generally reflected soil contaminants found in a particular borehole. However, several groundwater samples also contained volatile organic compounds not found in the respective soil boring. The distribution of contaminants in four major areas of AFP 59 is discussed in the following paragraphs.

E.2.a. Former Underground Waste Oil Storage Tanks. When the tanks were removed in the summer of 1985 all soil or gravel that was visibly stained was removed. Soil under the tanks was tested by O'Brien and Gere Engineers, Inc. and found to be nonhazardous (Schneider, 1987). HART is proposing the installation of a groundwater monitoring well downgradient of this area near the plating building. A well in that location would serve to monitor both the plating area and the former underground waste oil storage area.

E.2.b. Plating Building. While some metals are found in the soil borings here, none exceed the EP Toxicity tests for metals. Total chromium, however, was approximately 1.4 to 12 times higher in the borings than in the background sample (SW-1, 20 ft - 22 ft, Hart 005). The (CL5124A)

highest concentration of total chromium 67.4 (mg/kg) was found at the depth of 8 to 10 feet in borehole SB-3. The installation of a groundwater monitoring well directly downgradient of this area is being recommended. A well in this location will detect any potential contamination reaching the groundwater from the plating area and from the former underground waste oil storage area.

E.2.c. Production Well. Results of several sampling events indicate that Production Well No. 1 contains some organic and lead contamination. The production well analysis found the presence of four volatile organic compounds: 1,1-dichloroethane, trans-1,2-dichloroethene, 1,1,1-trichloroethane and trichloroethene. Only one shallow well, SW-3, had any detectable organic compounds. This could possibly indicate that there is a deeper organic groundwater problem emanating from an off-site source. Levels of metals found in the production well were consistent with levels found in the shallow wells. Analytical results from groundwater production wells in the vicinity of AFP 59 show that historically there has been organic contamination both upgradient, in Johnson City Well No. 6, and downgradient, in Johnson City Well No. 3. Several of the same parameters found in the deep well were observed in these municipal wells (i.e., 1,1-dichloroethane and trans-1,2-dichloroethene). These data are given in Appendix H.6. A preliminary assessment indicates there could be a potential off-site source of organic contamination. Currently, there is insufficient off-site data concerning metals analyses.

E.2.d. Shallow Groundwater Wells. Two contaminants have been identified in the shallow wells at concentrations exceeding applicable standards, criteria and guidance values. Lead concentrations exceeding the MCLG and NYSAWQSGV are present in all shallow wells at the site. Cadmium was detected in two of the shallow monitoring wells (SW-1 and SW-2) at concentrations exceeding the MCLG, but the cadmium level in SW-2 was also equal to the MCL and NYSAWQSGV. Trichloroethene was found in one of the shallow monitoring wells (SW-3) at a concentration of 6 ug/L which

exceeds the MCL but not the NYSAWQSGV. Reported lead values in the municipal wells surrounding the site are less than the MCL. Confirmation of these levels through additional testing would be useful to help delineate the distribution of lead and trichloroethene in the groundwater. The highest lead level was found in the upgradient well (SW-1) at the site. The groundwater flow direction indicates that the presence of lead could possibly be attributable to an off-site source. The highest levels of arsenic and barium were also in the upgradient well. Unfortunately, there are no known shallow wells in the vicinity of AFP 59 which could help discover the original source of these contaminants. Additional sampling of the on-site shallow wells is necessary to confirm the presence of these compounds over time.

E.3 Evaluation of Contamination

E.3.a. Pathway Analysis - Air. Based on the nature of the site surface, the majority of which is paved, migration of contaminants via this pathway is not considered to be significant at this site. No air samples, however, were analyzed to verify this.

Soil. Available pathways through soil at this site include transport to off-site areas via surface-water runoff from unpaved areas, contaminants leaching into the groundwater, and direct contact with contaminated soils on-site. At the onset of the investigation, Area No. 2 was identified as a potential source of contamination because of discoloration observed and the potential for vertical migration of contaminants due to soil leaching being a potential source of contamination of the production well and groundwater in the area of the site. Discoloration of soils potentially contaminated from plating wastes was observed while GE personnel were repairing a broken sprinkler main.

