(2)

INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH
WURTSMITH AFB, MICHIGAN

Prepared by:

Radian Corporation
7655 Old Springhouse Road
McLean, Virginia 22102

April 1985

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION	UNCLASSIFIED
1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY	
3. DISTRIBUTION/AVAILABILITY OF REPORT	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	
5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION	Radian Corp
6b. OFFICE SYMBOL (If applicable)	
7a. NAME OF MONITORING ORGANIZATION	HQ AFESC/DEVP
6c. ADDRESS (City, State and ZIP Code)	7655 Old Springhouse Rd McLean VA 22102
7b. ADDRESS (City, State and ZIP Code)	Tyndall AFB FL 34403
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	HQ SAC
8b. OFFICE SYMBOL (If applicable)	DEPV
9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	F08637 83 G0008 5001
8c. ADDRESS (City, State and ZIP Code)	Offutt AFB NE 68113-5001
10. SOURCE OF FUNDING NOS.	PROGRAM ELEMENT NO.: / PROJECT NO.: / TASK NO.: / WORK UNIT NO.:
11. TITLE (Include Security Classification)	Installation Restoration Program Phase I-Records Search, Wurtsmith AFB MI
12. PERSONAL AUTHOR(S)	F. J. Smith, M.A. Zapkin, A. M. Oven, T. G. Grome
13a. TYPE OF REPORT	
13b. TIME COVERED	FROM ____ TO ____
14. DATE OF REPORT (Yr., Mo., Day)	
15. PAGE COUNT	
16. SUPPLEMENTARY NOTATION	AFESC Project Officer: Capt John Arin

17. COSATI CODES		
FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Installation Restoration Program, Hazardous Waste Management, Past Solid Waste Disposal Sites, Groundwater Contamination.

19. ABSTRACT (Continue on reverse if necessary and identify by block number)
This report identified and evaluated several potentially hazardous waste disposal sites at Wurtsmith AFB. Records of past waste handling and disposal practices were reviewed. Interviews with past and present installation employees were conducted to develop a history of waste disposal practices. The environmental setting for effectively receiving the wastes was evaluated including soils geology, groundwater and surface water. A landfill, ten fuel and/or solvent spills, two fire training areas, and a waste treatment plant sludge drying bed were found to have sufficient potential to create environmental contamination and follow on investigations (Phase II) were recommended and outlined.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS ☐
21. ABSTRACT SECURITY CLASSIFICATION	
22a. NAME OF RESPONSIBLE INDIVIDUAL	
22b. TELEPHONE NUMBER (Include Area Code)	
22c. OFFICE SYMBOL	

DD FORM 1473, 83 APR

EDITION OF 1 JAN 73 IS OBSOLETE.

SECURITY CLASSIFICATION OF THIS PAGE

NOTICE

This report has been prepared for the U.S. Air Force by Radian Corporation for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the publishing agency, the United States Air Force or the Department of Defense.

Copies of this report may be purchased from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Federal Government agencies and their contractors registered with Defense Technical Information Center should direct requests for copies of this report to:

Defense Technical Information Center
Cameron Station
Alexandria, Virginia 22314

TABLE OF CONTENTS

TABLE OF CONTENTS

(Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

(Continued)

EXECUTIVE SUMMARY

A. BACKGROUND

1. Radian Corporation was retained on 24 May 1984 to conduct the Wurtsmith Air Force Base (AFB) Installation Restoration Program Phase I Records Search under Contract No. F08637 83 G0008 5001, with funds provided by the United States Air Force.

2. Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5 explains the Department of Defense (DOD) policy, which is to identify and fully evaluate suspected problems associated with past hazardous waste management practices on DOD facilities and to control the migration of hazardous constituents that could endanger health and welfare.

3. To implement the DOD policy, a four-phase Installation Restoration Program (IRP) has been directed. Phase I, the records search, is the identification of potential problems. Phase II, if required, (not part of this contract) consists of follow-on field work to determine the extent and magnitude of contaminant migration. Phase III, if required (not part of this contract) consists of technology development (research and development effort only when required). Phase IV, if required (not part of this contract), is the development and implementation of selected remedial actions.

4. The Wurtsmith AFB Phase I Records Search included a detailed review of pertinent installation records; contacts with six representatives of local and regional regulatory agencies, and an on-site visit conducted by Radian 15-19 October 1984. The records search also included Port Austin Air Force Station, Michigan; Empire Air Force Station, Michigan; and Bayshore Air Force Station, Michigan. During the base visit, interviews were conducted with 41 past and present installation employees and a ground tour of installation facilities and identified sites of potential environmental contamination was accomplished.

B. MAJOR FINDINGS

1. Since the 1940s, many hazardous and potentially hazardous wastes have been generated by industrial shop operations at Wurtsmith AFB. Waste oils, solvents, paint residues, etc. generally have been stored on-site at the various shops until disposed of or recycled by a hazardous waste contractor. Dumping of small quantities of wastes onto the ground and into storm and sanitary sewers occurred in the past but the current environmental awareness of base personnel has reduced these activities. Currently wastes are recycled whenever possible, or disposed of off-base by contractors through the Defense Property Disposal Office (DPDO).

2. The base is located on sandy soil. The ground water on most of the base is relatively shallow.

3. Since 1977, six major areas of contamination (spill plumes) on-base have been identified and characterized by Air Force and U.S. Geological Survey studies. Four of the six plumes are currently being purged or are scheduled to be purged to eliminate environmental contamination and prevent contaminant migration.

4. Fire training exercises have provided a means of disposal for waste jet fuel, oils, and miscellaneous combustible materials since at least 1951. The currently active fire training area has been in use since 1958. An inactive fire training area used from 1951 to 1958 was discovered during the records search.

5. Landfills and sludge spreading areas have been used for waste disposal since at least 1949. Most of the materials disposed have been domestic and construction wastes, although some hazardous wastes were reportedly landfilled. Seven landfills and two sludge spreading areas were identified. None of these are active. The last landfill was closed in 1979 and sludge spreading ceased in 1982.

6. Two active surface impoundments (aeration and seepage lagoons) are located on Wurtsmith AFB. These comprise the sanitary waste treatment plant. The seepage lagoons were built in the early 1960s and the aeration lagoons were completed in 1982. No problems with this system were reported.

7. There are 78 fuel storage tanks and 21 waste storage tanks on the installation. No leaks were reported for any of the tanks.

8. There are four active hazardous materials storage areas and 11 active hazardous waste accumulation areas. No major spills or leaks were reported at any of these areas.

9. Eighteen spill sites were identified including the known spill plumes and fuel spills on the SAC Instrument Runway. Interviews with base personnel resulted in identification of 16 spills on Wurtsmith AFB and two spills at Port Austin AFS.

10. A purge well and activated carbon treatment system is in-place for current remedial action at three spill sites. Spills at four other locations are migrating towards the existing purge system. Additional purge and treatment systems are planned for two of these sites.

11. An on-going sampling program is carried out on the base to monitor the migration of contaminants from the known plumes.

C. CONCLUSIONS

1. Review of the comprehensive data base assembled for the Phase I study resulted in ranking 15 sites using the Hazardous Assessment Rating Methodology (HARM) based on their potential for migration of hazardous constituents.

2. Figures 1 and 2 present the locations of the 15 HARM-rated sites.

3. Table 1 presents the 15 HARM-rated sites with their final HARM scores, and their potential risk rating.

D. RECOMMENDATIONS

1. It is recommended that the current and planned purge and treatment (Phase IV) programs be continued.

2. It is recommended that the current and planned ground-water monitoring program be continued.

3. A total of 11 new ground-water monitoring well locations and one soil boring location are recommended. Figure 3 presents the locations of these recommended sampling sites.

3a. Additional Phase II sampling and analysis of ground water and soil boring samples is recommended at Site FT-2 identified as having a high potential risk. Continued monitoring of existing wells is recommended for the other six sites (D-6, SP-3, SP-7, SP-2, SB-1, and SP-5).

3b. Additional Phase II sampling and analysis of ground water is recommended at two of the sites identified as having a moderate potential risk (SP-8, SP-9). Continued monitoring of existing wells is recommended for the other two sites (FT-1, SP-12).

3c. No Phase II activity is recommended for four sites identified as having a low potential risk (see Table 1).

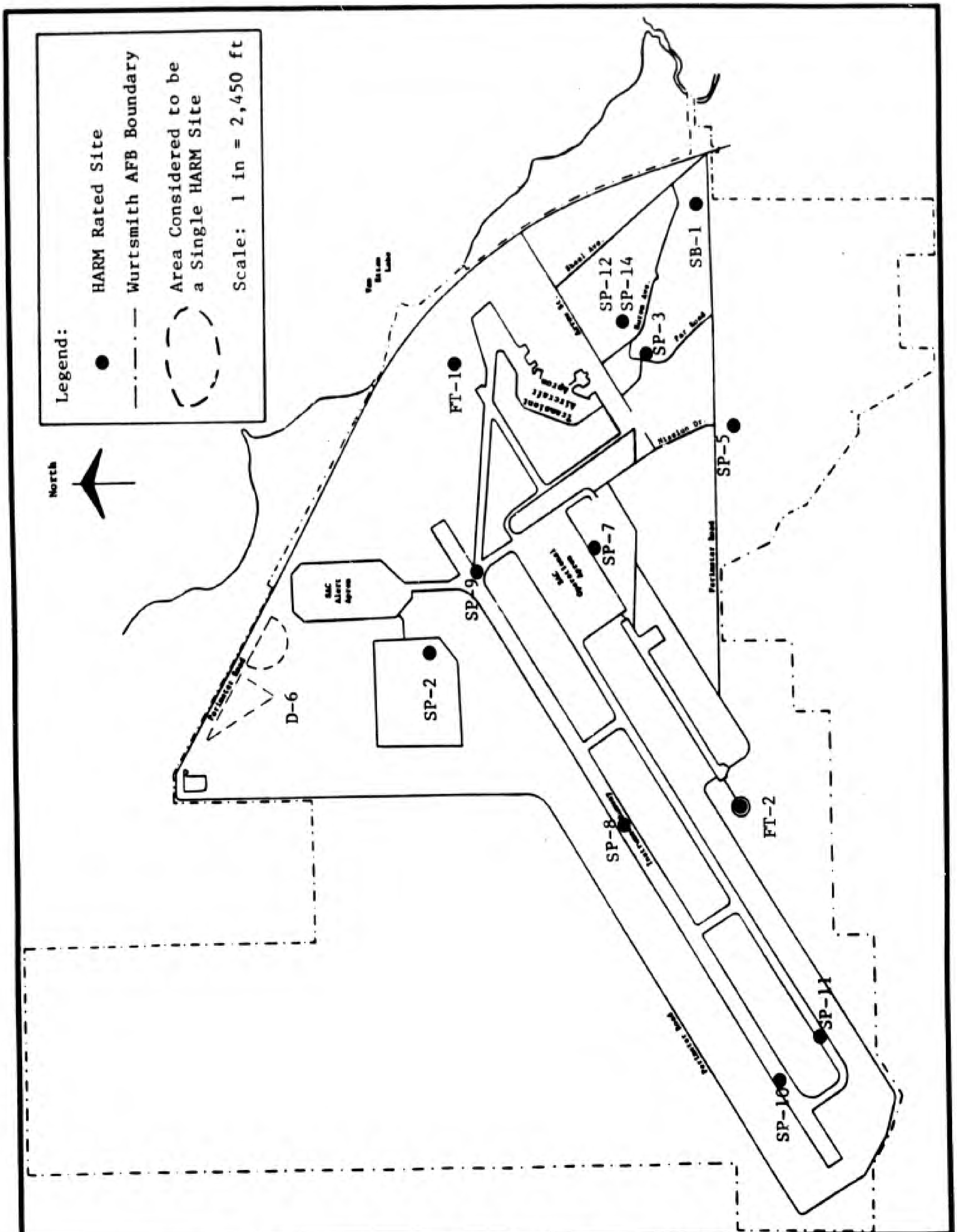
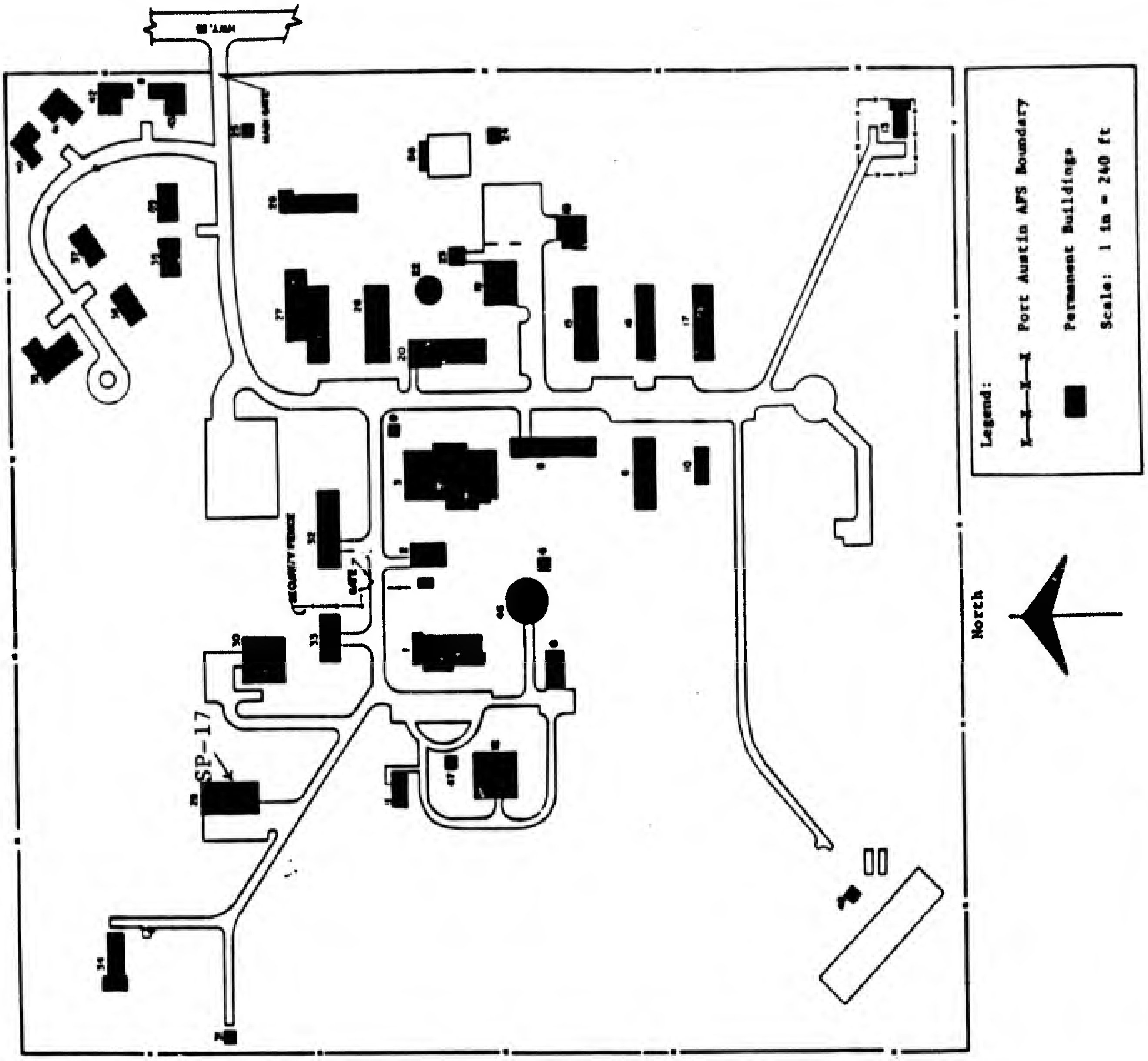
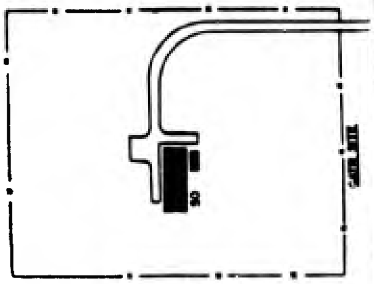


Figure 1. Locations of HARM Rated Sites, Wurtsmith AFB, Michigan



Source: Port Austin AFS, Dwg. PTA-810-040, Revised May 1984



Source: Port Austin AFS, Dwg. PTA-810-040, Revised May, 1984.

Figure 2. Location of HARM Rated Site, Port Austin AFS, Michigan

TABLE 1. POTENTIAL RISK RANKING BASED ON FINAL HARM SCORES

Site Number	Description	Final HARM Score	Potential Risk
D-6	Landfill, northern (Perimeter Road) area	80	High
SP-3	Fuel spill, POL Bulk Storage area	79	
SP-7	TCE and fuel spill, SAC Nose Dock and Operational Apron	79	
SP-2	TCE spill, southwest of SAC Alert Apron	77	
SB-1	Inactive waste treatment plant sludge drying beds	73	
SP-5	TCE spill, northwest base housing area	72	
FT-2	Active fire training area	71	
SP-8	JP-4 spill, center of SAC Instrument Runway	62	Moderate
SP-9	JP-4 spill, northeast end of SAC Instrument Runway	62	
FT-1	Inactive fire training area	61	
SP-12	MOGAS spill, Building 394 (motor pool)	60	
SP-11	JP-4 spill, southwest to south-central taxiway	59	Low
SP-17	Diesel fuel spill, Power Plant at Port Austin	59	
SP-10	JP-4 spill, southwest end of SAC Instrument Runway	59	
SP-14	JP-4 spill, southwest of Building 3029	57	

4. It is recommended that all of the samples be analyzed for volatile organics and semi-volatile organics. In addition, the ground water samples should be analyzed for oil and grease and total organic carbon (TOC).

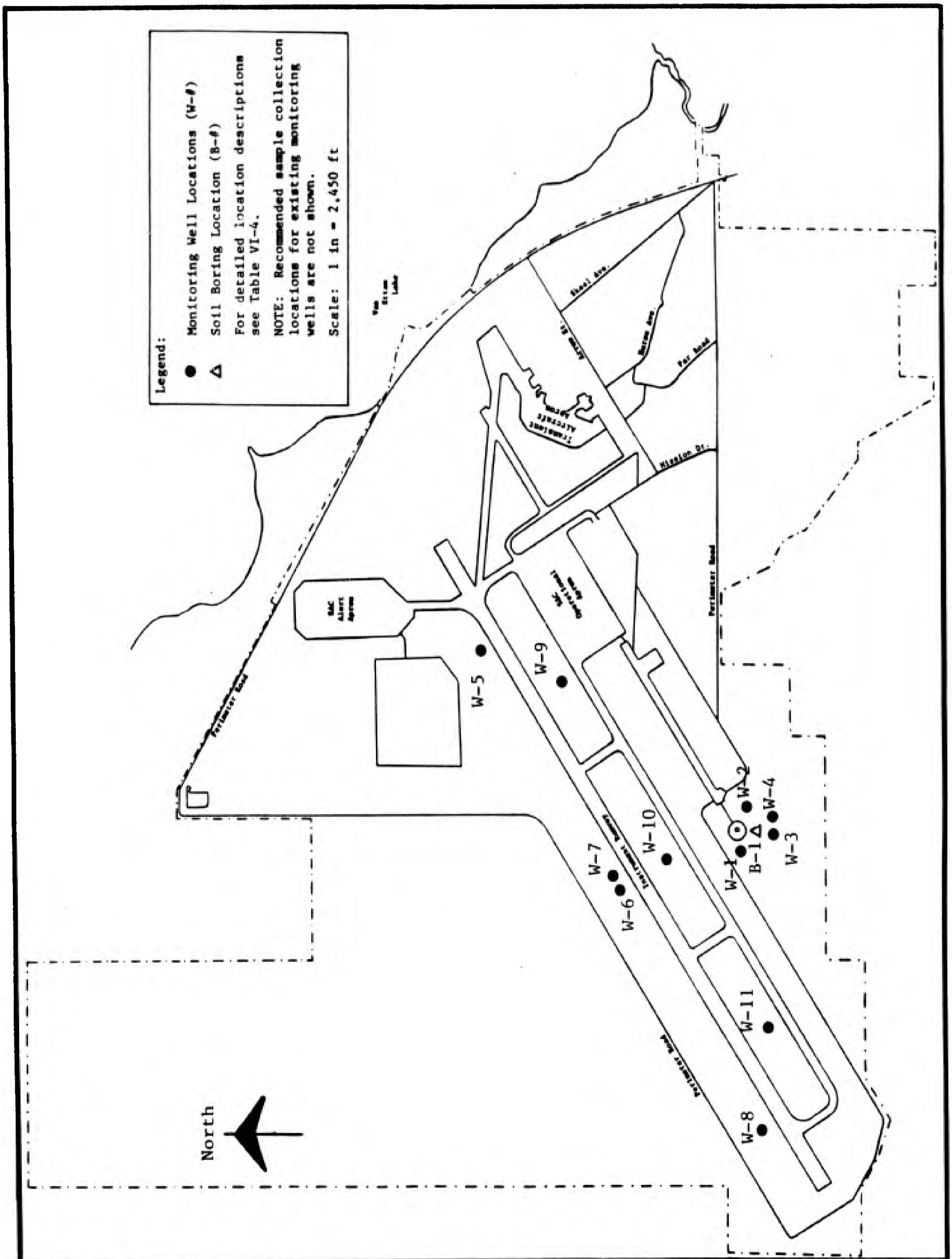


Figure 3. Recommended Sample Collection Locations at Wurtsmith AFB, Michigan

I. INTRODUCTION

A. Background

The United States Air Force has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations which require disposers to identify the locations and contents of disposal sites and to take action to eliminate the hazards in an environmentally responsible manner. The primary federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Sections 6003 and 3012 of the Act, Federal agencies are directed to assist the Environmental Protection Agency (EPA) and state agencies to inventory past disposal sites and make the information available to the requesting agencies. The Department of Defense (DOD) Installation Restoration Program (IRP) assures compliance with these hazardous waste regulations. The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and implemented by Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the IRP. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous contamination, and to control hazards to health and welfare that resulted from these past operations. The IRP is the basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as clarified by Executive Order 12316 and 40 CFR 300 Subpart F (National Contingency Plan). CERCLA is the primary legislation governing remedial action at past hazardous waste disposal sites.