Surface Water. The storm sewer system at AFP 59 empties directly into Little Choconut Creek. Little Choconut Creek and the Susquehanna River recharge the Clinton Street-Ballpark Valley aquifer. There are two

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possible surface water pathway scenarios. First, if contaminants were discharged into the storm sewer system at the plant, they would flow directly to Little Choconut Creek. Second, if potential contaminants were leached from the soil and into a storm water sewer they would flow into the surface water system. The sprinkler main leak discussed earlier beneath the plating building could provide such a pathway, although the chances of this entering a leak in the storm sewer system is very remote.

Groundwater. Contaminants of concern in the Clinton Street-Ballpark Valley aquifer include some volatile organic compounds and metals. A literature review indicates that historically the aquifer discharged to the river. Currently, owing to lower groundwater levels, the rivers and streams in the area recharge the aquifer (NYSDEC, 1977). The direction of groundwater flow is presently from the southeast to the northwest. This gradient will most likely be affected by pumping the production well and the municipal wells immediately southwest and northeast of AFP 59. The specific discharge of the groundwater has been estimated at approximately 3 ft/day. Based on this discharge rate, potential contamination from the site could be detected in the municipal wells southwest and northeast of the site in approximately 300 days depending on the location of the contaminant source. However, for contaminants to reach the municipal wells, the flow direction would have to change, which is a possible scenario under different pumping conditions.

At present, the sampling data indicate minor contamination in both the shallow wells and the deeper production well. There is a clay layer in the vicinity of the production well which probably provides some barrier between the upper and lower zone. This clay, however, is not continuous, as shown by other deep boreholes at the site. The primary pathway of concern for contaminated groundwater is the Clinton Street-Ballpark aquifer. This aquifer has been designated as a sole source aquifer and is tapped by many public supply wells. Historically, organic contamination has been documented in municipal production wells both upgradient and downgradient of AFP 59.

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E.3.b. Receptor Identification - Air. Air is not a significant pathway for transport of contaminants in this particular situation. No significant receptors are identified.

Soil. Potential receptors for this pathway would include on-site personnel or casual users of the site who could come in direct contact with contaminated soil. Since all of the contaminated soil at the site is covered with pavement, the only time when this pathway would be applicable is during excavation of a potentially contaminated portion of the site. In addition, contaminated soil has the potential to be transported off-site via the drainage system to Little Choconut Creek.

The major receptors at risk from potentially contaminated surface and subsurface soils would be the eventual users of potentially contaminated groundwaters which have leached these contaminants from the soils. The principal receptors are the populations utilizing potable water wells, and possible users of the surface waters.

Surface Water. Surface water has a minor potential to be a pathway for contaminant transport off-site via the storm sewer system, if large quantities of contaminants were released into it. The receptor would be the municipal wells to the southwest of the site. Potentially contaminated water flowing in Little Choconut Creek could recharge into the aquifer of concern.

Groundwater. Potential receptors for contaminated groundwater are populations using the groundwater downgradient of the site as a potable water supply. Groundwater is the only major source of potable water for the Johnson City area. The Johnson City well field is within 1,000 feet of AFP 59 to the southwest. Another municipal well to the northeast is also within 1,000 feet, but is presently not being used. Although the groundwater flow direction, as presently mapped, is to the northwest, the flow direction could change with seasonal variations and different pumping conditions.

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E.3.c. Summary of Contaminant Evaluation. This section summarizes the results, assessments and conclusions used in evaluating contamination at AFP 59. Where appropriate, a qualitative assessment of risk has been developed and classified as low, moderate or high. For the purposes of this assessment only, most of the risks classified as low will not require the implementation of remedial actions, while moderate and high risks may require remedial action to protect public health and the environment.

A classification of the potential toxicity of contaminants detected at AFP 59 is detailed in Table IV-11.

Summary of Air Pathway

- ° Source: Contaminated surface soils at AFP 59; wind-blown contaminants and volatile emissions.
- ° Pathway: Emissions of volatiles into the ambient air at AFP 59; transport of particulates off-site by wind.
- ° Potential
Receptors: On-site personnel and workers in areas surrounding the site.
- ° Associated
Risks: LOW, due to the fact that the paved site surface prevents wind dispersal of potentially contaminated particulates, and volatile organics and metals are used indoors at AFP 59.

TABLE IV-11

TOXICITY CLASSIFICATION OF COMPOUNDS
DETECTED AT USAF PLANT NO. 59

<u>Constituent</u>	<u>Toxic Hazard Review</u>
<u>Volatiles</u>	
1,1-Dichloroethane	Experimental TER, ETA; MOD oral; hepatotoxic in experimental animals
Trans-1,2-Dichloroethene	Human CNS; skin irritant
1,1,1-Trichloroethane	Human PSY, GIT, CNS, MOD skin irritant
Trichloroethene	MUT data, experimental ETA, TER, CARC
<u>Metals</u>	
Cadmium	Experimental CARC, TER, ETA, NEO; MUT data; human SYS
Chromium	Experimental ETA, CARC
Nickel	Experimental CARC, ETA, NEO
Lead	Human CNS; moderate irritant; $\pm$ CARC (lungs, kidneys); experimental TER
Arsenic	Human CARC, SKN, GIT; experimental TER, ETA, $\pm$ CARC; MUT data
Silver	Experimental ETA; human SKN
Selenium	Experimental ETA and CARC; skin irritant

TABLE IV-11 (CONTINUED)

TOXICITY CLASSIFICATION OF COMPOUNDS
DETECTED AT USAF PLANT NO. 59Footnotes

CARC	Carcinogenic effects
CNS	Central nervous system effects
ETA	Equivocal tumorigenic agent
GIT	Gastrointestinal tract effects
MOD	Moderate irritant effects
MUT	Mutagen
NEO	Neoplastic effects
PSY	Psychotropic effects
SKN	Skin effects (systemic)
SYS	Systemic effects
TER	Teratogenic effects

Source: Sax, N. Irving, Dangerous Properties of Industrial Materials;
Sixth Edition, Van Nostrand Reinhold Company, New York, 1984.

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Summary of Soil Pathway

- ° Source: Subsurface soils containing low concentrations of heavy metals.
- ° Pathway: Direct contact; lateral migration of soils or contaminants off-site and into nearby surface waters due to run-off from precipitation via the storm sewer system.
- ° Potential Receptors: On-site personnel; nearby surface waters; human receptors associated with direct contact and ingestion of these waters.
- ° Associated Risks: A LOW human health risk is associated with prolonged direct contact to surface soils at AFP 59, since there is very little open soil area: the majority of the site is paved. Human health risks associated with contact of contaminated subsurface soils are LOW, due to the improbability of prolonged direct contact. A LOW health risk is associated with human exposure to and ingestion of surface waters and sediments containing contaminants from the site. A LOW to MODERATE risk is associated with continued leaching of existing soil contaminants at the Plating Building.

Surface Waters

- ° Source: Migration of contaminated soils via drainage into storm sewer system and nearby surface waters.
- ° Pathway: Storm sewer system into Little Choconut Creek; Susquehanna River.

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- Potential

Receptors: Populations of humans and organisms potentially ingesting and in direct contact with downgradient surface waters; organisms in direct contact or associated with contaminated sediments and populations ingesting such organisms; infiltration of surface water into the Clinton Street-Ballpark sole source aquifer.

- Associated

Risks: A LOW human health risk is associated with direct contact, ingestion and organisms downgradient of the site. The major source of potable water for this area is groundwater, and so use of surface waters and organisms from these waters would be expected to be intermittent, or for recreational purposes only. There is a LOW to MODERATE risk of contaminated surface waters recharging the Clinton Street-Ballpark sole source aquifer. A more definitive assessment of these and other risks associated with surface waters will require a more quantitative characterization of these waters.