To conduct the IRP Hazardous Materials Disposal Sites Records Search for the Wurtsmith Air Force Base (AFB) Installation, Radian Corporation was retained on 24 May 1984 under Contract No. F08637 83 G0008 5001.

There are four phases to the IRP. The records search comprises Phase I. During this phase, installation records are reviewed to identify possible hazardous waste-contaminated sites and to assess the potential for contaminant migration. Only Phase I activities are covered in this report. Phase II of the IRP consists of follow-on field work to determine the extent and magnitude of contaminant migration. Phase III consists of technology development (R&D effort only when necessary). Phase IV includes the development and implementation of a remedial action plan.

B. Purpose

The purpose of the Phase I records search is to identify past hazardous materials disposal and spill sites and assess the potential for contaminant migration from these sites. The existence of and potential for migration of hazardous material contaminants were evaluated at Wurtsmith AFB by reviewing Air Force supplied data, technical reports, and conducting interviews with past and present base personnel and regulatory officials familiar with Wurtsmith AFB. This report addresses the history of operations, the geological and hydrogeological conditions which may directly influence migration potential, and the ecological setting of the facility.

This Phase I records search also covers three radar sites which are supported by Wurtsmith AFB. These are Port Austin Air Force Station (AFS), Empire Air Force Station, and Bayshore Air Force Station.

C. Scope

Phase I activities included:

- Reviewing site records;
- Interviewing personnel familiar with past generation and disposal activities;
- Compiling an inventory of wastes;

- Determining waste quantities and locations of current and past hazardous waste storage, treatment and disposal;
- Defining the environmental setting at Wurtsmith AFB;
- Reviewing past disposal practices and methods;
- A helicopter overflight of Wurtsmith AFB, Port Austin AFS, Empire AFS and Bayshore AFS;
- Gathering information from state, local and federal agencies;
- Assessing the potential for contaminant migration; and
- Recommending follow-on activities if required.

The pre-performance meeting was held at Wurtsmith AFB on 5 September 1984. Representatives of the Air Force Engineering and Services Center (AFESC), Strategic Air Command (SAC), Wurtsmith Air Force Base, and Radian attended the meeting. The purpose of the pre-performance meeting was to provide detailed project instruction to the Radian project team. The AFESC and SAC representatives provided clarification and technical guidance and defined the responsibilities of all parties participating in the Wurtsmith AFB Records Search.

The on-site installation visit was conducted by three Radian technical staff members from 15 October through 19 October 1984. Activities performed during the on-site visit included a detailed search of installation records, ground tour of Wurtsmith AFB, helicopter overflight of Wurtsmith AFB and the three radar sites, and interviews with past and present base personnel. The following individuals comprised the entire Radian Phase I Records Search team:

1. Francis J. Smith, Program Manager, M.S. Sanitary Engineering;
2. Michael A. Zapkin, Project Director, M. Eng. Environmental Engineering and M.S. Biology - Team Chief and Ecologist;
3. Andrew M. Oven, M.S. Environmental Engineering - Hydrogeologist and Environmental Engineer; and
4. Thomas G. Grome, B.S. Chemical Engineering - Chemical Engineer.

Resumes of team members are included in Appendix A.

The principal Air Force representatives who assisted in the Wurtsmith AFB study are the Base Environmental Coordinator (Installation Point of Contact), Bioenvironmental Engineer and Real Property Officer.

D. Methodology

The methodology for the Wurtsmith AFB records search is shown graphically in Figure I-1. The first step was a review of past and present industrial operations. This allowed the identification of waste stream contents and quantities. Information was obtained from records such as the Tab A-1 Environmental Narrative, shops and substances lists, landfill maps, storage tank inventory lists, and U.S. Geological Survey reports.

The second step was to define and evaluate past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the industrial operations identified in Step 1. At this stage, sites of former landfills, storage areas and tanks were identified. Other potentially contaminated sites, such as the locations of spills of waste oils, solvents, and fuels were determined.

The Records Search team conducted a detailed ground tour of the base and an overflight of the base and the three radar sites. The team looked for any evidence of environmental impact, such as vegetation stress or disrupted topography. It was during this on-site visit that interviews with past and current base employees occurred. A list of interviewees and outside agency contacts is presented in Appendix B.

At this time a number of decisions were made. The first decision pertained to the potential for contamination of each site. If it was determined that the site was potentially contaminated, then the potential for migration of hazardous constituents from the site was evaluated. The site was rated using the Air Force Hazard Assessment Rating Methodology (HARM). This

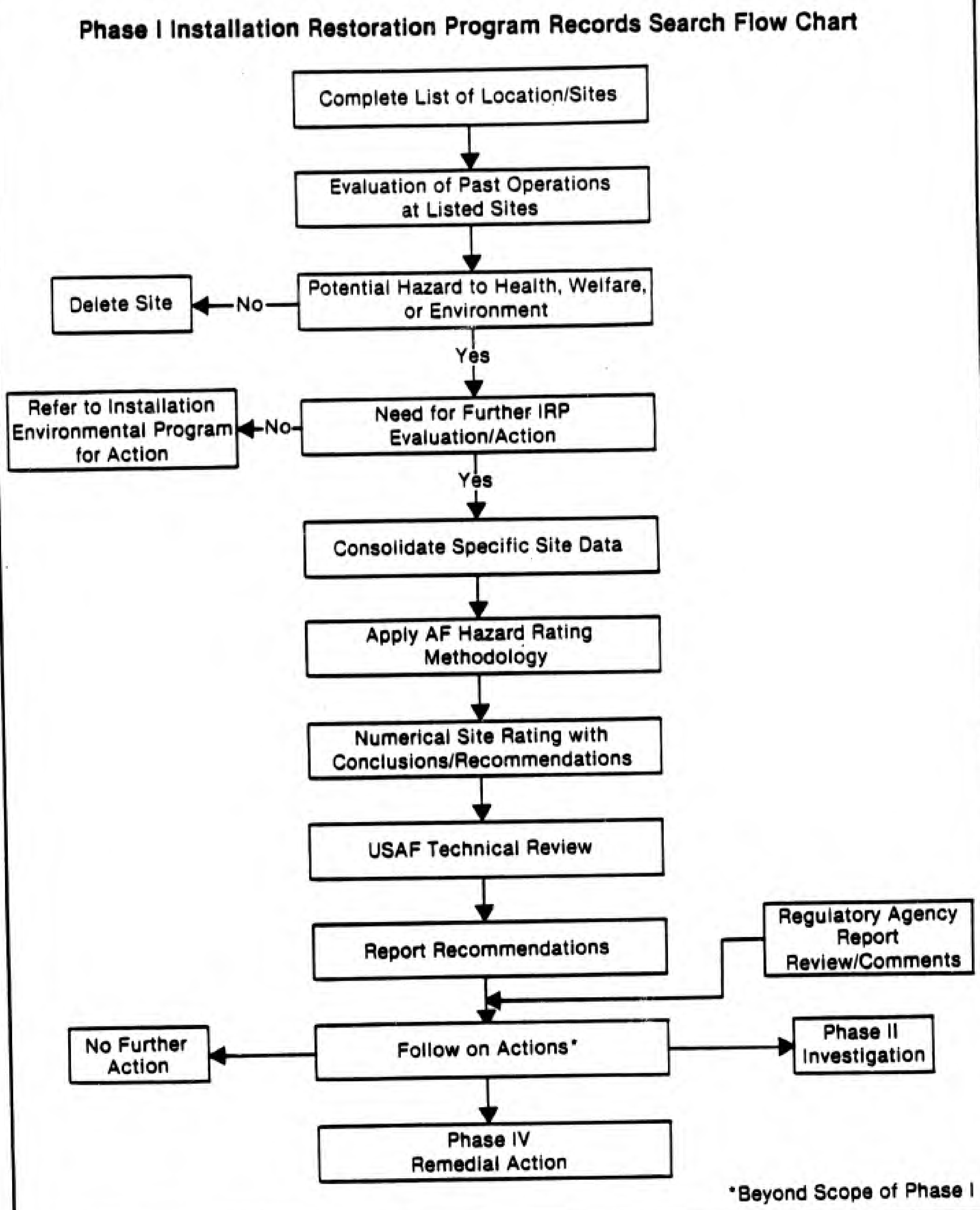


Figure I-1. Installation Restoration Program Phase I Decision Tree.

rating system results in a single score for each site based on evaluation of factors such as waste type and quantity, receptors, and pathways. This allows the relative ranking of sites with different environmental settings and waste characteristics. Following the hazard rating, recommendations for follow-on activities were developed. Recommendations may vary from no action to a complete monitoring and sampling program for those sites receiving a high HARM score. A limited Phase II program may be recommended for sites receiving a moderate HARM rating to confirm that hazardous materials are not migrating from the site. The site rating methodology is described in Appendix C.

II. INSTALLATION DESCRIPTION

A. Location, Size, and Boundaries

Wurtsmith Air Force Base (WAFB) is located in the east central portion of the lower peninsula of Michigan, two miles west of Lake Huron. Figure II-1 shows the location of Wurtsmith AFB in relation to the rest of Michigan. The incorporated township of Oscoda is approximately two miles south of the base and has a population of 11,400. Au Sable township, adjacent to Oscoda, has a population of 2,200.

Wurtsmith AFB covers 5,223 acres in northeastern Iosco County as shown in Figure II-2. Portions of WAFB land are USAF owned (1,943 acres), 2,466 acres are leased, and 814 acres are registered as easement tracts. Figure II-3 shows the layout of the base. The base is bounded on the north and northeast by Van Ettan Lake, on the east and southeast by the village of Oscoda, on the northwest by State Forest woodlands, and on the west and south by wooded marshlands.

B. History

The history of Wurtsmith Air Force Base began in 1923 when Army Officials proposed to the townspeople of Oscoda that a landing area be cleared nearby for use by fighter aircraft from Selfridge Field, Michigan. The following summer, 40 acres of land immediately west of Van Ettan Lake were cleared of jackpine trees and ground personnel from Selfridge set up tents and targets so crews could use the area for gunnery practice. During the winter of 1924-1925, fliers from Selfridge Field conducted winter maneuvers and tests of aircraft and supplies in the extremely cold environment. The Curtiss P-1 pursuit aircraft were equipped with skis in order to land on the frozen Van Ettan Lake. The first formal name for the field at Oscoda was Camp Skeel, named after Capt Burt E. Skeel, Commander of the 27th Pursuit Squadron at Selfridge.

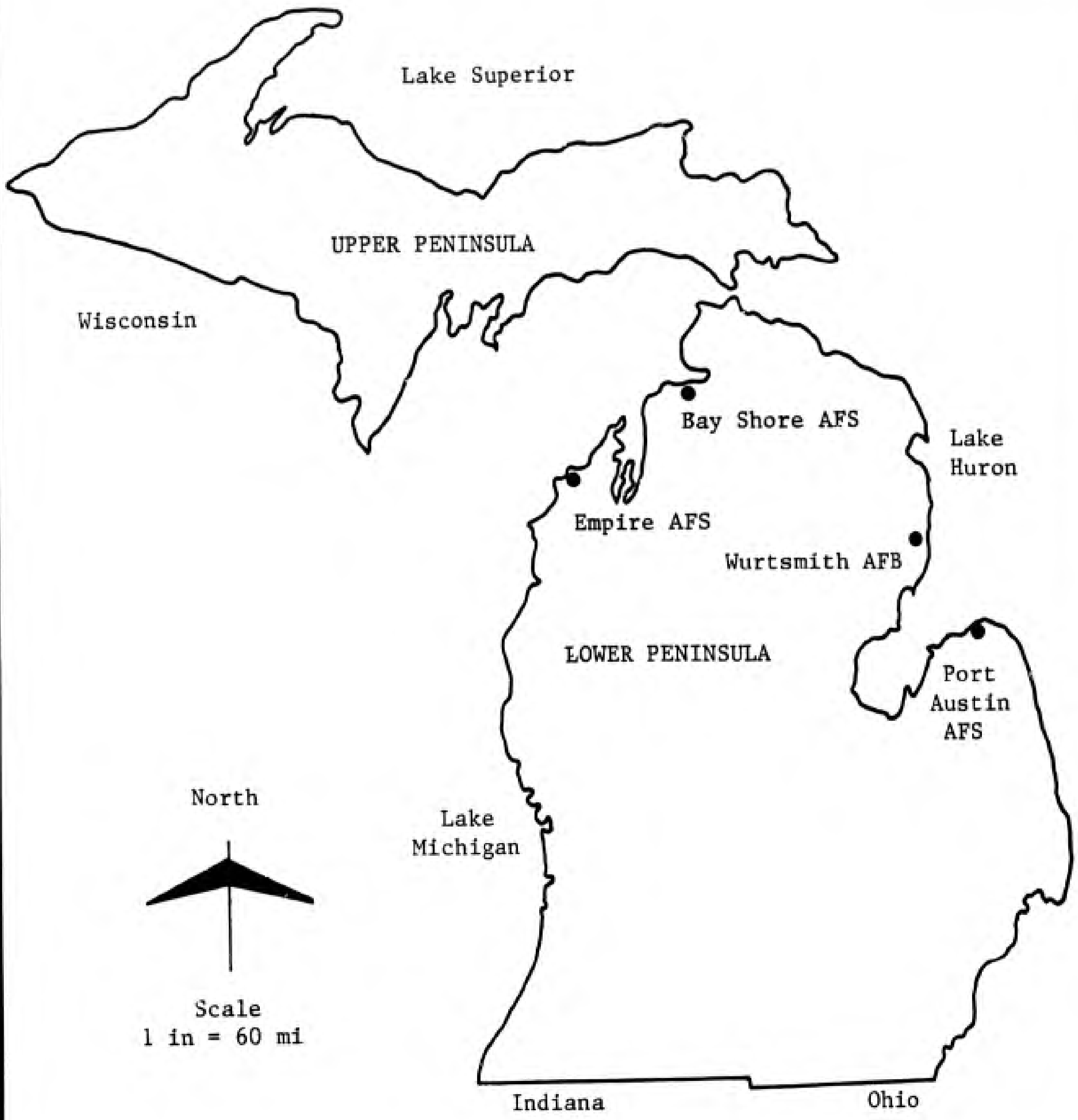
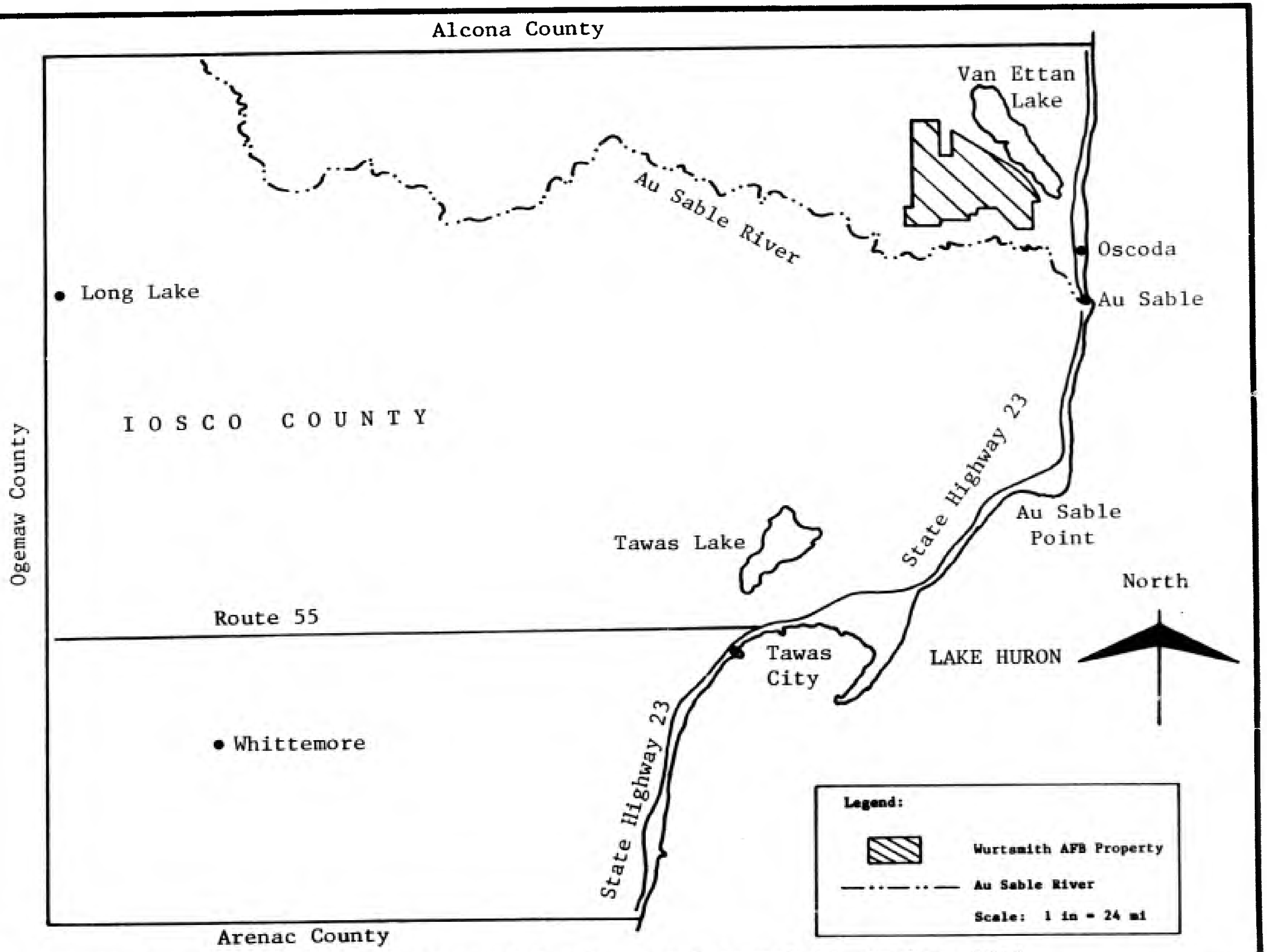
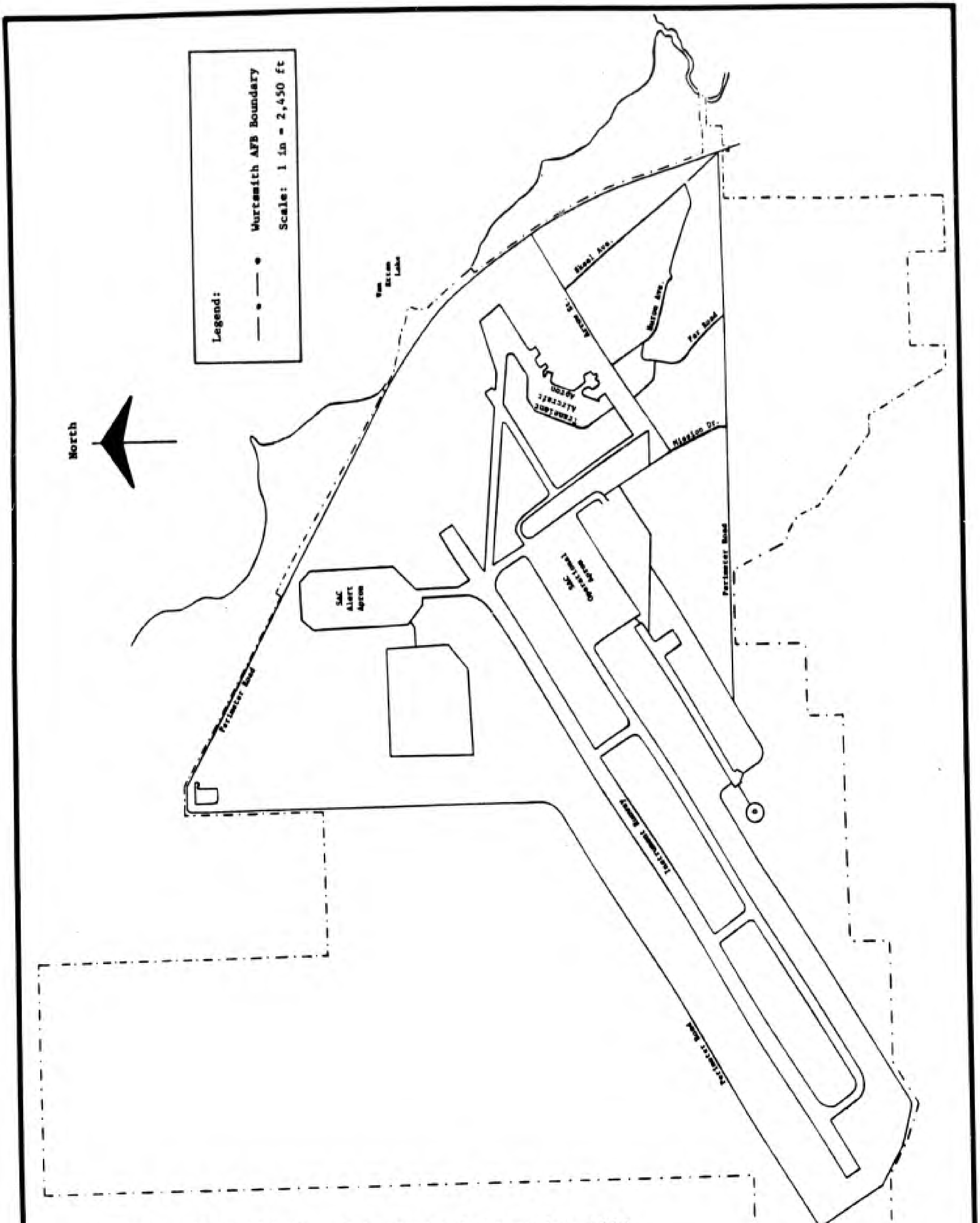