Groundwater

- Source: Waste materials stored and used in industrial processes on-site, including volatile organic compounds, heavy metals, and total petroleum hydrocarbons. In addition, organic constituents have been found in several of the Johnson City municipal wells both upgradient and downgradient of AFP 59.
- Pathway: Vertical transport of contaminants from on-site soils into groundwater; horizontal and vertical groundwater flow.

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- Potential

Receptors: Human populations potentially ingesting contaminated groundwater via potable water supply wells. The Johnson City well field is less than 1,000 feet from the site; wells are located north, east and southwest of AFP 59. The Clinton Street-Ballpark aquifer has been designated as a sole source aquifer.

- Associated

Risk: At present, the human health risks associated with the ingestion of contaminated groundwaters via the Johnson City well field appear to be MODERATE. Only one volatile organic compound and two heavy metals are present in the groundwater beneath the site at concentrations at, or exceeding, the MCLs, NYSAWQSGVs, PPCLs and/or MCLGs for human ingestion.

At some point in the future, should these contaminants be detected at similar concentrations in the well field system, associated human health risks would be MODERATE. Appreciable dilution of the contaminants present beneath the site would be expected, however, prior to entry into the well field system. An important note: the lack of properly constructed deep wells for groundwater monitoring up and downgradient of the site limits the conclusions which can be drawn in terms of associated risks.

V. ALTERNATIVE MEASURES

Based on the data collected, several alternative actions regarding the contamination detected at the facility are available. One option is the No-Action alternative. This alternative involves accepting the data without any additional investigation to evaluate the effect of any identified contaminants on human health or the environment. Conclusions that can be drawn from the existing data are that: 1) Area No. 1 (near the former oil storage tanks) does not have any serious oil or heavy metal contamination; 2) the heavy metals found in Area No. 2 (near the plating building) do not exceed any regulatory action levels; 3) there is some metal and organic contamination in the groundwater and some data indicating this could be from an off-site source. The No-Action alternative is not feasible because of insufficient data on the contaminant source and migration pathways at the site.

The second alternative is a long-term groundwater monitoring program using the wells installed during this study. The wells would be sampled quarterly for the same parameter list used in the Phase II, Stage I investigation. This alternative also is not feasible due to insufficient data on the contaminant source and migration pathways at the site.

The third alternative requires further investigations of the site hydrogeology and contaminant distribution. Because this investigation was only a Phase II, Stage I Study, this alternative would normally be included in the re-evaluation procedure. This alternative is recommended because it would provide the information necessary to understand the relationship between the site hydrogeology and the vertical and horizontal extent of contamination.

VI. RECOMMENDATIONSA. Introduction

The purpose of this chapter is to present preliminary recommendations regarding the need for future investigations. As discussed previously, the placement of the borings and wells, and the tests performed were designed to serve two purposes: 1) to assess the presence of contamination and to characterize the geologic conditions at Area No. 1 and Area No. 2, and 2) to evaluate hydrogeologic conditions and contaminant distribution for the plant as a whole. Recommendations presented here will not only address the individual sites, but also the plant as a whole.

Before presenting recommendations, the preliminary findings of the field investigation are summarized below. Geologically, the plant is underlain by Pleistocene glacial valley fill sediments. These deposits consist of sand and silt with occasional layers of gravel. The upper 36 feet of the Clinton Street-Ballpark Valley aquifer, which has been designated a sole source aquifer, were investigated in this study. The shallow zone of the aquifer is separated from the lower portion by a discontinuous clay and gravel layer. This layer thins significantly from the west to the east side of the plant site, indicating that the upper and lower portions of the aquifer are most likely hydrologically connected. Groundwater flow in the shallow water-bearing zone is toward the northwest. Groundwater flow in the lower portion of the aquifer is also assumed to be toward the northwest, since it is most likely hydrologically connected with the upper water-bearing zone.