Figure II-1. Locations of Air Force Installations Included in this IRP Phase I Study in the State of Michigan



Source: East Central Michigan Planning and Development Regional Commission, 1973.

Figure II-2. Iosco County and Wurtsmith AFB Location



Source: WAFB, Tab No. C-6, Revised September 1984.

Figure II-3. General Layout of Wurtsmith AFB, Michigan

As a subsidiary of Selfridge, Camp Skeel was used for gunnery practice and winter maneuvers until World War II. Then the base was renamed Oscoda Army Air Field (AAF). Oscoda AAF became the home of the 134th AAF Base Unit (Fighter) in 1943. The 134th was a support unit responsible for the needs of personnel undergoing flight training at the base. On 12 July 1944, Oscoda AAF was designated an independent base, providing a complete training program for Free French aircrew members.

With the end of the war in Europe near, Oscoda AAF again became a sub-base of Selfridge on 12 April 1945. Most of the personnel assigned to the 134th were transferred on that date, leaving only a caretaker staff. The base itself reverted to a bombing and gunnery range for Selfridge aircraft and crews. Later in 1945, the base was closed completely.

The base came under control of the Continental Air Command and was reactivated on 15 May 1947 when P-80 jet aircraft and crews from Selfridge moved in to provide support to transient air traffic. The creation of the Department of the Air Force in September 1947 caused another name change to Oscoda Air Force Base. Transient fighter aircraft continued to use the base as a stopover in the late 1940's. As of January 1950, a formal authorization was established for the 2476th Base Service Squadron. The base was placed on alert status 25 June 1950 due to the outbreak of hostilities in Korea. The 63rd Fighter- Interceptor Squadron (FIS), an Aerospace Defense Command (ADC) unit, moved to Oscoda from Selfridge on 5 January 1951, and the base passed to ADC control.

On 4 July 1953, the base was renamed Wurtsmith Air Force Base in honor of Michigan's outstanding World War II air hero, Major General Paul B. Wurtsmith. WAFB became the home of the 412th Fighter Group (ADC) which remained until April 1960. On 23 January 1958, Headquarters USAF announced that Wurtsmith AFB would receive a Strategic Air Command (SAC) bombardment wing. The estimated costs of expansion to accommodate the new unit were set at about 22 million dollars. During the next two years, flight facilities underwent change and expansion to allow SAC operations.

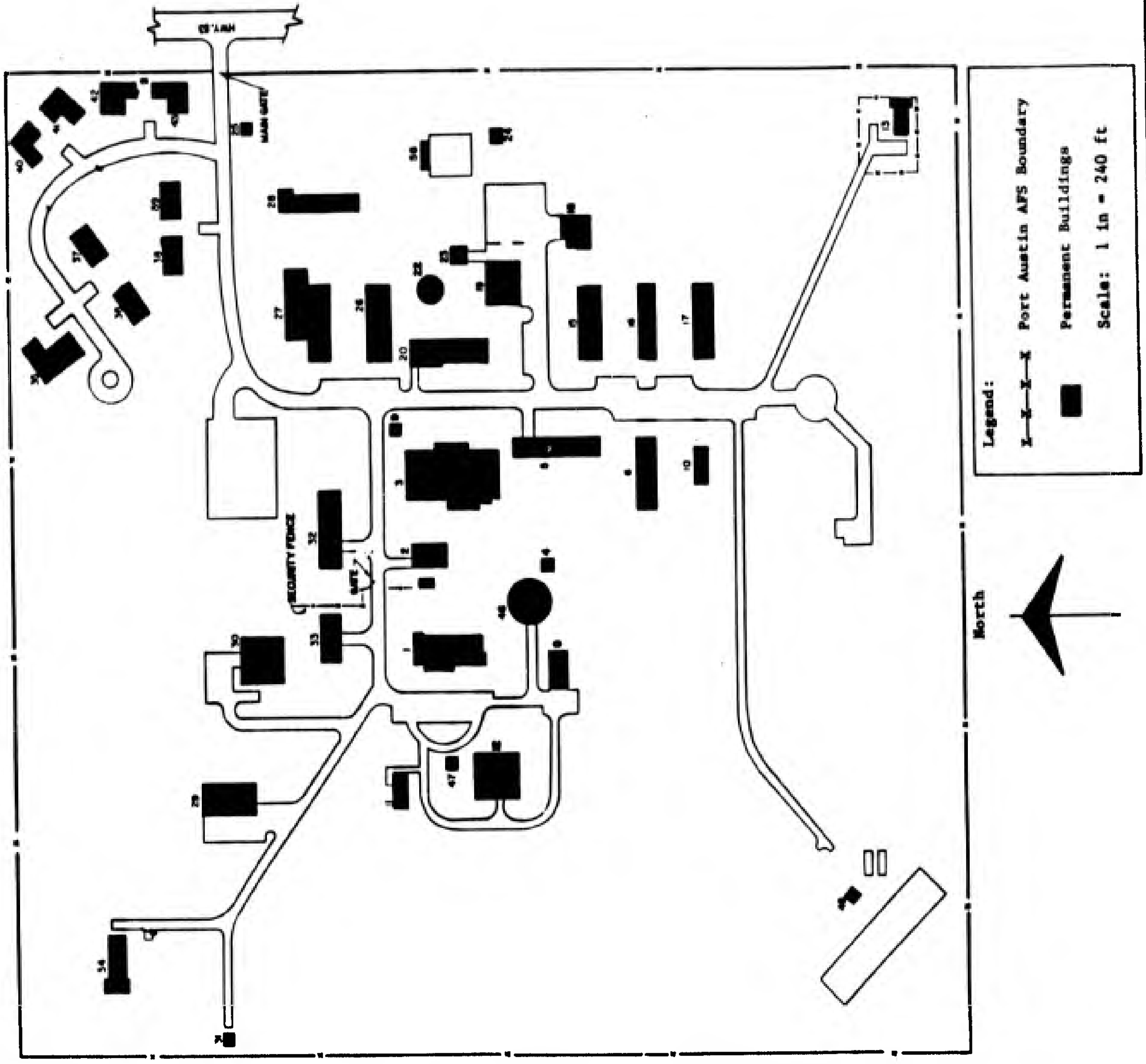
The 4026th Strategic Wing, a SAC holding unit, was activated 1 January 1959 and assigned to Wurtsmith 1 July 1959. On 1 April 1960, SAC assumed control of the base and the 4026th began organizing its units. The 412th Fighter Group (ADC) remained at Wurtsmith as a tenant, and its 445th FIS stayed until September 1968.

The SAC wing gained its first tanker squadron on 15 July 1960, when the 920th Air Refueling Squadron, flying KC-135A jet tankers, arrived from Carswell AFB, Texas. The following months were spent preparing for the arrival of the 379th Bombardment Wing (Heavy). On 9 January 1961, the 379th moved from Homestead AFB, Florida, to Wurtsmith. The 379th took over control of the base, and assimilated the personnel and equipment belonging to the 4026th, which was inactivated. The 524th Bombardment Squadron moved with the 379th Bombardment Wing and joined the 920th Air Refueling Squadron. The arrival of the new B-52G Stratofortress bombers in May 1961 designated Wurtsmith AFB as the home of the 40th Air Division's 379th Bombardment Wing (WAFB, Tab A-1, Environmental Narrative, 1978).

Included in the Wurtsmith AFB Phase I study are three radar sites which utilize Wurtsmith AFB as a support base. These are Port Austin Air Force Station, Michigan; Empire Air Force Station, Michigan; and Bayshore Air Force Station, Michigan.

Port Austin AFS is located in Huron County, 17 miles north of Bad Axe, Michigan and 1.5 miles south of Lake Huron. The station covers 54 acres. Approximately 100 military and 26 civilian personnel man the station. Figure II-4 shows the layout of the station.

Empire AFS is located in Leelanau County, 27 miles west of Traverse City, Michigan, on the shore of Lake Michigan. The site originally covered 73.54 acres. In July 1982, 72.08 acres were transferred to the National Parks Service and the remaining 1.46 acres were transferred to the Federal Aviation Administration (FAA). Seven military and two civilian personnel man the station, although none of the land is currently owned by the Air Force. Figure II-5 shows the layout of the station.



Source: Port Austin AFS, Dwg. PTA-810-040, Revised May 1984

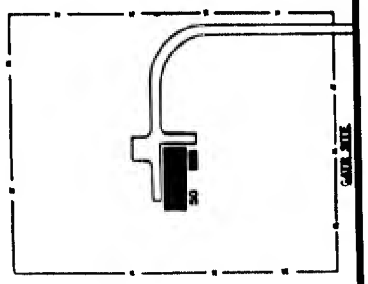
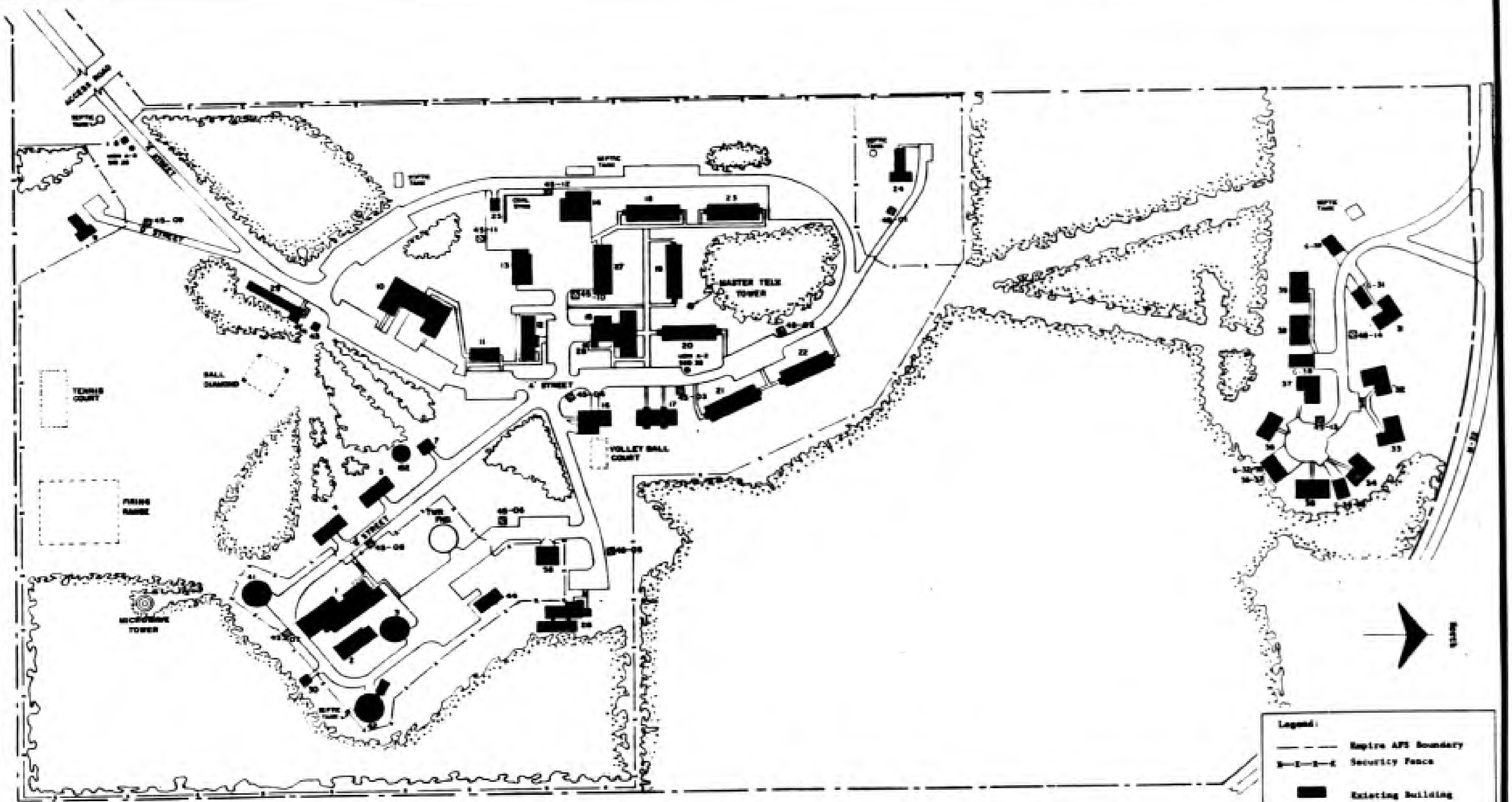


Figure II-4. Location Plan of Port Austin AFS, Michigan



Source: Empire AFS, Dwg. No. EMP 900-001.

Figure II-5. Site Plan of Empire AFS, Michigan

Bayshore AFS is located in Charlevoix County, nine miles west of Petoskey, Michigan and one-half mile south of Lake Michigan. The station covers 3.1 acres. The station was formally closed on 1 October 1984; however, seven personnel remain on-station until the deactivation date, 30 June 1985. Figure II-6 shows the layout of the station.

C. Organization and Mission Summary

The primary mission of Wurtsmith Air Force Base is to maintain full readiness to conduct strategic bombing operations on a world-wide scale according to the Emergency War Order. This mission responsibility is executed by the 40th Air Division which supervises and monitors the operation of the 379th Bombardment Wing at WAFB, in addition to wings at other air bases. The 379th fulfills a role of deterrence by maintaining a combat-ready capability for retaliatory action in the event of an attack on the United States. In addition, the Wing performs tasks assigned in current emergency plans and related operational orders, trains bombardment crews and units for the performance of global bombardment operations, and equips these units for the accomplishment of the assigned tasks.

The 524th Bombardment Squadron and the 920th Air Refueling Squadron both support and supplement the mission of the 40th Air Division. The 524th maintains continuous retaliatory readiness and flies training or higher headquarters missions each month to develop teamwork and proficiency. The 920th provides air refueling support throughout the world to all Air Force aircraft. Its primary role is to support the Strategic Air Command bomber force. In addition to its Emergency War Order alert commitment, the majority of the squadron's home-based flights are proficiency training missions. The 920th supports fighter aircraft from the Tactical Air Command, Military Airlift Command, Air National Guard units, and the U.S. Navy.

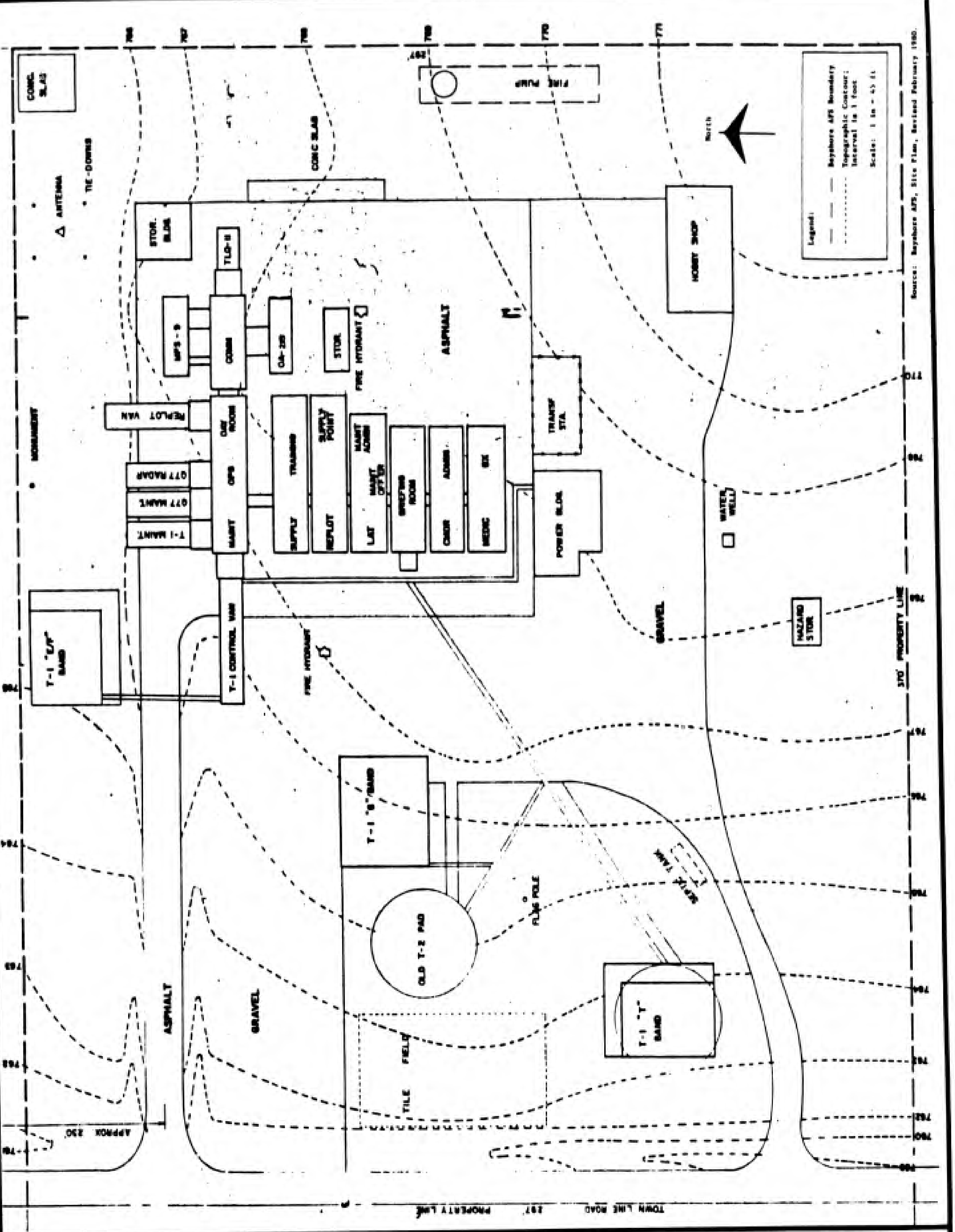


Figure II-6. Site Plan of Bayshore AFS, Michigan

Operations and maintenance support for the mission of the Bombardment Wing and its two associated squadrons is provided by a host of maintenance squadrons including avionics, field, munitions, and organizational maintenance squadrons. In addition, the transportation, supply, civil engineering, security police, services, and communications squadrons operate efficiently and complete the duties that enable the base to carry out its missions. The duties of each squadron are discussed in detail in Section IV.A. of this report.

Currently, Wurtsmith AFB has a force of approximately 3,200 military personnel, the majority of whom live on base. Dependents of military personnel number approximately 4,900. The aircraft stationed at WAFB include B-52G Stratofortress bombers of the 379th Bombardment Wing which can be armed with a combination of gravity bombs, short-range attack missiles, and air-launched cruise missiles. The 920th Air Refueling Squadron has KC-135A Stratotankers stationed at WAFB which hold 32,000 gallons of fuel each, or may be used to carry 80 passengers, 83,000 pounds of cargo, or a combination of both.

Port Austin AFS was established in 1952 as an Air Traffic Control and Warning (ATC&W) site. In the late 1950's the station became part of the Semi-Automatic Ground Environment (SAGE) system, which provides coordination for air battles. From the early 1960's to approximately 1970 the station served as a back-up control for Interceptor missions. In July 1983 the station became a part of the Region Operation Control Center (ROCC) system.

Port Austin is a Tactical Air Command (TAC) site that reports to the 24th Air Division at Griffiss AFB, New York. The station has a search radar and a height finding radar with a survey area of approximately 200 miles. Radar echoes are processed as video to distinguish real airplanes from false images. The information is then sent to Griffiss AFB.

Empire AFS was established 18 September 1958. In July 1982, all of the land was transferred to the National Park Service and the FAA. The Air Force currently is maintaining and operating the height finding radar located on FAA property.

Empire AFS is a TAC site that is an Operating Location for Air Defense (OLAD) associated with the 24th Air Defense Squadron located at Griffiss AFB, New York. The station is being operated as a Joint Use Operation with the FAA as a peacetime cost cutting measure. FAA search radar data and Air Force radar height inputs are reported to the Northeast ROCC at Griffiss AFB. The mission at Empire AFS is essentially the same as the mission at Port Austin AFS.

Bayshore AFS began operations in July 1963 as a SAC radar bombing site. The station was formally closed on 1 October 1984 with a scheduled deactivation date of 30 June 1985. During its 21 years of operation the station operated as Detachment 6 of the 1st Combat Evaluation Group with headquarters at Barksdale AFB, Louisiana.

Bayshore AFS had two mission functions. One was radar bomb scoring in which bombers would make simulated bombing runs and the station radar would pinpoint the locations where the bombs would have hit. The other mission was involved with electronic warfare where the station would simulate antiaircraft missile launches and foreign radar to test equipment on-board the bombers.

III. ENVIRONMENTAL SETTING

A. Meteorology

The average annual temperature at Wurtsmith AFB is 44°F, with extremes of -23° to 102°F. Yearly precipitation averages 29.4 inches and is rather evenly distributed throughout the year. Rainfall occurs predominantly as slow and prolonged storms or as frequent showers, but rarely as destructive downpours. Maximum rainfall for a 24 hour period in the last 38 years of record was 3.7 inches. Table III-1 is a summary of temperature, precipitation, and weather data for the Wurtsmith AFB terminal. Net precipitation data for the Wurtsmith AFB area was not available at the time of this study.

Snowfall is heaviest from November through March and snow remains on the ground throughout the winter. The greatest monthly snowfall recorded was 35.3 inches in February 1959. Annual snowfall averages 61.2 inches. The 1959 winter recorded 94.4 inches of snow for the highest seasonal total. The winter of 1963-64 had a record low of only 33.2 inches of snowfall. The maximum snowfall in any 24 hour period was 14 inches.

Winds blow regularly in the area, though seldom surpassing 20-25 miles per hour. Thunderstorms are common during the summer months and blizzards occur about three times a year. The proximity of the base to Lake Huron may result in low level wind shear on the base from April through mid October caused by lake breezes. The wind from the lake noticeably moderates temperatures during the summer and winter seasons and frequently influences precipitation patterns (WAFB, 1978).

B. Geology and Soils

1. Soils

Information about soils in the Wurtsmith AFB area is not complete or well documented by regional and state agencies. Fifteen soil borings drilled on the installation in the early 1970s reveal that Rubicon and Grayling soils

TABLE III-1. METEOROLOGICAL DATA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Temperature (°F)													
Extreme Maximum	60	55	78	88	95	99	102	99	99	86	74	64	102
Mean Daily Maximum	27	29	37	51	62	74	78	77	69	58	44	32	53
Mean Daily Minimum	12	13	21	32	42	52	57	57	49	39	30	19	35
Extreme Minimum	-22	-23	-10	6	21	30	35	33	27	16	3	-15	-23
Mean Number of Days													
Max Temp ≥ 85°F	0	0	0	0	1	5	7	5	1	0	0	0	19
Min Temp ≤ 32°F	30	27	27	16	4	0	0	0	0	7	19	28	158
Min Temp ≤ 0°F	6	5	1	0	0	0	0	0	0	0	0	2	14
Precipitation (Inches)													
Mean Monthly	1.8	1.6	2.0	2.6	2.8	3.0	2.8	3.1	2.8	2.3	2.5	2.1	29.4
Mean Monthly Snowfall	16.0	13.0	11.0	3.0	0.1	0	0	0	T	0.1	5.0	13.0	61.2
Mean Number of Days													
Measurable Snowfall	22	19	16	7	1	0	0	0	1	2	12	21	102
Snowfall ≥ 1.5 in	3	2	2	1	1	0	0	0	0	0	1	3	13
Terminal Weather													
Ceiling < 1,000 ft and/or Visibility < 2 miles (%)	14.0	12.0	14.0	10.0	7.0	6.0	5.0	7.0	7.0	6.0	13.0	15.0	10.0
Ceiling < 500 ft and/or Visibility < 1 miles (%)	6.2	3.4	6.7	3.8	3.9	3.6	1.4	1.7	1.7	3.5	5.6	7	4.1

T = Trace

Source: USAF, SAC Master Plan Meteorological Data, WAFB, TAB No. D-1, 1983.

are predominant. A map of the general soil types present in Iosco County was published in 1973 and a portion of this map is reproduced in Figure III-1.

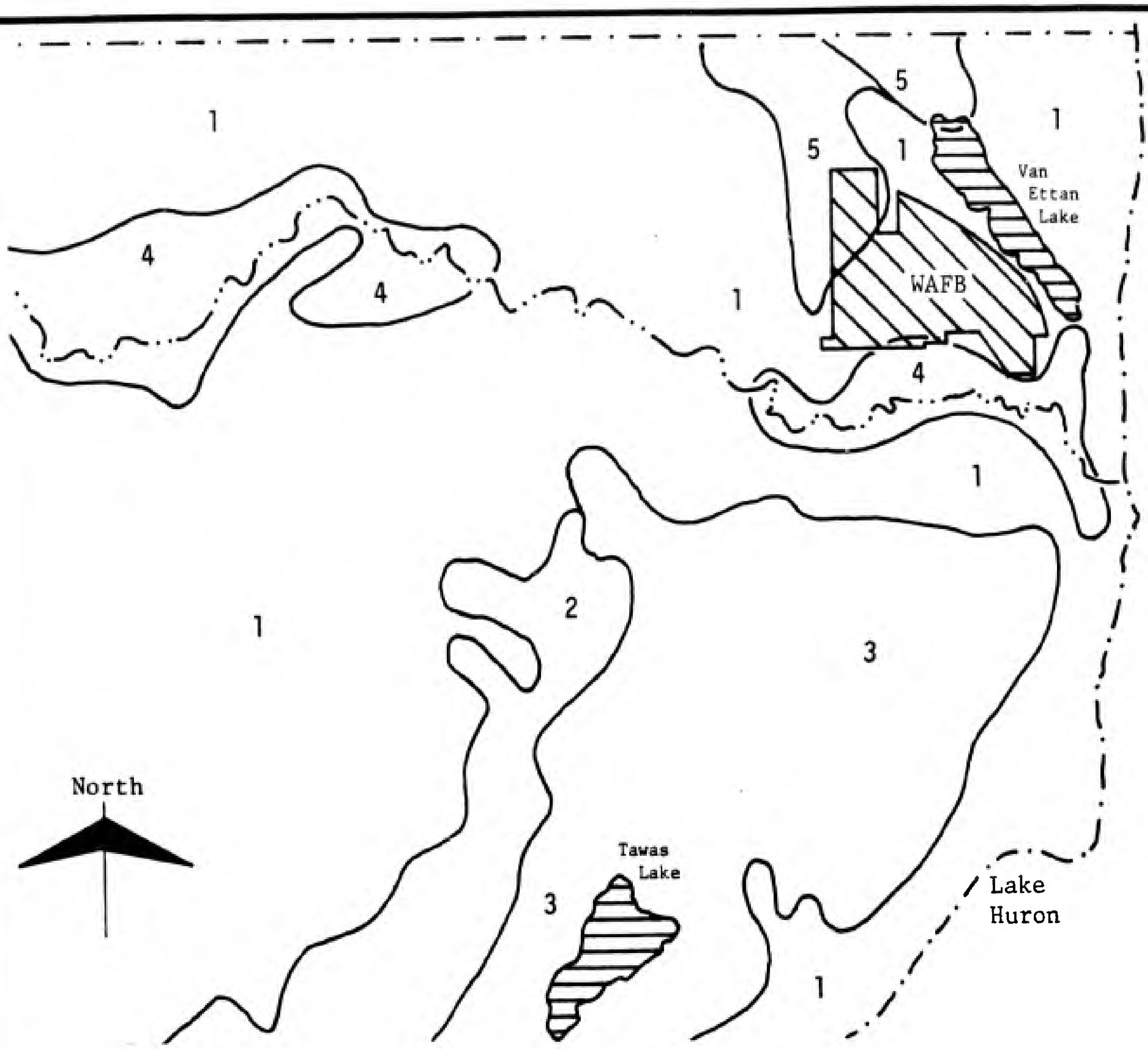
Rubicon and Grayling units account for much of the soil in northeast Iosco County. They make up the delta that was formed by the Au Sable River. These soils are deep dry sands with six to nine inches of loamy sand or sand topsoil. They are characteristically droughty and have rapid permeability. They are subject to wind and water erosion where exposed (ECMPDRC, 1973).

On the installation, soil borings indicate that below the thin topsoil (generally less than one foot thick) are layers of light brown, fine to medium-coarse sands with traces of silts. At the western end of the base there are also traces of gravel, while the eastern end comprises more medium-coarse sands of a darker brown color. As is typical of Rubicon and Grayling soils, base soils exhibit rapid seepage rates and are susceptible to erosion where no vegetal cover exists. Analysis of base soil indicates it is non-plastic, not susceptible to frost action, and is predominantly composed of fine to medium sized poorly graded sand. Grain sizes vary from 0.1 to 1.1 millimeters (WAFB, 1978).

Surface soil permeability coefficients are not available. The United States Geological Survey (USGS) study of base ground-water hydrology determined that the permeability of the underground aquifer ranges from 5.6×10^{-3} to 1.1×10^{-1} cm/sec and averages 5×10^{-2} cm/sec (USGS, 1983). It is expected that surface soil permeabilities are consistent with this range of values. The organic content of the soil is low, and construction properties are good for industrial, residential, or recreational development.

2. Geography and Topography

Wurtsmith AFB is located in Iosco County in the east central portion of Michigan's lower peninsula. Located in the northeastern part of the



LEGEND:

1. Rubicon - Grayling association: Deep sandy soils of the jack pine plains.
2. Nester - Kawkawlin association: Well and moderately well drained to somewhat poorly drained clayey soils of the undulating till plains.
3. Roscommon - AuGres association: Deep wet sandy soils, in places containing sandy ridges that are somewhat better drained.
4. Alluvial land - Tawas - Carbondale assocation: Alluvial and organic deposits on flood plains of streams and rivers.
5. Not reported.

—·—·— Iosco County Boundary

—··—··— Au Sable River

Lakes

Wurtsmith AFB Property

Scale: 1 in = 16 mi

Source: ECMPDRC, 1973.

Figure III-1. General Soil Map of Eastern Iosco County

county as shown in Figure II-2, WAFB is only two miles from Lake Huron which borders the entire eastern side of the county. Large cities nearest to Wurtsmith AFB are Saginaw located 100 miles to the south, and Detroit located 200 miles south of WAFB.

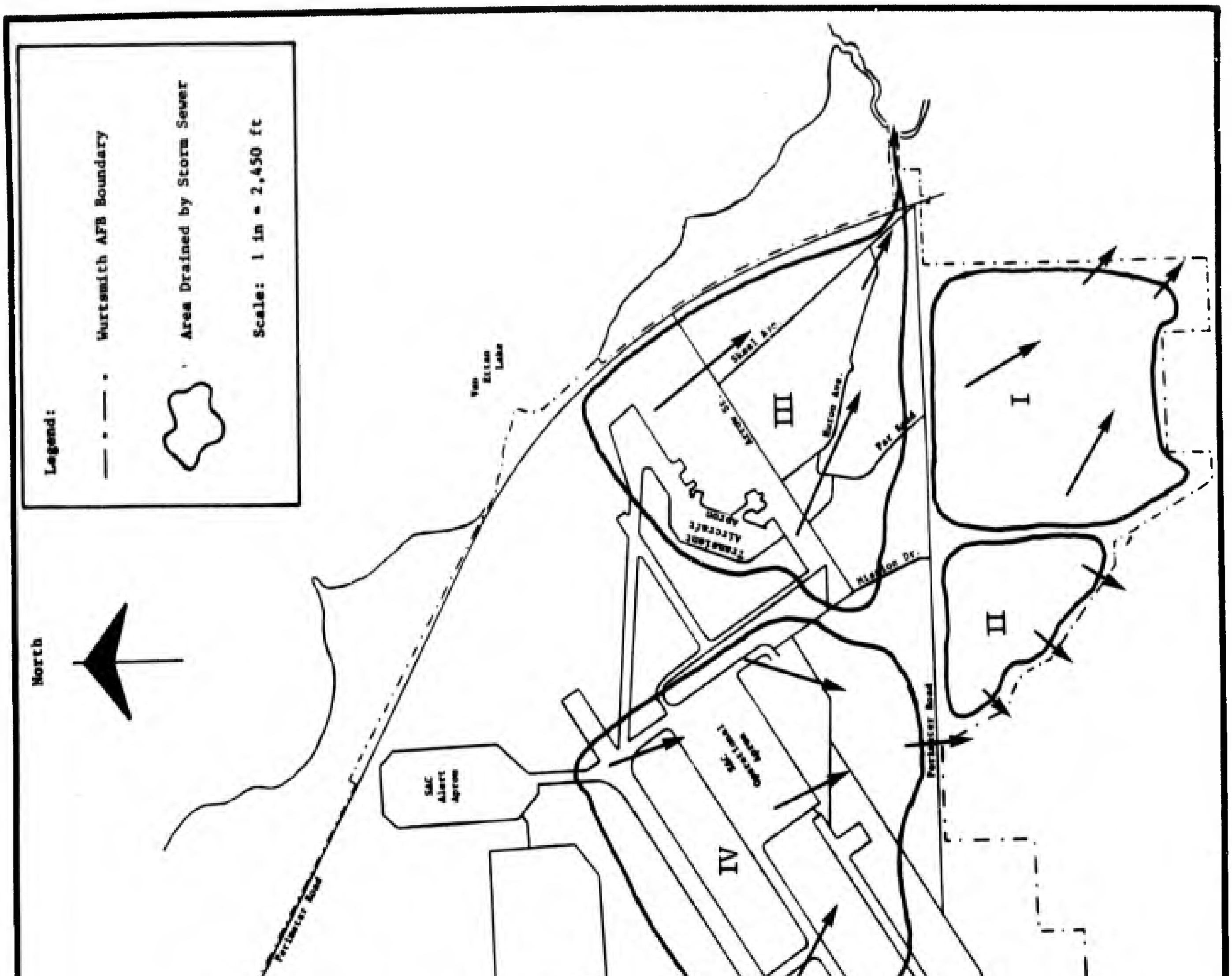
The topography of Iosco County varies from low, flat sandy plains in the east and southeast, to rolling hills and bluffs in the west. The installation is on a nearly level sand plain five miles wide and bounded on the west by 80-foot high bluffs. Adjacent to the base on the east and northeast side is Van Ettan Lake, an inland lake four miles long and half a mile wide. The Au Sable River, which drains into Lake Huron, is half a mile south of the base. The land between the base and the river is generally swampy.

The elevation of the land surface in the area surrounding Wurtsmith AFB ranges from 580 to 750 feet above mean sea level (MSL). The elevation at Wurtsmith AFB ranges between 600 and 645 feet above MSL. The topographically lowest area is the housing district along the southern base perimeter; the runway elevation is reported to be 634 feet above MSL.

3. Drainage

Drainage of precipitation and snowmelt is handled two different ways at Wurtsmith AFB. The areas on base that are well developed with roads, buildings, parking lots and other impermeable surfaces, have stormwater collection systems which route the runoff to either Van Ettan Creek or Au Sable River. All other areas on base rely on downward percolation of precipitation. Because of the sandy permeable soils throughout the installation, this mechanism generally provides adequate drainage on undeveloped land.

Five regions of the installation are drained using storm sewers. These areas are shown on Figure III-2 and discussed below. Area I includes the base military family housing. Runoff is collected by storm sewer lines and discharged at five points to the gully located in the southeast corner of



Source: WAFB, Tab G-3, Revised September 1983.

Figure III-2. Areas of WAFB Drained by Storm Sewer Systems the base. Area II is the Military Family Housing Area and drains to the southwest into Three Pipes Drainage Ditch. This ditch discharges to the Au Sable River south of the base. The third area (III), is the cantonment area. Collected storm flows discharge into Van Ettan Creek southeast of the base. Presently, treated ground water from the base TCE treatment system discharges to this storm sewer network. This drainage is monitored under NPDES permit number 0042285. Area IV is the SAC operational apron and nosedock area. Included in this drainage area are two storm sewer lines that drain the central and eastern end of the instrument runway. Discharge of storm water from this region is to the Three Pipes Drainage Ditch along the southern base boundary. Prior to discharge the storm water passes through an oil/water separator. The last area, (V) comprises a single storm sewer line which drains the west central portion of the instrument runway. Discharge is to the swampy area east of the aeration lagoons.

The direction of runoff in unsewered areas is variable but generally follows the topography. Low-lying collection points are generally grassy areas which drain into the ground. Slopes on the base are slight, reducing the chance of erosion damage from surface runoff. In addition, overland flow is minimal due to the pervious characteristics of the soil.