Samples were obtained from subsurface soils and groundwater for chemical analysis. Soil samples were analyzed for EP Toxicity levels and showed trace levels of arsenic, barium, cadmium, chromium, lead, selenium and silver. All results indicated concentrations well below applicable

reference standards (EP Toxicity Maximum Concentrations) for soil. Total petroleum hydrocarbons were detected in only one well boring sample (AFP 59, SW-1, 24'-26', HART 007); however, the analytical results for this sample are questionable, as discussed in Chapter IV. No volatile organic compounds or cyanide were detected in any of the soil samples. Total chromium was analyzed for in the SB soil series and found in all samples, but EP Toxicity chromium analysis for all soil samples (SB and SW Series) indicated no values exceeding established limits.

Four metals (barium, cadmium, lead and arsenic) were detected in groundwater samples. Barium and arsenic were detected at concentrations below MCLs and NYSAWQSGVs. Cadmium was detected at a concentration equal to the standard, and lead exceeded these standards. Volatile organic compounds were detected in two of the wells sampled (Table IV-9). In SW-3, trichloroethene was detected below reference standards; however, trans-1,2-dichloroethane exceeded the NYSAWQSGV. The Production Well sample contained volatile organics at concentrations below reference standards, except for trichloroethene which exceeded the MCL and NYSAWQSGV. Volatile organics were detected in the Production Well (screened in the deep portion of the aquifer) and only in one of the shallow monitoring wells. This indicates that the volatile organic contaminants may be migrating from the shallow zone into the deeper zone, or that there are two sources of contamination--one affecting the shallow zone, the other affecting the deeper zone. Further investigation of the deeper water-bearing zone is needed to understand the source and migration of this organic contamination.

B. Site-Specific Recommendations

This section addresses recommendations for areas of investigation (Area No. 1, Area No. 2 and the plant site as a whole). The site has been classified in USAF Category II, which requires additional monitoring to quantify and further assess the extent of contamination. When the Scope of Work for this investigation was originally developed, the background