4. Bedrock Geology

In Michigan's lower peninsula, the bedrock formations are Paleozoic and Mesozoic in age. Younger unconsolidated Cenozoic sediments associated with glaciation overlie the bedrock in many areas. During the Paleozoic and Mesozoic eras, Michigan's climate and environment underwent several transformations. Warm tropical seas covered the area and deposits of sandstone, limestone, shale, and halite (salt) were formed. Retreat of the seas was succeeded by establishment of dense tropical forests. Decay of the tropical vegetation resulted in coal, oil, and natural gas formation. Each retreat and advance of the sea resulted in the deposition of stratified (layered) sediments. With time and progressive burial, these unconsolidated sediments were transformed into the bedrock formations present today.

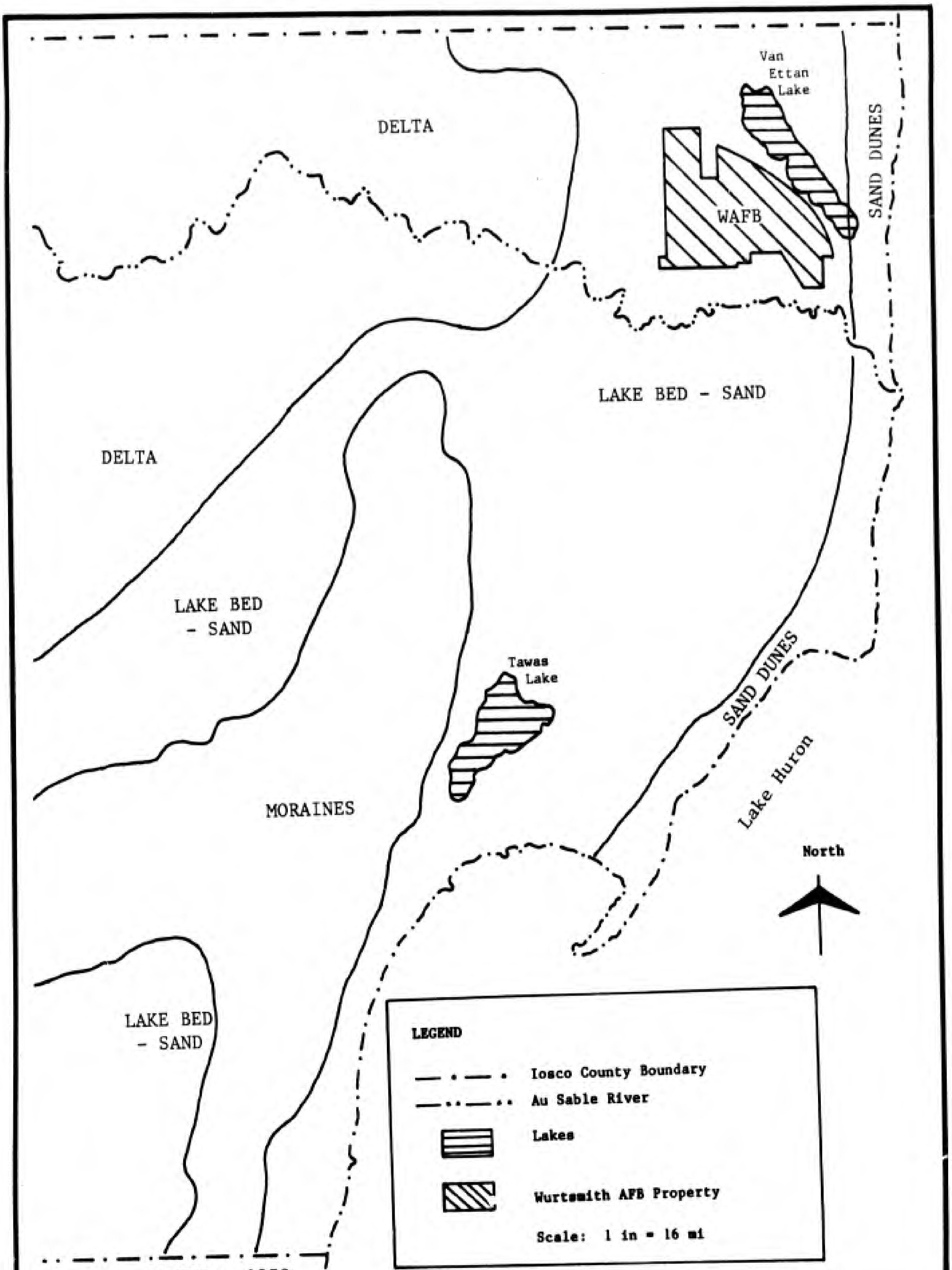
The uppermost bedrock in Iosco County consists of Mississippian-age formations of the Paleozoic era. These formations consist of limestone, sandstone, and shale and locally contain some economic mineral deposits. In southeastern Iosco County gypsum is mined in open pits. Throughout Michigan, oil, natural gas, limestone, gypsum, and salt are obtained from the Mississippian formations. The overlying Pennsylvanian deposits are composed predominantly of a lower sequence of shaley limestones and shales, grading upward to sandstones (ECMPDRC, 1975). This sequence reflects a progressive withdrawal of the sea from formerly submarine lands.

Thickness of the Mississippian system is approximately 2,400 feet; the Pennsylvanian system is 750 feet thick, and the overlying Mesozoic era sediments and coal beds are 220 to 500 feet thick. Depth to bedrock on Wurtsmith AFB varies between 200 and 250 feet. Thus, no outcrops are present on or in the vicinity of the base.

5. Glacial Geology

Glacial activity during the Illinoian and the younger Wisconsin stages covered much of Michigan as many as four times. Advance and recession of the glaciers effected massive topographical changes in the state, and is largely responsible for the present surface configuration of Michigan.

In Iosco County, four major glacial features are present: river delta deposits, moraines (unsorted, unstratified glacial sediments), sand dunes, and lake bed sands. Figure III-3 shows the glacial features of the eastern portion of Iosco County. Significant morainal deposits are found in the south central and northwest parts of the county. Erosive action of the Au Sable River during the glacial period produced a wide delta in the location of its former mouth. At that time, Lake Huron extended westward to the bluffs five miles inland of the present lake shore (ECMPDRC, 1973).



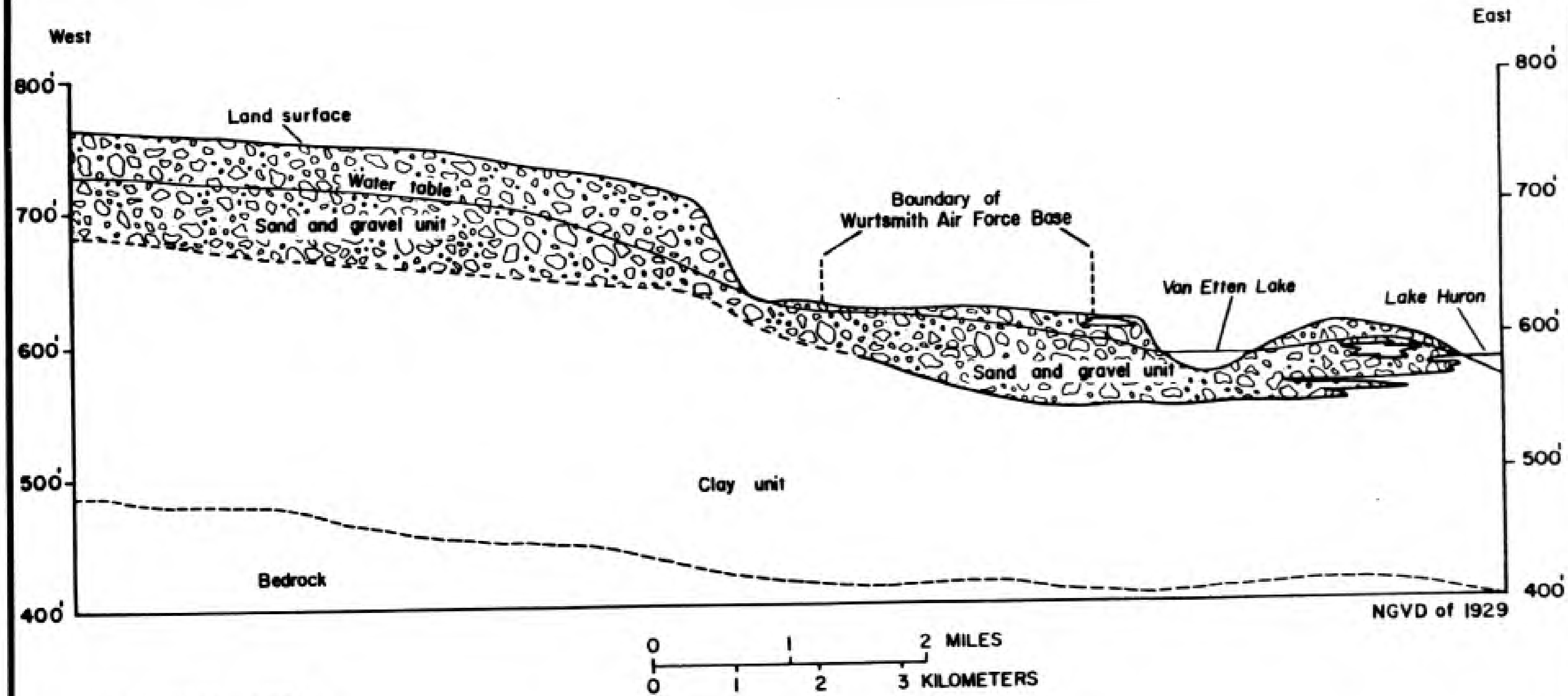
Source: ECMPDRC, 1973

Figure III-3. Glacial Features of Eastern Iosco County

Glacial deposits in the area surrounding Wurtsmith AFB consist of two distinct units - clay and overlying sand and gravel. A cross sectional view of the unconsolidated glacial deposits in this area is depicted in Figure III-4. The clay unit is brown to gray, relatively impermeable, and cohesive. Its thickness varies from 125 to 250 feet at Oscoda and places north and east of Van Ettan Lake. Thickness of this layer on Wurtsmith AFB has never been determined. The clay unit is just 10 to 15 feet below the ground surface along the foot of the bluffs and dips downward toward the northeast part of the base where it may be encountered at a depth of 80 feet below the surface. Sand and gravel deposits overlie the clay and range in thickness from 30 to 80 feet. Depth to the top of this unit generally increases to the east of the base. The sand and gravel unit is a brown to gray-brown coarse sand with gravel occurring more frequently in the western part of the base (Stark, 1983).

C. Ground-water Hydrology

Aquifers in Iosco County occur at depths ranging from 60 to 415 feet. The aquifers are confined or unconfined, and comprise sandstone or unconsolidated sand and gravel deposits. In many areas, a deep sandstone aquifer underlies shale, gypsum, limestone, or clay units that act as a barrier to prevent surface contamination of the ground water. Clay is typically found overlying sand and gravel or sandstone aquifers located near the surface and no more than 180 feet deep. In other areas and particularly along the Lake Huron shoreline, the aquifer is unconfined and consists of unconsolidated sand and gravel overlying an impervious clay layer or bedrock. This type of aquifer may vary in thickness and attain depths of less than 100 feet. In some areas of eastern Iosco County, deep bedrock aquifers contain highly mineralized water with dissolved solids concentrations around 1,000 ppm. Recharge from these aquifers to good quality aquifers must be prevented by moderated pumping of the better ground water in the vicinity (ECMPDRC, 1973).



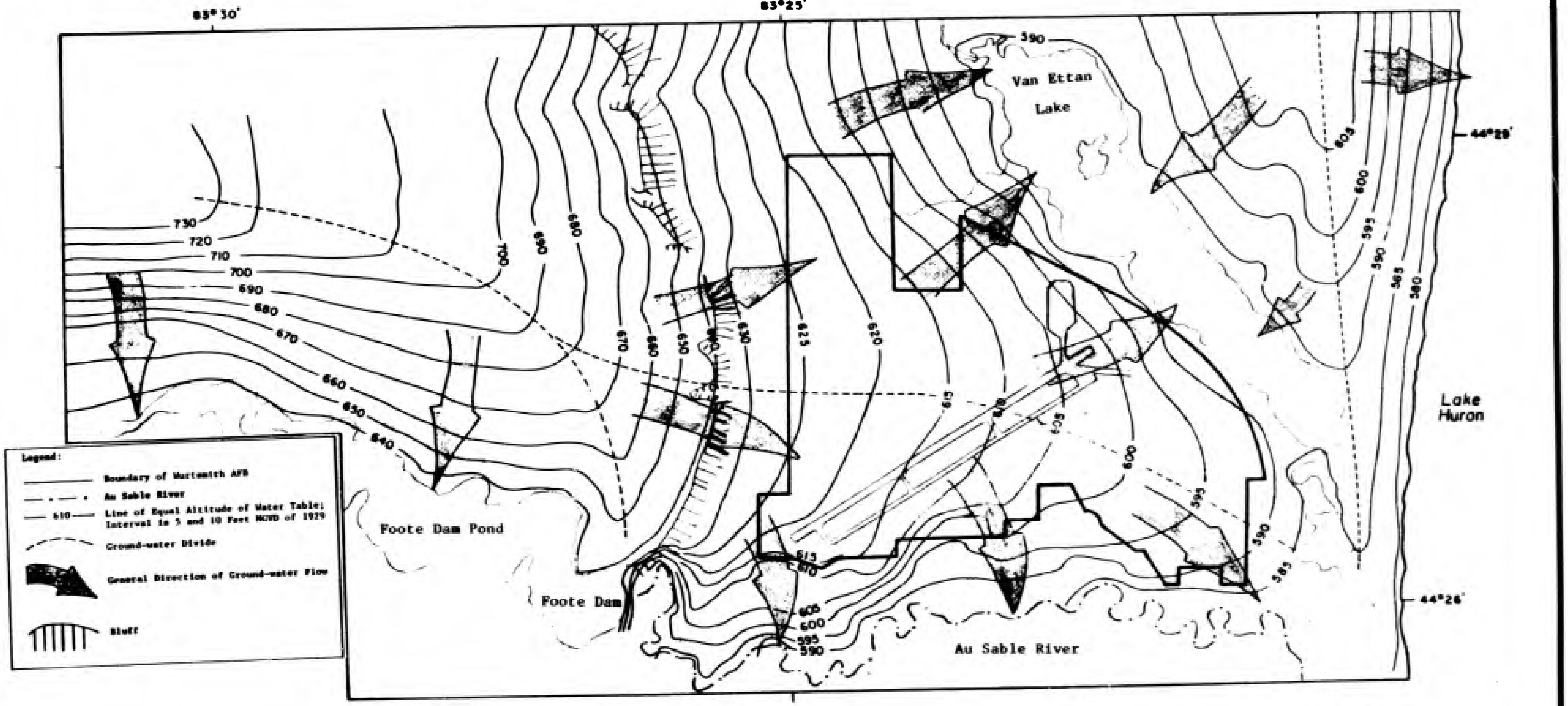
Source: USGS, 1983.

Figure III-4. Geohydrologic Section Showing Relation of Sand and Gravel Unit to Clay Unit

On Wurtsmith AFB the ground-water aquifer is unconfined and consists of unconsolidated sand and gravel overlying an impermeable clay layer. Depth from ground surface to the water table varies from 10 feet in the western part of the base to 25 feet in the eastern part and thickness of the aquifer ranges from 20 to 55 feet respectively. Flow in this sand and gravel aquifer is generally eastward. Hydrologic studies have determined that there is a ground-water divide cutting diagonally across the base from northwest to southeast, as shown in Figure III-5. South of the divide flow is toward the Au Sable River. North of it, ground water flows toward Van Ettan Lake and Van Ettan Creek (Stark, 1983).

The elevation of the water table under Wurtsmith AFB is also shown in Figure III-5. Seasonal fluctuations in the water table result from variations in precipitation, snowmelt, and the levels of nearby lakes, streams, and swamps. Water levels are low in the late fall and winter, and high in the late spring after recharge is increased by snowmelt. Ground-water pumping and variations in pumping patterns increases localized fluctuations of the water table; unless significant flows are pumped for long periods of time in one area, pumping will not seriously effect ground-water flow characteristics (Stark, 1983).

Information on the properties of the aquifer below Wurtsmith AFB include hydraulic conductivity or permeability, transmissivity, and specific yield. The average permeability for the aquifer is 140 ft/day (4.9×10^{-2} cm/sec) and the range of values is from 75 to 310 ft/day. Transmissivity is about 5,000 ft^2/day, and specific yield is 0.2. Horizontal hydraulic gradients of the aquifer range from 10 to 25 feet per mile. In the bluff area to the west of the installation, gradients may be as high as 50 feet per mile. Flow from this bluff area recharges the sand and gravel aquifer west of the base and maintains high ground-water levels in the western portion of the installation. Recharge of the aquifer as a whole is through surface percolation of precipitation and snowmelt. At present, there is no indication that ground-water pumping for consumptive use in the region served by the unconfined sand and gravel aquifer is depleting the aquifer resources. Sufficient recharge is available to meet present requirements indefinitely.



Source: U.S. Geologic Survey
1:62,500 Quadrangles

Figure III-5. Elevation of Water Table and Direction of Ground-water Flow, September 1980

1. Ground-water Quality

The quality of water from wells drilled in Iosco County is good. Treatment of well water for domestic uses may include softening followed by chlorination. There are areas in which the bedrock aquifer contains excessively mineralized ground water but these zones are not in production. Unconfined aquifers, especially those near the ground surface may become contaminated from septic tank seepage, runoff from agricultural land containing fertilizers and pesticides, and seepage of liquid materials spilled on the ground surface. One ground-water quality problem presently exists in Oscoda, south of the Au Sable River, where in the early 1970s a non-Air Force industrial source dumped a large quantity of trichloroethylene (TCE). Concentrations of TCE in the ground water were found to be as high as 10-12 ppm by the State Department of Natural Resources (Polasek, 1984). As yet, nothing has been done to contain or remove the contaminants, and in time the contaminant plume will migrate to Lake Huron.

Ground-water quality on Wurtsmith AFB has also been degraded. In past years, fuel, solvent, and waste management practices were not as thorough and stringent as during the last six to seven years. Consequently, trichloroethylene (TCE), dichloroethylene (DCE), and benzene have been discovered in the ground water at various locations on WAFB. Details of this contamination are given in Section IV of this report. Presently, good quality ground water is available from several of the wells on the installation, although some wells have been shut down due to contamination. Analyses on the chemical, physical, and biological characteristics of the ground water are presented in Appendix F.

2. Local Ground-water Use

In most parts of Iosco County, well water is used as a domestic water source for individual housing units. However, the township of Oscoda has a central water supply system as a result of the degradation of the local ground water from the TCE spill of the early 1970s. This system draws water from shallow wells located west of Au Sable.

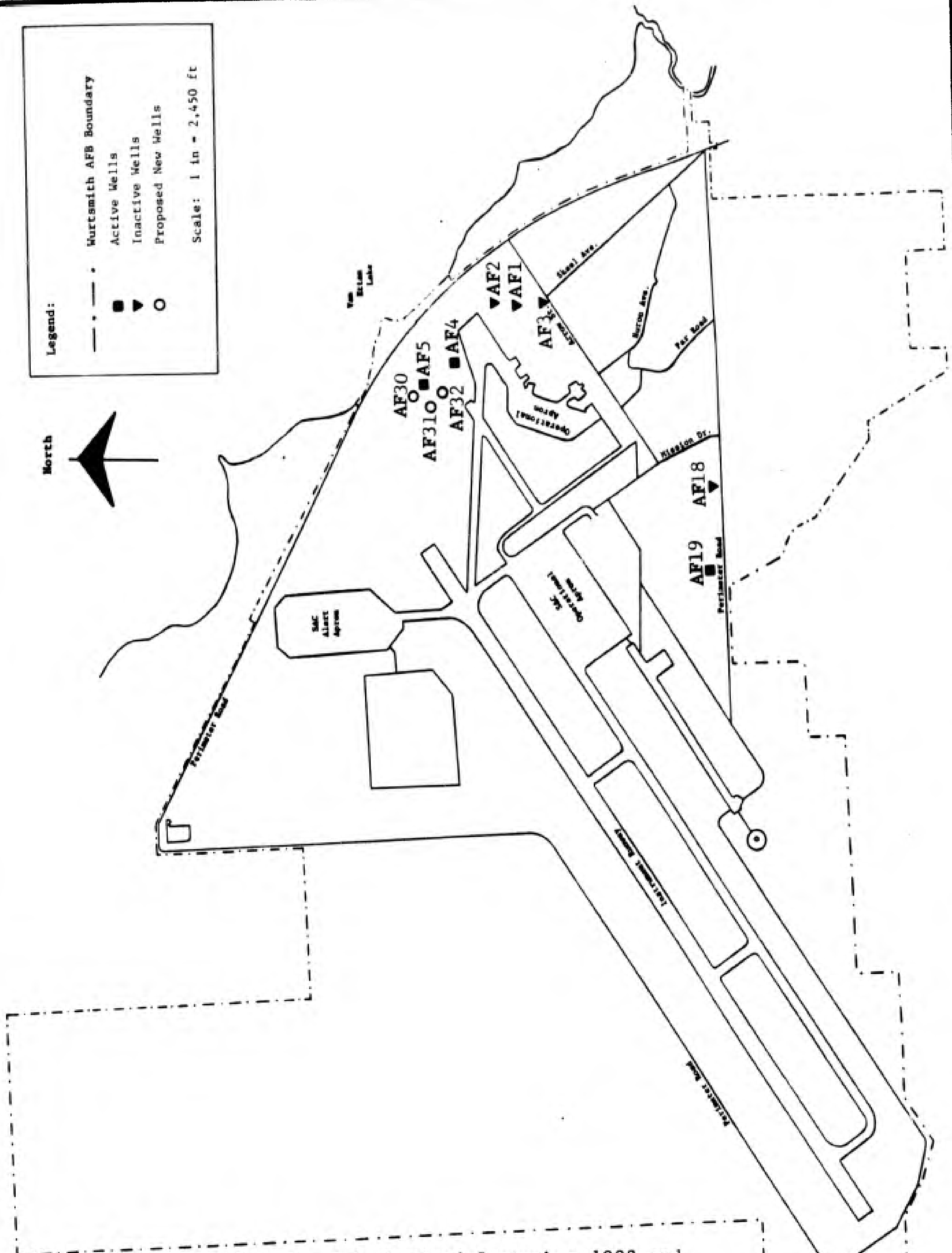
Wurtsmith AFB, which depends solely on ground-water for its domestic and industrial needs, has shut down four of its seven major drinking water wells because of chemical contamination and their proximity to sanitary sewer mains. Because of the shutdown of some of their higher yielding wells the installation plans to construct three new wells beyond the contaminant plume boundaries to supplement drinking water production. The locations of all major active, inactive and proposed ground-water supply wells on WAFB are illustrated on Figure III-6. Treatment of base water includes chlorination and fluoridation.

Water supply for the three Air Force Stations included in this Phase I study is provided by wells. Port Austin AFS has three 280 foot wells on-site. These are housed in Buildings 24, 25, and 31 and shown in Figure II-4. Empire AFS has two wells on-site. The Building 7 well shown in Figure II-5 is presently in use. Building 43 houses an inactive water well. The only water well on Bayshore AFS is located in the south central part of the station. It is shown on the station site plan in Figure II-6.

D. Surface Water Quality and Hydrology

No permanent natural surface water bodies occur within the boundaries of Wurtsmith AFB.

Wurtsmith AFB is located within the Au Sable River Basin. The Au Sable River drains approximately 1,800 square miles as it flows 200 miles from west to east in the northern portion of Michigan's lower peninsula. The mouth of the Au Sable River is at the town of Au Sable on the shore of Lake Huron, just south of Oscoda. The average flow of the Au Sable River at its mouth is 1,960 cubic feet per second. The Au Sable River has excellent water quality



Source: WAFB, Tab No. G-1, Revised September 1983 and personal communication with base environmental coordinator, February 1985.

Figure III-6. Locations of Major Water Supply Wells on Wurtsmith AFB as a result of the preservation of the river basin land. Approximately 80 percent of the basin is forested, and point-source pollutant loadings to the river are minimal (Chester Eng., 1978).

Van Ettan Lake, east of WAFB, is one of the largest lakes in the Au Sable River Basin. Pine River empties into Van Ettan Lake at the north end, and Van Ettan Creek drains the lake into the Au Sable River at the south end. Van Ettan Lake has been designated a cold water fisheries lake by the Department of Natural Resources Fisheries Division. Water quality of Van Ettan Lake is good; the primary use of the lake is for recreation.

Several small creeks are present in the area surrounding Wurtsmith AFB. Dry Creek to the north of the base flows east into Van Ettan Lake. This and other creeks are fed by ground-water discharge from the bluffs west of the installation. Swampy areas south of the base along the Au Sable River are also fed by ground water. This area is situated on the floodplain of Au Sable River and is a wildlife habitat. Thus its development potential is appropriately low.

Permanent surface water bodies on the installation consist of three wastewater treatment aeration lagoons. These lagoons treat all domestic sewage generated on the base. Effluent may flow to any of eight seepage ponds, but since the sandy soils on the base are very permeable, little or no standing water exists in any of the seepage ponds. Precipitation on base is either drained to Van Ettan Creek or the Au Sable River, or percolates into the ground.

E. Environmentally Sensitive Conditions

Wurtsmith AFB is located on 5,223 acres of land. Three hundred fourteen acres are covered by airfields and pavements, 840 acres comprise improved grounds, 2,500 acres comprise semi-improved grounds, and 1,883 acres are unimproved grounds. The predominant tree on the base is Jack Pine followed in abundance by Norway Pine, Oak, and other deciduous hardwood trees. Grassy areas are covered with meadow fescue and orchard grass, as well as common weeds. Animal life on the installation includes small mammals such as squirrels, rabbits, muskrats and mice, birds such as warblers, sparrows, blackbirds and crows, and reptiles and amphibians such as turtles, frogs, and snakes. Waterfowl and fish abound in the rivers, streams, and lakes around WAFB. No endangered species' habitat exist within the boundaries of WAFB (WAFB, 1978).

There are three sensitive environments within the region of potential influence of Wurtsmith AFB. The first is the forest land. Forest fire damage would destroy natural habitats and increase the possibility of surface erosion. The second includes the local streams and lakes. Van Ettan Lake is a known habitat of two species of threatened flora: Armoracia Aquatica (Lake Cress) and Zizania Aquatica var Aquatica (variety of wild rice). In addition, lakes and streams are habitats for fish and shell fish. This wildlife may be disturbed by changes in water quality stemming from overdevelopment along lakeshores, poor quality discharges from waste treatment plants, or toxic discharges.

The third environmentally sensitive environment at Wurtsmith AFB is the ground-water system. Factors contributing to the potential for adverse impacts are the lack of confinement of the sand and gravel ground-water aquifer, the high permeability of the soils in the region, and the shallow water table. Because the mission of WAFB involves handling of large quantities of liquid fuels and solvents, contamination of the ground water is always a possibility.

IV. FINDINGS

Past hazardous waste management practices at Wurtsmith AFB were identified and evaluated for their potential to cause environmental contamination and/or to pose a threat to human health. This section provides a summary of typical wastes and estimated quantities generated by activity, a description of past and current disposal practices used at Wurtsmith AFB, and a site-specific evaluation of all disposal sites identified. This section also covers activities and disposal practices at three radar sites, Port Austin AFS, Empire AFS and Bayshore AFS.

A. Wurtsmith AFB Activity Review

To identify past activities on the base and the radar sites that generated hazardous wastes, a review of current and past waste generation and disposal methods was conducted. This review included interviews with current and former (both civilian and military) base employees, a search of files and records (maintained by Wurtsmith AFB and outside agencies), and site inspections.

1. Wastes Generated by Activity

Potentially hazardous wastes generated by Wurtsmith AFB can be associated with one of four groups of activities conducted on base:

- Industrial Operations (Shops, including the radar sites);
- Fuels Management (POL);
- Pesticide Utilization; and
- Base Hospital and Laboratory Operations.

The following discussion addresses only those wastes generated on base which are either hazardous wastes or potentially hazardous wastes. A hazardous waste is defined as hazardous by the regulations implementing either the Resource Conservation and Recovery Act (RCRA) or the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). Compounds such as polychlorinated biphenyls (PCBs) which are listed in the Toxic Substances Control Act (TSCA) are also considered hazardous. Other substances such as oil spills, munitions and radioactive wastes, which affect the quality of the environment are also considered hazardous wastes or potentially hazardous wastes. A potentially hazardous waste is one which is suspected of being hazardous, even in cases where insufficient data are available to fully characterize the waste.

a. Industrial Operations (Shops, including the radar sites)

Several industrial shops and operations at Wurtsmith AFB generate potentially hazardous wastes as a result of mission support activities. The Civil Engineering Squadron (CES) provided information which was used as a basis for evaluating waste generation and location of hazardous material usage. The files were examined for information on chemical usage, hazardous waste generation, and disposal practices.

To supplement the information obtained from CES on which shops handled hazardous materials or generated hazardous waste, key personnel within the Wurtsmith maintenance support functions were interviewed. During the interviews, information was gathered concerning hazardous materials utilized, waste quantities generated and disposal practices for each shop. Where possible, past disposal methods were determined for the major wastes generated. Confirmation of some of the past disposal methods within the shops was difficult because written information was essentially nonexistent and remembered incidents were often not confirmed due to the elapsed time since occurrence. The information on waste quantities is based on information derived through record searches of the files as well as verbal estimates given by shop personnel at the time of the interviews.

In general, shop wastes have been drummed or stored in tanks or bowsers prior to contract disposal off-site. The drums are generally stored at the buildings in which the wastes are generated until drum pick-up. Much of the material, especially waste oils, hydraulic fluid, and solvents, are contracted out for recycling.

Other past methods of waste disposal identified are through the Defense Property Disposal Office (DPDO), sanitary sewer, and the storm sewer. Waste discharged to the storm sewers is discharged to one of three installation outfalls to either Van Ettan Creek or the Au Sable River. Waste discharged to sanitary sewers is treated in aeration lagoons. These waste disposal methods are discussed in detail in Section IV.2 and Table IV-4.

Brief descriptions of the industrial shops which generate hazardous wastes are provided in the following paragraphs. The location and amount of each waste are provided.

1) Avionics Maintenance Squadron

The 379th Avionics Maintenance Squadron (AMS) performs organizational and intermediate-level maintenance on avionics systems installed in the B-52G and KC-135A aircraft. The squadron operates nine shops to achieve its mission.

Electronic Countermeasure (ECM) Shop. Maintenance of electronic countermeasure equipment, which includes transmitters and receivers, is performed in Building 5008. Wastes generated in this shop include DC200 silicon damping fluid (240 gal/yr) and PD680 solvent (25 gal/yr). The shop also uses Freon 113, dry cleaning fluid, and lubricating oil but all of these materials are consumed in-process.

Fire Control Shop. The Defensive Fire Control Shop maintains the turrets, guns, computers, receiver-transmitters, sights, and other components of the defensive fire control system. The Fire Control Shop is located in Building 5008. Wastes generated include trichloroethylene (TCE) used as a degreaser (150-300 gal/yr), bore cleaner for guns (50 gal/yr), and Solvent Mil C372 (100 gal/yr). This is the only shop currently using TCE.

Precision Measurement Equipment Laboratory (PMEL). The PMEL conducts maintenance, calibration, and certification of test equipment. This laboratory serves all government agencies in Michigan's lower peninsula. It is located in Building 57. The PMEL uses electronic vacuum tubes of low radioactivity which are disposed of as ordinary refuse. The PMEL also uses mercury, 1,1,1-trichloroethane, methyl ethyl ketone (MEK) and Freon but all of these materials are consumed in-process.

Additional AMS Shops. The remaining six shops in AMS generate no hazardous or potentially hazardous wastes. These shops are: the Radar Shop, the Photographic Shop, the Auto-Pilot Shop, the Instrument Shop, the Bomb-Navigation Shop, and the Inertial Navigation Shop.

2) Field Maintenance Squadron

The 379th Field Maintenance Squadron (FMS) provides intermediate-level maintenance for the quick repair of aircraft systems and related equipment. The work is accomplished by 15 shops through in-shop repair, specialist dispatch, and local manufacture.

Propulsion Branch. The Propulsion Branch repairs aircraft jet engines in Building 43. Wastes generated in this area include: engine oils (300-500 gal/yr), PD680 solvent (720 gal/yr), fingerprint remover for bearings (60 gal/yr), and synthetic lubricating oil (110 gal/yr). Up until 1978, this shop also generated TCE (120 gal/yr) as waste. Up until 1980, carbon remover compound (5-10 gal/yr) waste was also generated.

Aerospace Ground Equipment (AGE) Maintenance Shop. The AGE Maintenance Shop is located in Building 5009. This shop is responsible for repair, maintenance, and inspection of all aerospace ground equipment. Wastes generated consist of turbine engine oil (500-1,500 gal/yr), PD680 solvent (500-1,200 gal/yr), and hydraulic oil (100 gal/yr). Up until 1980, carbon remover compound (600 gal/yr) waste was also generated.

Nondestructive Inspection (NDI) Laboratory. Nondestructive testing methods, including X-ray, magnaflux, and ultrasound, are performed to determine material defects of aircraft structures, component parts, and related ground equipment. The NDI laboratory is located in Building 5008. Wastes generated include methyl isobutyl ketone (15-20 gal/yr) and fluorescent penetrant/emulsifier (100 gal/yr). The shop also uses 1,1,1-trichloroethane, PD680 solvent and miscellaneous photographic developers and fixers which are consumed in-process.

Pneudraulics Shop. The Pneudraulics Shop is located in Building 5008. This shop services and repairs all aircraft pneumatic and hydraulic equipment. The only wastes generated are PD680 solvent (600 gal/yr) and hydraulic fluid (600 gal/yr). Other solvents and fluids (MEK and Freon) are consumed during their use.

Wheel and Tire Shop. The Wheel and Tire Shop operates in Dock #3 (Building 5067). Wastes generated include paint remover (300-500 gal/yr), PD680 solvent (1,000-2,000 gal/yr), and hydraulic fluid (75 gal/yr).

Corrosion Control Shop. Corrosion control includes cleaning, stripping, sanding, wiping, priming, repainting, and stenciling aircraft and ground support equipment. The Corrosion Control Shop is located in Dock #5 (Building 5066). Wastes generated in this area include paints/thinners (500-1,500 gal/yr), MEK (300-500 gal/yr), toluene (300-500 gal/yr), PD680 solvent (1,200-2,000 gal/yr), and carbon remover compound (300 gal/yr). Other materials, such as epoxy primers and polyurethane paints are consumed in process.

Environmental Systems Shop. The Environmental Systems Shop is located in Building 5008. The only wastes generated are tricresyl phosphate (5-10 gal/yr) and vacuum oil (5-10 gal/yr).

Survival Equipment Shop. The Survival Equipment Shop is also located in Building 5008. The only waste generated is lubricating oil (5-10 gal/yr).

Test Cell Shop. The Test Cell Shop is loated in Building 5098. Wastes generated include PD680 solvent (120 gal/yr) and JP-4, engine oil, lubricating oil and hydraulic fluid (220 gal/yr total).

Additional FMS Shops. The remaining FMS shops generate no hazardous or potentially hazardous wastes. All materials used are consumed in the operational processes. These shops are:

- The Electric Shop,
- The Fuel Cell Repair Shop,
- The Welding Shop,
- The Machine Shop,
- The Egress Shop, and
- The Structural Repair Shop.

3) Munitions Maintenance Squadron

The Munitions Maintenance Squadron (MMS) is accountable for all munitions-related items for base organizations which require explosives to support the wing mission. Two of the three shops in MMS generate wastes in significant quantities. These are the Munitions Maintenance shop and the Equipment Maintenance shop. No hazardous or potentially hazardous wastes are generated in the Integrated Maintenance shop.

Munitions Maintenance Shop. Munitions are warehoused, inspected, and maintained by the technicians of the Munitions Maintenance Shop (Building 5109) in the Weapons Storage Area. The only wastes generated are various solvents/thinners (110 gal/yr). The shop also uses MEK, V.M. and P. Naptha, isopropyl alcohol, and JP-10 which are all consumed in-process.

Prior to 1981, munitions maintenance was performed in Building 5090, south of the SAC Instrument Runway. Many of the same materials were used then, in approximately the same quantities as current materials. TCE was also used in small quantities until 1973.

Equipment Maintenance Shop. The Equipment Maintenance Shop maintains the munitions lift trailers and other support equipment essential to munitions maintenance, storage, and loading. Housed in Buildings 5043 and 5045, the Equipment Maintenance Shop generates various waste solvents, oils, fluids, and lubricants. Those in significant quantities include PD680 solvent (300-500 gal/yr), hydraulic fluid (500-1,000 gal/yr), brake fluid (20-100 gal/yr), and paint remover (40 gal/yr). The shop also uses engine oil and gear lubricating oil which are consumed in-process.

4) Organizational Maintenance Squadron

The 379th Organizational Maintenance Squadron (OMS) provides operationally ready bomber and tanker aircraft for all wing missions. The unit also provides minor maintenance, servicing, and inspection of transient aircraft. OMS consists of four branches: bomber, tanker, support, and alert force.

Bomber and Tanker Branches. The Bomber branch conducts inspections and extensive repair of the B-52G systems. The Bomber branch operates in Dock #4 (Building 5061) and Dock #5 (Building 5066). The Tanker branch is responsible for performing periodic pre-flight, basic post-flight, and thru-flight inspections of aircraft structures and components. It is responsible for the launch, recovery, towing, and parking of all assigned and transient KC-135 aircraft. The Tanker branch operates in Dock #2 (Building 5060) and Dock #5 (Building 5066). The only wastes are generated at Dock #2. These include waste JP-4 (6,000-10,000 gal/yr) and engine oils (240 gal/yr). These two branches also use aircraft cleaning compounds and detergents, PD680 solvent, carbon remover, and dry cleaning solution which are consumed in-process.

Support Branch. The Support branch is comprised of five sections: nonpowered support equipment, consolidated tool room, tow vehicle operation section, aircraft equipment section, and transient maintenance. The main work area is Dock #3 (Building 5067). The Nonpowered Aerospace Ground Equipment shop generates wastes that include PD680 solvent (120 gal/yr) and paints/ thinners (45 gal/yr). The Transient Maintenance Shop generates waste hydraulic fluid (120 gal/yr). Other materials used in these and the other Support branch shops are consumed in the operational processes.

Alert Force Branch. The Alert Force Branch gives the organizational maintenance support needed for the immediate launch of aircraft. The branch is responsible for performing preflight inspections and the service, towing, parking, maintenance and launching of alert craft. The Alert branch works in the SAC Alert Apron and SAC Operational Apron areas. This branch uses approximately 5,000 to 7,000 gal/yr of deicing fluid, depending on the weather conditions but generates no hazardous or potentially hazardous wastes.

5) Transportation Squadron

The 379th Transportation Squadron provides traffic management, vehicle operation services, and vehicle maintenance. Hazardous substances and materials are used only in the vehicle maintenance branch, which is responsible for maintaining all government-owned motor vehicles in serviceable condition.

Heavy Equipment Maintenance Shop. Heavy equipment maintenance is performed in Building 140. The principal wastes generated include PD680 solvent (110 gal/yr), waste engine oils (1,500-3,000 gal/yr), hydraulic fluid (300 gal/yr), and brake fluid (24 gal/yr).

Fire Department Vehicle Maintenance Shop. The Fire Department Vehicle Maintenance Shop is located in Building 16. The only waste generated in this shop is PD680 solvent (220 gal/yr). Antifreeze, transmission fluid, and engine oil are also used in this shop but are consumed in-process.

General Repair Shop. General maintenance of base vehicles occurs at Building 394. Wastes generated include PD680 solvent (25 gal/yr), engine oil (360 gal/yr), transmission fluid (120 gal/yr), and antifreeze (120 gal/yr).

Refueling Maintenance Shop. Refueling maintenance occurs in Building 393. The wastes generated are PD680 solvent (120 gal/yr) and JP-4/Gas mixture (1,500 gal/yr).