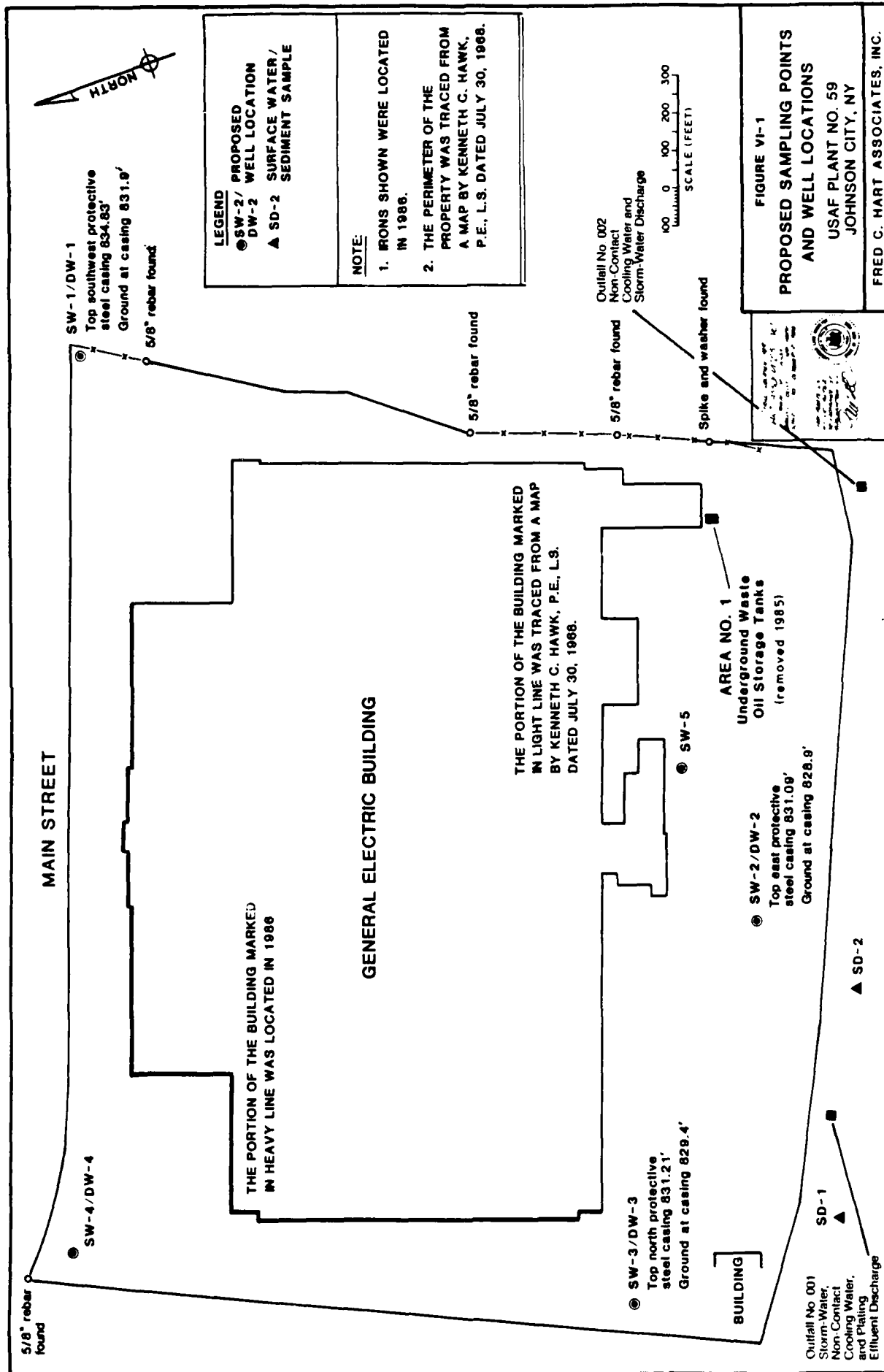
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material available at that time indicated that contamination might be confined to individual hazardous waste storage areas. Based on this information, the study was designed to ascertain the presence of soil and groundwater contamination near these areas and at the plant as a whole. Analyses of these results show that contaminants are present in minor concentrations, and there is no readily apparent pattern to the contamination. Additional work must be performed at these sites in order to characterize the vertical and horizontal extent of any contamination.

B.1 Area No. 1 - Former Underground Waste Oil Storage Tanks

Wells were installed at three locations around AFP 59, including near Area No. 1, which allowed HART to assess contamination as well as determine overall site conditions. Shallow groundwater monitoring wells SW-1 (upgradient well), SW-2, and SW-3 were installed for these purposes. The wells are screened at depths between 25 and 30 feet. Continuous soil samples were taken during drilling, and two samples per borehole were selected for laboratory analysis. The selection was generally based on the highest OVA headspace readings. As discussed previously, trace concentrations of metals (arsenic, barium, cadmium, chromium, lead, selenium, and silver) and total petroleum hydrocarbons were found in the soils. The groundwater samples also contained trace levels of several metals, two of which (cadmium and lead) were detected at or above MCL and NYSAWQSGV limits. Four volatile organic compounds were detected in two of the four wells sampled. The volatile organic contamination found in SW-3 and the production well are compounds which would not be expected from the storage of waste oil. Potential waste oil in the soil and groundwater would be indicated by the presence of TPH, benzene, toluene, or xylene.

A well downgradient of Area No. 2 is being proposed, which could more accurately evaluate contamination downgradient of the former underground waste oil storage tanks (Figure VI-1). In addition, ongoing sampling of all groundwater monitoring wells will be proposed to observe seasonal variation.



B.2 Area No. 2 - Plating Building

Three test borings (SB-1, SB-2, and SB-3) were completed at this site. Each boring was continuously sampled to a depth of ten feet, and two samples per boring were sent to the laboratory for chemical analysis. Trace levels of metals (arsenic, barium, cadmium, chromium, lead, selenium and silver) were detected in all of the soil samples below EP Toxicity Maximum Concentration Limits.