Minor Maintenance Shop. Minor maintenance is performed in Building 394. Wastes generated include oils (1,500-2,400 gal/yr), antifreeze (300 gal/yr), transmission fluid (240 gal/yr), and PD680 solvent (110 gal/yr).

Special Purpose Vehicle Maintenance Shop. The Special Purpose Vehicle Maintenance Shop is located in Building 395. Wastes generated include PD680 solvent (110 gal/yr), antifreeze (600 gal/yr), hydraulic fluid (600 gal/yr), brake fluid (2 gal/yr), transmission fluid (600 gal/yr), engine oils (4,400 gal/yr), and paints/thinners (50 gal/yr).

Additional Transportation Squadron Shops. Four other Transportation Squadron shops; Wash Rack Shop, Paint Shop, Machine Shop, and the Packing and Crating Shop; use small quantities of cleaners, oils, and fluids. These substances are consumed in the operational processes.

6) Combat Support Group

The 379th Combat Support Group operates in direct support of the 379th Bombardment Wing. Its functions include central base administration, personnel, services, operation and training, disaster preparedness, morale, welfare, and recreation. The Combat Support Group also includes civil engineering and the security police. The Civil Engineering Squadron is discussed separately below. Three shops operated by the Combat Support Group generate significant quantities of wastes. These are the Auto Hobby Shop, the Military Gas Station and Fuels Distribution.

Auto Hobby Shop. The Auto Hobby Shop (Building 388) is operated to allow military personnel to work on their private vehicles. Wastes generated include engine oils, antifreeze and hydraulic fluid (1,500 gal/yr total), solvent (165 gal/yr), and cleaning compound (495 gal/yr).

Military Gas Station. The Military Gas Station is located in Building 460. The wastes generated are oils and gas (1,000 gal/yr).

Fuels Distribution. The fuel distribution locations are Buildings 361, 5073, and 5075. Wastes generated include JP-4 (8,000 gal/yr), diesel (220 gal/yr), and MOGAS (80 gal/yr).

7) Civil Engineering Squadron

The primary mission of the 379th Civil Engineering Squadron (CES) is to acquire, design, construct, operate, and maintain real property facilities and utilities. Nine shops within CES generate significant quantities of wastes.

Heat Shop. The Heat Shop (Building 288) maintains the heating boilers throughout the base. Wastes generated include ethylene glycol (100-300 gal/yr) and asbestos (annual quantity varies).

Power Production Shop. The Power Production Shop is located in Building 385. Wastes generated include lube oil (300-500 gal/yr), fuel oil/gas mixture (220 gal/yr), solvents/thinners (110 gal/yr) and antifreeze (200 gal/yr).

Pavement and Grounds Shop. In the course of maintaining roads, runways, and grounds, the Pavement and Grounds Shop (Building 140) generates used engine oils and hydraulic fluid (1,000-2,000 gal/yr), antifreeze (500 gal/yr), diesel fuel/gas mixture (110 gal/yr), and denatured alcohol (110 gal/yr). Prior to 1979, the shop also generated waste toluene (10-50 gal/yr).

Refrigeration Shop. The Refrigeration Shop is located in Building 290. The only waste generated is used oil (200 gal/yr).

Entomology Shop. The Entomology Shop (Building 140) has generated chlordane (5 gal/yr), dieldrin (45 gal/yr), and Naled (45 gal/yr) as a one-time excess. More information about pesticide usage at Wurtsmith AFB is presented in Section IV.1.c.

Exterior Electric Shop. The Exterior Electric Shop is located in Building 385. The only waste generated is PCB transformer oil (1-2 gal/yr).

Heat Plant. The Heat Plant is located in Building 305. The only waste generated is an FS-6 and Solvent 140 mixture (220 gal/yr).

Liquid Fuels Management Shop. The Liquid Fuels Management Shop operates in Building 25. Wastes generated include fuel filters (150 filters/yr), JP-4 sludge (150-300 gal/yr), MOGAS sludge (75 gal/yr), antifreeze (30 gal/yr), JP-4, MOGAS, and diesel fuels (325 gal/yr) and asbestos (annual quantity varies).

Paint Shop. The only waste generated by the Paint Shop (Building 290) is paints and thinners (100-200 gal/yr).

8) 2030th Communications Squadron

The 2030th Communications Squadron operates and maintains the base switchboard, message center, and intra-base radio support. It also provides Combat Communications air traffic control services to Wurtsmith and the surrounding area. Three maintenance shops in the 2030th Communications Squadron use solvents and cleaners. These materials are consumed during the operational processes.

9) Port Austin Air Force Station

Port Austin AFS uses natural gas for heating but the power plant has a supply of #2 diesel fuel as a back-up. Used engine oil is collected in the motor pool oil storage area. At the time of the on-site visit a few 55-gallon drums of waste oil were stored on a diked, concrete slab covered with sand. These drums were going to be removed by a contractor. Some asbestos-insulated pipes are present on the station; however, they are sealed and painted.

10) Empire Air Force Station

No significant quantities of hazardous material are used at Empire AFS. At the present time, the Air Force is only operating one radar tower (Building 58 in Figure II-5) and owns no land at the site.

11) Bayshore Air Force Station

Bayshore AFS is formally closed and all radar equipment has been removed. During station operations prior to 1 October 1984, TCE was used as a cleaning solvent. The TCE was dispensed from a 55-gallon drum. Small quantities of spent TCE were disposed of on the station ground. Used engine oil from the hobby shop was sometimes used to keep weeds down. Small quantities of paint thinners were also disposed of on the ground. There was a barrel storage area located near the center of the eastern property boundary. Any spills in this area would have drained towards the south. Asbestos sheets were used in ceiling spacers between the lights and the ceilings in the 1960s; however, after a fire at the site in 1968 all of the asbestos was removed.

b. Fuels Management

The Wurtsmith AFB Fuels Management storage system includes a number of above ground and underground storage tanks and pipelines located throughout the base. Table IV-1 is a summary of above ground and below ground fuel storage capacities. A more detailed analysis of fuel storage by tank capacity and fuel type is presented in Appendix E. Table IV-2 shows the distribution of above ground and below ground tank sizes for each material stored.

Most of the large (10,000 gallon or greater) tanks are within the POL (Petroleum, Oil, and Lubricants) storage area southeast of the Transient Aircraft Operational Apron. There are seven large surface tanks in this area: two JP-4, two fuel oil (#2 and #6 heating), two MOGAS (unleaded and leaded automotive gas), and one deicing fluid. All other tanks in this area are underground. An underground slop waste tank is used to collect any spillage or rainwater drained from the POL storage area.

Only two of the 36 medium size (1,000 to 10,000 gallon) POL storage tanks are above ground. One of these (6,000 gallon) is located in a Munitions Maintenance area (Building 5043). The second (2,000 gallon) is located at Building 16 near the Transient Aircraft Operational Apron. Both are used for #2 heating fuel oil.

Two of the 13 small size (<1,000 gallon) tanks are above ground. One (550 gallon at Building 5305) is used for #2 heating fuel oil. The other (275 gallon, at Facility 5070, southeast of the SAC Operational Apron) is used to store leaded MOGAS.

TABLE IV-1. SUMMARY OF ACTIVE POL STORAGE CAPACITIES, WURTSMITH AFB[1]

ABOVE GROUND TANKS

Material	Number of Tanks	Maximum Tank Volume (gal)	Minimum Tank Volume (gal)	Total Storage Volume (gal) (Shell-Rated Capacity)
JP-4	2	1,260,000	630,000	1,890,000
Fuel Oil (#2)	4	315,000	550	323,550
Fuel Oil (#6)	1	---	---	210,000
Diesel (#2)	0	---	---	---
MOGAS (Leaded)	3	25,000	275	50,275
MOGAS (Unleaded)	0	---	---	---
Deicing Fluid	1	---	---	25,000
JP-9	0	---	---	---
JP-10	0	---	---	---

BELOW GROUND TANKS

Material	Number of Tanks	Maximum Tank Volume (gal)	Minimum Tank Volume (gal)	Total Storage Volume (gal) (Shell-Rated Capacity)
JP-4	11	50,000	2,000	414,000
Fuel Oil (#2)	33	20,000	500	70,650
Fuel Oil (#6)	1	---	---	25,000
Diesel (#2)	7	50,000	1,500	61,000
MOGAS (Leaded)	5	50,000	1,000	93,000
MOGAS (Unleaded)	6	15,000	2,000	69,000
Deicing Fluid	0	---	---	---
JP-9	3	7,000	7,000	21,000
JP-10	1	---	---	7,000

[1]Does not include heating oil tanks at base housing areas.

TABLE IV-2. DISTRIBUTION OF ACTIVE POL STORAGE CAPACITIES, WURTSMITH AFB[1]

		Number of Above Ground Tanks		
Material	Total	Capacity: ≥ 10,000 gal	1,000 to 10,000 gal	<1,000 gal
JP-4	2	2	0	0
Fuel Oil (#2)	4	1	2	1
Fuel Oil (#6)	1	1	0	0
Diesel (#2)	0	0	0	0
MOGAS (Leaded)	3	2	0	1
MOGAS (Unleaded)	0	0	0	0
Deicing Fluid	1	1	0	0
JP-9	0	0	0	0
JP-10	0	0	0	0
TOTAL	11	7	2	2

		Number of Below Ground Tanks		
Material	Total	Capacity: ≥ 10,000 gal	1,000 to 10,000 gal	<1,000 gal
JP-4	11	9	2	0
Fuel Oil (#2)	33	2	20	11
Fuel Oil (#6)	1	1	0	0
Diesel (#2)	7	1	6	0
MOGAS (Leaded)	5	4	1	0
MOGAS (Unleaded)	6	5	1	0
Deicing Fluid	0	0	0	0
JP-9	3	0	3	0
JP-10	1	0	1	0
TOTAL	67	22	34	11

[1]Does not include heating oil tanks at base housing areas.

The fuels are delivered to the base and distributed in a variety of ways. JP-4 is piped in from a private firm in Harrisville, Michigan. Tank trucks are also used for JP-4 deliveries to the base. Tanks at the SAC Operational Apron are filled via pipeline from the POL Bulk Storage area. Fuel for "top offs" at the SAC Alert Apron are handled by tank truck.

MOGAS, fuel oil for heating, and diesel fuel are brought to Bulk Storage and distributed throughout the base by tank truck. Deicing fluid is trucked to Bulk Storage. Tank trucks equipped with "cherry pickers" are then filled half full with deicer and half with water before proceeding to the nose dock area or SAC Alert Apron for deicing planes.

In the past, railroad tanker cars have been used to deliver fuels. This practice was discontinued a few years ago.

c. Pesticide Utilization

The Wurtsmith AFB pest control program is conducted by the Entomology Shop in the Civil Engineering Squadron. The pesticide program involves routine and specific job order chemical application and spraying of pesticides. Pesticides are stored in Building 140 and 5081. Table IV-3 presents a list of the types of pesticides used, the pests controlled and the quantities of each chemical applied in a typical year.

Pesticides are used primarily for mosquito and other insect control, rodent control, tree protection and weed control purposes. Pesticides are applied directly as sprays in the air as fog, or to the ground in pellets.

d. Base Hospital and Laboratory Operations

Wurtsmith AFB operates a 20-bed composite medical facility which provides clinical and dental services to base personnel. Toxic materials are used in the Dental Clinic. Mercury is reused. Acetone, MEK, formaldehyde and

TABLE IV-3. PESTICIDES USED BY ENTOMOLOGY SHOP, WURTSMITH AFB

Trade Name	Pest Controlled	Quantity Used (Pounds) 10/01/83 to 12/31/83	01/01/84 to 03/31/84	04/01/84 to 06/30/84	07/01/84 to 09/30/84	Annual Total
Baygon	Cockroach/Ants	12	9	15	11	47
Onatorgin	Cockroach/Wasps/Bees	4	3	3	8	18
Oorgphosp	Fleas	3	-	-	-	3
Alphos	Gophers	1	-	-	-	1
Anticoagu	Mice	-	3	-	-	3
Malathion	Mosquitoes/Defoljusu	-	-	60	160	220
Ochemcomp	Fibfabani/Fleas	-	-	1	3	4
24D	Broadleaf	-	-	30	-	30
Simazine	Mixed	-	-	-	3	3

Source: Wurtsmith AFB Pesticide Quarterly Reports.

various alcohols are consumed in-process. Spent fixer and developer solutions from the hospital X-ray laboratory are collected and sold for silver recovery. All other hospital wastes are disposed of in the sanitary sewer.

2. Description of Waste Disposal Methods

Wurtsmith AFB has used a variety of disposal methods for wastes since World War II. Table IV-4 presents the shops that generate hazardous wastes, waste quantities, and disposal method timelines. A detailed analysis of individual sites is provided in Part B of Section IV.

Refuse generated at Wurtsmith AFB includes paper, garbage, glass, metal, and other components of general municipal refuse. Refuse was disposed of on base in sanitary landfills from 1949 to October, 1979. Seven different landfill areas have been used.

Construction debris consisting of wood, concrete, asphalt, wire, etc., and ashes from an old coal-fired heating plant were disposed of at several landfill sites. However, most of these wastes were disposed at one particular landfill. Currently, refuse is deposited in dumpsters located throughout the base and is contract hauled to a landfill site off-base. Small amounts of hazardous wastes probably were disposed of in the landfills over the history of the base. Two tank trailers buried in one of the landfills from 1971 to 1979 held waste solvents and oils. Analytical data from a U.S. Geological Survey study and interviews with base personnel indicate that spillage around the tank trailers occurred. Also, interviews with present and former base personnel revealed that occasionally spent solvents, paint thinner, and waste paints were dumped in the landfills in small quantities.

Since the late 1970's most hazardous wastes generated by Wurtsmith AFB have been stored on-site at the various shop locations until disposed of or recycled off-base by a hazardous waste contractor. Wastes consisting of spent solvents, cleaners, oils, thinners, etc., are stored in 55-gallon drums, slop waste tanks, and bowzers at the shops. Drums and bowzers are stored both

TABLE IV-4. INDUSTRIAL OPERATIONS (SHOPS) ASSOCIATED WASTES AND DISPOSAL METHODS, WURTSMITH AFB

Shop Name	Location (Bldg. No.)	Waste Material	Annual Waste Quantity	Method(s) of Treatment, Storage, and Disposal (1940 / 1950 / 1960 / 1970 / 1980)
379th BMW				
Avionics Maint. Sq.				
Electronic Countermeasure	5008	PD680 (Stoddards Solvent) Silicone Damping Fluid	25 gal 240 gal	OBCR (estimated) → OBCR → DPDO
Fire Control	5008	Trichloroethylene (TCE)	150-300 gal	OBCR → DPDO
		Bore Cleaner Solvent MIL C372	50 gal 100 gal	OBCR (estimated) → OBCR → DPDO
Field Maint. Sq.				
Age	5009	PD680 Engine Oils (Turbine)	500-1,200 gal 500-1,500 gal	OBCR (estimated) → OBCR → DPDO
		Hydraulic Oil Carbon RMV Compound	100 gal 600 gal	OBCR (estimated)
Corrosion Control	5066	Methyl Ethyl Ketone (MEK) Toluene PD680 Carbon RMV Compound Paints/Thinners	300-500 gal 300-500 gal 1,200-2,000 gal 300 gal 500-1,500 gal	OBCR (estimated) → OBCR → DPDO

KEY:

--------------- Estimated time frame data by shop personnel.

_______________ Confirmed time frame data by shop personnel.

NOTE: Activity locations may have changed over life of waste generation.

OBCR - Off-base Contract Removal
DPDO - Defense Property Disposal Office
FPTA - Fire Protection Training Area

(1) - Recycled on base.

(2) - Material turned into DPDO on one time basis as excess.

(3) - Landfilled.

(4) - Fuel filters aged 30-60 days at landfills then disposed of as waste in landfill.

(5) - Drained to ground.

TABLE IV-4. INDUSTRIAL OPERATIONS (SHOPS) ASSOCIATED WASTES AND DISPOSAL METHODS, WURTSMITH AFB (Continued)

Shop Name	Location (Bldg. No.)	Waste Material	Annual Waste Quantity	Method(s) of Treatment, Storage, and Disposal (1940 – 1950 – 1960 – 1970 – 1980)
Field Maint. Sq. (Cont.)				
Environmental Systems	5008	Tricresyl Phosphate Vacuum Oil	5-10 gal 5-10 gal	OBCR (estimated) → OBCR → DPDO
Non-Destructive Insp.	5008	Methyl Isobutyl Ketone (MIBK) Fluorescent Penetrant/Emulsifier	15-20 gal 100 gal	OBCR (estimated) → OBCR → DPDO
Pneudraulics	5008	PD680 Hydraulic Fluid	600 gal 600 gal	OBCR (estimated) → OBCR → DPDO
Propulsion Branch	43	TCE	120 gal	OBCR (estimated)
		PD680 Synthetic Lubricating Oil Fingerprint Remover Engine Oils	720 gal 110 gal 60 gal 300-500 gal	OBCR (estimated) → OBCR → DPDO
		Carbon RMV Compound	5-10 gal	OBCR (estimated)
Survival Equipment	5008	Lubricating Oil	5-10 gal	OBCR (estimated) → OBCR → DPDO
Test Cell	5098	PD680 JP-4, Engine Oil, Lub. Oil & Hydraulic Fluid	120 gal 220 gal	OBCR (estimated) → OBCR → DPDO

KEY:

--------------- Estimated time frame data by shop personnel.

_______________ Confirmed time frame data by shop personnel.

NOTE: Activity locations may have changed over life of waste generation.

OBCR - Off-base Contract Removal
DPDO - Defense Property Disposal Office
FPTA - Fire Protection Training Area

(1) - Recycled on base.

(2) - Material turned into DPDO on one time basis as excess.

(3) - Landfilled.

(4) - Fuel filters aged 30-60 days at landfills then disposed of as waste in landfill.

(5) - Drained to ground.

TABLE IV-4. INDUSTRIAL OPERATIONS (SHOPS) ASSOCIATED WASTES AND DISPOSAL METHODS, WURTSMITH AFB (Continued)

Shop Name	Location (Bldg. No.)	Waste Material	Annual Waste Quantity	Method(s) of Treatment, Storage, and Disposal | 1940 | 1950 | 1960 | 1970 | 1980 |
Wheel and Tire	5067	PD680 Paint Stripper Hydraulic Fluid	1,000-2,000 gal 300-500 gal 75 gal	| OBCR (est.) | OBCR | DPDO →
Munitions Maint. Sq.				
Equipment Maint.	5043, 5045	PD680 Hydraulic Fluid Brake Fluid Paint Remover	300-500 gal 500-1,000 gal 20-100 gal 40 gal	| OBCR (est.) | OBCR | DPDO →
Munitions Maint.	5109	Solvents/Thinners	110 gal	| OBCR (est.) | OBCR | DPDO →
Organizational Maint. Sq.				
Non-Powered Age	5067	PD680 Paints/Thinners	120 gal 45 gal	| OBCR (est.) | OBCR | DPDO →
Tanker Phase	5060	Engine Oils	240 gal	| OBCR (est.) | OBCR | DPDO →
		JP-4	6,000-10,000 gal	| OBCR (est.) | | (1) →
Transient Maint.	5067	Hydraulic Fluid	120 gal	| OBCR (est.) | OBCR | DPDO →

KEY:

--------------- Estimated time frame data by shop personnel.

_______________ Confirmed time frame data by shop personnel.

NOTE: Activity locations may have changed over life of waste generation.

OBCR - Off-base Contract Removal
DPDO - Defense Property Disposal Office
FPTA - Fire Protection Training Area

(1) - Recycled on base.

(2) - Material turned into DPDO on one time basis as excess.

(3) - Landfilled.

(4) - Fuel filters aged 30-60 days at landfills then disposed of as waste in landfill.

(5) - Drained to ground.