It is recommended that a shallow well (SW-4) be installed near the plating building to monitor for potential migration of contaminants from underneath the building. The well should be similar in depth to the other shallow wells so that sampling results can be compared between wells. This well will be downgradient of Area No. 1 and will also serve to monitor contamination from this area. The well boring would be sampled continuously and samples analyzed with an OVA to determine which samples, if any, will be sent to the laboratory for analysis. Any samples which were visually contaminated would also be sent to the laboratory for analysis.

C. Recommendation for Additional Study to Further Evaluate Plant-Wide Contaminant Distribution

In addition to further evaluation of contamination at the above noted individual sites, several recommendations are also presented that are designed to investigate overall hydrogeologic conditions beneath the plant and the contamination distribution within the whole system.

The site has been classified as a Category II site, which is defined as a site requiring additional Phase II efforts. The recommendations and rationale for each area are presented in Table VI-1, and the recommendations for the plant as a whole are discussed below. Proposed locations for additional work are shown in Figure VI-1. The

TABLE VI-I
RECOMMENDATIONS FOR POTENTIAL PROBLEM AREAS

<u>Location</u>	<u>Recommended Action</u>	<u>Rationale</u>
All Monitoring Wells	Sample existing wells for priority pollutants; based on the results, continue to monitor groundwater VOCs, petroleum hydrocarbons and primary metals or priority pollutants. Assess groundwater flow patterns.	To assess if other contaminants are present. Contaminant concentrations in groundwater are trace levels and monitoring is necessary to quantify contaminants in groundwater.
Areas No. 1 & 2	Install shallow well near plating building.	To monitor for potential migration of contaminants from underneath building (Area No. 2), and to detect possible contaminant releases from Area No. 1.
Plant Site	Install three deep wells near the existing shallow wells. Install a well nest consisting of one deep well and one shallow well in the northwest corner of the site.	To verify the existence/extent of any contaminants in the zone utilized for potable water; monitor groundwater quality down-gradient of the site.
	Perform a pumping test with the production well to assess the interconnection between upper and lower water-bearing zones.	To evaluate site-specific hydrologic conditions, and establish extent of hydrologic connection between upper and lower water-bearing zones. This will help to determine whether downward migration of contaminants from the site are the source of the contaminants in the lower zone.
	Sample the surface water and sediment in Little Choconut Creek upstream and downstream of OUTFALL 001, and analyze for priority pollutants.	To establish the contribution, if any, of contaminants in Little Choconut Creek as it recharges the underlying aquifer.

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recommendations below are based on Phase II data, and are proposed in order to more fully develop an understanding of existing groundwater conditions at the AFP 59 site:

1. Install deep wells next to the existing shallow well locations, to monitor the quality of water upgradient and downgradient of the site in the zone used for potable water supply.
2. Install a shallow well near the plating building to monitor for potential contaminant migration from soils underneath the plating building. This well may also serve as a detection system for potential contaminant migration from the underground waste oil storage area.
3. Install a well nest consisting of one deep and one shallow well in the northwest corner of the site. Groundwater flow direction appears to be to the northwest, and this well would serve to monitor groundwater quality leaving the site.
4. Sample the existing monitoring wells for all of the Priority Pollutants to assess if there are other contaminants present in the groundwater, in addition to verification of initial analytical results, and to document any trends.
5. Depending on the results of the Priority Pollutant analyses, continue to monitor and sample for VOCs, total petroleum hydrocarbons and primary metals or Priority Pollutants.
6. Sample the surface water and sediment in Little Choconut Creek upstream (of plant runoff) and downstream of Outfall 001 and analyze for Priority Pollutants.

7. Conduct a pump test using the on-site production well as the pumping well to assess the extent of interconnection between the lower water-bearing zone and the upper water-bearing zone in the Clinton Street-Ballpark Valley aquifer.