TABLE IV-4. INDUSTRIAL OPERATIONS (SHOPS) ASSOCIATED WASTES AND DISPOSAL METHODS, WURTSMITH AFB (Continued)

Shop Name	Location (Bldg. No.)	Waste Material	Annual Waste Quantity	Method(s) of Treatment, Storage, and Disposal (1940 | 1950 | 1960 | 1970 | 1980)
379 CSG				
Civil Engineering				
Entomology	140	Chlordane Dieldrin Naled	5 gal 45 gal 45 gal	(2)
Exterior Electric	385	PCB Transformer Oil	1-2 gal	OBCR - - - - | DPDO →
Heat Plant	305	FS-6 and Solvent 140 Mixture	220 gal	OBCR - - - - | OBCR | DPDO →
Heat Shop	288	Ethylene Glycol	100-300 gal	OBCR - - - - | OBCR | DPDO →
		Asbestos	Varies	- - - - (3) - - - - →

KEY:

--------------- Estimated time frame data by shop personnel.

_______________ Confirmed time frame data by shop personnel.

NOTE: Activity locations may have changed over life of waste generation.

OBCR - Off-base Contract Removal
DPDO - Defense Property Disposal Office
FPTA - Fire Protection Training Area

(1) - Recycled on base.

(2) - Material turned into DPDO on one time basis as excess.

(3) - Landfilled.

(4) - Fuel filters aged 30-60 days at landfills then disposed of as waste in landfill.

(5) - Drained to ground.

TABLE IV-4. INDUSTRIAL OPERATIONS (SHOPS) ASSOCIATED WASTES AND DISPOSAL METHODS, WURTSMITH AFB (Continued)

Shop Name	Location (Bldg. No.)	Waste Material	Annual Waste Quantity	Method(s) of Treatment, Storage, and Disposal (1940 | 1950 | 1960 | 1970 | 1980)
Civil Engineering (Cont.)				
Liquid Fuels Mgt.	25	Fuel Filters	150 filters	(4) ----- | (4) | FPTA →
		JP-4 Sludge MOGAS Sludge	150-300 gal 75 gal	(3) ----- | OBCR | DPDO →
		Antifreeze	30 gal	(5) ----- | DPDO →
		Asbestos	Varies	(3) -----→
		Fuels (JP-4, MOGAS and Diesel)	325 gal	OBCR ----- | OBCR | DPDO →
Paint Shop	290	Paints and Thinners	100-200 gal	OBCR ----- | OBCR | DPDO →
Pavements and Grounds	140	Toluene	10-50 gal	OBCR ----- | |
		Oils and Hydraulic Fluid Diesel Fuel/Gas Mixture Antifreeze Denatured Alcohol	1,000-2,000 gal 110 gal 500 gal 110 gal	OBCR ----- | OBCR | DPDO →

KEY:

--------------- Estimated time frame data by shop personnel.

_______________ Confirmed time frame data by shop personnel.

NOTE: Activity locations may have changed over life of waste generation.

OBCR - Off-base Contract Removal
DPDO - Defense Property Disposal Office
FPTA - Fire Protection Training Area

(1) - Recycled on base.

(2) - Material turned into DPDO on one time basis as excess.

(3) - Landfilled.

(4) - Fuel filters aged 30-60 days at landfills then disposed of as waste in landfill.

(5) - Drained to ground.

TABLE IV-4. INDUSTRIAL OPERATIONS (SHOPS) ASSOCIATED WASTES AND DISPOSAL METHODS, WURTSMITH AFB (Continued)

Shop Name	Location (Bldg. No.)	Waste Material	Annual Waste Quantity	Method(s) of Treatment, Storage, and Disposal (1940 | 1950 | 1960 | 1970 | 1980)
Civil Engineering (Cont.)				
Power Production	385	Lube Oil Fuel Oil/Gas Mixture Solvents/Thinners Antifreeze	300-500 gal 220 gal 110 gal 200 gal	OBCR --- | OBCR | DPDO →
Refrigeration	290	Oil	200 gal	OBCR --- | OBCR | DPDO →
Fuels Distribution	361, 5073, 5075	JP-4	8,000 gal	OBCR --- | OBCR | FPTA →
		Diesel MOGAS	220 gal 80 gal	OBCR --- | OBCR | DPDO →
Morale, Welfare and Recreation				
Auto Hobby Shop	388	Engine Oils, Antifreeze and Hydraulic Fluid Solvent Cleaning Compound	1,500 gal 165 gal 495 gal	OBCR --- | OBCR | DPDO →

KEY:

--------------- Estimated time frame data by shop personnel.

_______________ Confirmed time frame data by shop personnel.

NOTE: Activity locations may have changed over life of waste generation.

OBCR - Off-base Contract Removal
DPDO - Defense Property Disposal Office
FPTA - Fire Protection Training Area

(1) - Recycled on base.

(2) - Material turned into DPDO on one time basis as excess.

(3) - Landfilled.

(4) - Fuel filters aged 30-60 days at landfills then disposed of as waste in landfill.

(5) - Drained to ground.

TABLE IV-4. INDUSTRIAL OPERATIONS (SHOPS) ASSOCIATED WASTES AND DISPOSAL METHODS, WURTSMITH AFB (Continued)

Shop Name	Location (Bldg. No.)	Waste Material	Annual Waste Quantity	Method(s) of Treatment, Storage, and Disposal (1940 | 1950 | 1960 | 1970 | 1980)
Morale, Welfare and Recreation (Cont.)				
Military Gas Station	460	Oils, Gas, Etc.	1,000 gal	OBCR (estimated) → OBCR → DPDO
Transportation Sq.				
Fire Dept. Maint.	16	PD680	220 gal	(estimated) → OBCR → DPDO
General Repair Shop	394	PD680 Engine Oil Transmission Fluid Antifreeze	25 gal 360 gal 120 gal 120 gal	OBCR (estimated) → OBCR → DPDO
Heavy Equip. Maint.	140	PD680 Hydraulic Fluid Brake Fluid Oils	110 gal 300 gal 24 gal 1,500-3,000 gal	OBCR (estimated) → OBCR → DPDO
Minor Maint.	394	Oils Antifreeze Transmission Fluid PD680	1,500-2,400 gal 300 gal 240 gal 110 gal	OBCR (estimated) → OBCR → DPDO

KEY:

---------------- Estimated time frame data by shop personnel.

________________ Confirmed time frame data by shop personnel.

NOTE: Activity locations may have changed over life of waste generation.

OBCR - Off-base Contract Removal
DPDO - Defense Property Disposal Office
FPTA - Fire Protection Training Area

(1) - Recycled on base.

(2) - Material turned into DPDO on one time basis as excess.

(3) - Landfilled.

(4) - Fuel filters aged 30-60 days at landfills then disposed of as waste in landfill.

(5) - Drained to ground.

TABLE IV-4. INDUSTRIAL OPERATIONS (SHOPS) ASSOCIATED WASTES AND DISPOSAL METHODS, WURTSMITH AFB (Continued)

Shop Name	Location (Bldg. No.)	Waste Material	Annual Waste Quantity	Method(s) of Treatment, Storage, and Disposal (1940 | 1950 | 1960 | 1970 | 1980)
Transportation Sq. (Cont.)				
Refueling Maint.	393	PD680 JP-4, Gas Mixture	120 gal 1,500 gal	OBCR (est., 1960–1970) | OBCR (1970s) | DPDO →
Special Purpose Maint.	395	PD680 Antifreeze Hydraulic Fluid Brake Fluid Transmission Fluid Engine Oils Paint/Thinners	110 gal 600 gal 600 gal 2 gal 600 gal 4,400 gal 50 gal	OBCR (est., 1960–1970) | OBCR (1970s) | DPDO →

KEY:

--------------- Estimated time frame data by shop personnel.

_______________ Confirmed time frame data by shop personnel.

NOTE: Activity locations may have changed over life of waste generation.

OBCR - Off-base Contract Removal
DPDO - Defense Property Disposal Office
FPTA - Fire Protection Training Area

(1) - Recycled on base.

(2) - Material turned into DPDO on one time basis as excess.

(3) - Landfilled.

(4) - Fuel filters aged 30-60 days at landfills then disposed of as waste in landfill.

(5) - Drained to ground.

outside and inside the buildings. The storage containers are usually set on pallets or racks, either on concrete or asphalt slabs or on the ground. Several exterior storage areas are diked and covered. The private contractor pumps the waste from the containers at each storage site. Contractor disposal of wastes was administered by Civil Engineering through 1983. Currently, DPDO handles this practice.

Spills were cleaned up with absorbent material or rags, depending on the spill size. Spent absorbents and rags were disposed in the dumpsters. Occasionally, spills may have been washed onto the ground or into the drain system. Some facilities are equipped with oil/water separators to remove oily wastes before discharge to sanitary sewers. These are listed in Appendix E.

In wintertime, plane deicing fluid runs off with snowmelt and enters drainage systems or flows to the ground. In the past, small quantities of waste solvents and oils were occasionally dumped outside shop facilities and behind the blast fences at the SAC Operational Apron.

Sanitary sewers are used for disposal of small quantities of wastes at some shops. Caustics and acids are neutralized and washed into sanitary drains. Hospital laboratory wastes are also disposed of in the sanitary sewer. Wastes from spent photographic solutions in the hospital, e.g., X-ray, dental clinic wastes, and other base photographic facilities are collected and sold for silver recovery. The hospital operates its own incinerator which is used primarily for the destruction of pathological tissues and cultures. A second incinerator existed on base and was used only for the disposal of classified documents.

The base wastewater treatment plant treats wastes collected by the sanitary sewer system. The treatment plant consists of three aeration lagoons in series and eight seepage lagoons (ground application). The wastewater treatment plant is discussed in greater detail in Section IV.B.c and d.

Some other hazardous or potentially hazardous materials are recycled or reused on the station. Pesticides are mixed in small quantities and any leftover material is kept for subsequent use. Some waste fuels are filtered and reused in heaters and power units. Fire training exercises provide a means of disposal for jet fuel. Two fire training areas were identified in the review of base records and in interviews with base personnel. Only one of these (located south of the center of the SAC Instrument Runway) remains active, using waste JP-4.

Prior to the 1970's, hazardous wastes were probably disposed of using techniques similar to those currently employed. Interviews with base personnel and review of base records failed to identify consistent methods of hazardous waste disposal. Some incidents recounted by the interviewees could not be verified by other independent sources. This was due in part to the lack of environmental awareness among base personnel during this period as well as the absence of waste disposal records. Some contract hauling was practiced, but landfilling was the predominant method of waste disposal. Some of the wastes were dumped onto the ground or into sanitary and storm sewer systems.

B. Disposal Site Identification, Evaluation, and Hazard Assessment

As a result of Phase I activities at Wurtsmith AFB, Port Austin AFS, Empire AFS and Bayshore AFS, 31 sites/areas of potential environmental concern were evaluated. The sites have been divided into five major groupings:

- Landfill sites,
- Fire training areas,
- Hazardous material storage and hazardous waste accumulation sites,
- Chemical spill sites, and
- Miscellaneous sites.

In the following sections, each of the sites is described in greater detail. Based on the information available, a determination of the potential for hazardous chemical migration from the site was made. Those sites determined to pose a potential threat to human health and the environment via migration of hazardous constituents resulting from past operations were analyzed using the Hazard Assessment Rating Methodology (HARM). The Decision Tree logic used to determine whether each site should proceed to the HARM rating step is outlined in Table IV-5.

Screening of the original 31 sites resulted in 15 sites progressing to the HARM model ranking step. These sites, along with their HARM scores, are listed in Table V-1 (Conclusions). The remaining sites, though they were determined to require no further study in their present condition, still represent potential environmental concerns. If future activities will disrupt any of these sites, their potential for environmental impact should be reevaluated in light of planned activities.

Selection of sites was aided by detailed information and analytical data characterizing known major spills obtained from a U.S. Geological Survey (USGS) study of ground water at Wurtsmith AFB. The USGS, at the request of the USAF, began an investigation of geologic and hydrologic conditions at the base in September 1979. The investigation resulted in the discovery of a number of incidents of ground-water contamination. The findings of USGS are reported in Ground-water Contamination at Wurtsmith Air Force Base, Michigan (1983). This investigation will hereafter be referred to as "the USGS study." The USGS analytical data are contained in Appendix F.

1. Landfill Areas

Throughout its history, Wurtsmith AFB has used seven different areas on base for surface disposal of solid and liquid wastes. The locations of all landfills identified in this study are shown on Figure IV-1. The sites are described briefly in Table IV-6.

TABLE IV-5. SUMMARY OF DECISION TREE LOGIC FOR ALL SITES IDENTIFIED IN THE WURTSMITH AFB PHASE I STUDY

Site Number	Description	Potential for Contamination by Hazardous or Toxic Materials	Potential for Contaminant Migration	Rate Using HARM
D-1	Landfill, east of SAC Alert Apron	No	No	No
D-2	Landfill, south of the center of SAC Instrument Runway	No	No	No
D-3	Landfill, southeast of POL Bulk Storage	No	No	No
D-4	Landfill, east of eastern SAC Runway overrun	No	No	No
D-5	Landfill, northern area of SAC Alert Apron	No	No	No
D-6	Landfill, northern (Perimeter Road) area	Yes	Yes	Yes
D-7	Landfill, south-southwest of DPDO	No	No	No
FT-1	Inactive fire training area	Yes	Yes	Yes
FT-2	Active fire training area	Yes	Yes	Yes
SP-1	TCE spill, northeast of Bldg. 43	Yes	Yes	No*
SP-2	TCE spill, southwest of SAC Alert Apron	Yes	Yes	Yes
SP-3	Fuel spill, POL Bulk Storage area	Yes	Yes	Yes

TABLE IV-5. SUMMARY OF DECISION TREE LOGIC FOR ALL SITES IDENTIFIED IN THE WURTSMITH AFB PHASE I STUDY (Continued)

Site Number	Description	Potential for Contamination by Hazardous or Toxic Materials	Potential for Contaminant Migration	Rate Using HARM
SP-4	JP-4 spill, Bldg. 393 (motor pool) area	No	No	No
SP-5	TCE spill, northwest base housing area	Yes	Yes	Yes
SP-6	JP-4 spill, Test Cell area (Bldg. 5001)	No	No	No
SP-7	TCE and fuel spill, SAC Nose Dock and Operational Apron area	Yes	Yes	Yes
SP-8	JP-4 spill, center of SAC Instrument Runway	Yes	Yes	Yes
SP-9	JP-4 spill, northeast end of SAC Instrument Runway	Yes	Yes	Yes
SP-10	JP-4 spill, southwest end of SAC Instrument Runway	Yes	Yes	Yes
SP-11	JP-4 spill, southwest to south-central part of SAC Taxiway	Yes	Yes	Yes
SP-12	MOGAS spill, Bldg. 394 (motor pool) area	Yes	Yes	Yes
SP-13	JP-4 spill, southwest of Bldg. 43	Yes	Yes	No*

TABLE IV-5. SUMMARY OF DECISION TREE LOGIC FOR ALL SITES IDENTIFIED IN THE WURTSMITH AFB PHASE I STUDY (Continued)

Site Number	Description	Potential for Contamination by Hazardous or Toxic Materials	Potential for Contaminant Migration	Rate Using HARM
SP-14	JP-4 spill, southwest of Bldg. 3029	Yes	Yes	Yes
SP-15	Fuel oil spill, near Bldg. 25	Yes	Yes	No*
SP-16	Pesticide spill, near Bldg. 140	Yes	No	No
SP-17	Fuel spill, in power plant at Port Austin AFS	Yes	Yes	Yes
SP-18	PCB spill, Port Austin AFS	No	No	No
SB-1	Inactive waste treatment plant sludge drying beds	Yes	Yes	Yes
SI-1	Surface impoundment, aeration lagoons	No	No	No
SI-2	Surface impoundment, seepage lagoons	No	No	No
SS-1	Sludge spreading area	Yes	No	No

*This site would normally receive a HARM rating. However, clean-up activities are already underway so the site was not rated. See the text for additional information.

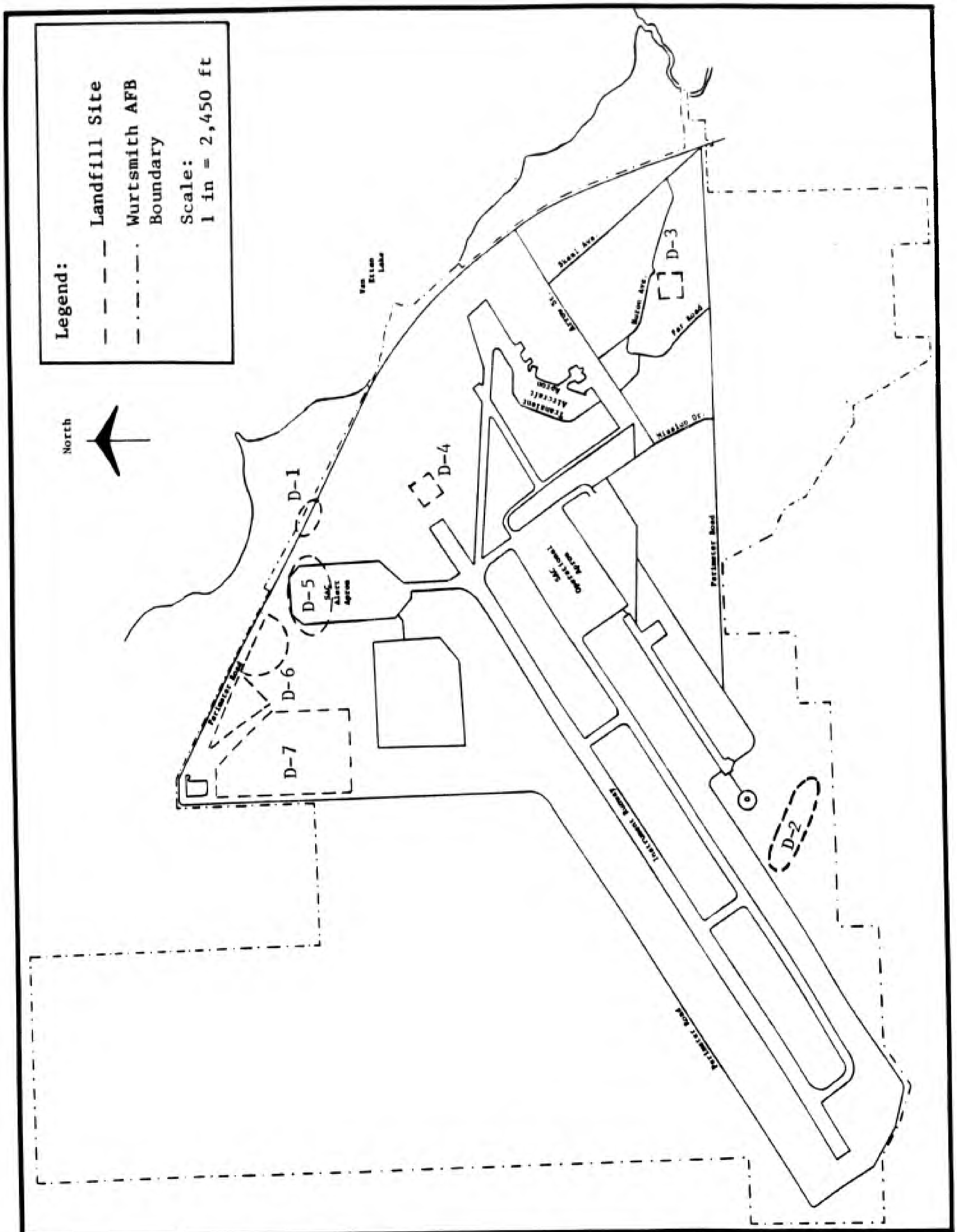


Figure IV-1. Locations of Landfill Areas, Wurtsmith AFB, Michigan

Table IV-6. IDENTIFIED AREAS OF POTENTIAL ENVIRONMENTAL CONTAMINATION FROM LANDFILLS AT WURTSMITH AFB, MICHIGAN

Site Number	Description	Site Status*
D-1	Landfill, east of SAC Alert Apron (1949-1951)	I
D-2	Landfill, south of the center of SAC runway (1950-1972)	I
D-3	Landfill, southeast of POL Bulk Storage (1951-1953)	I
D-4	Landfill, east of eastern SAC runway overrun (1953-1958)	I
D-5	Landfill, northern area of SAC Alert Apron (1958-1959)	I
D-6	Landfill, northern (Perimeter Road) area (1960-1973)	I
D-7	Landfill, south-southwest of DPDO (1973-1979)	I

* I = inactive

The types of wastes which have been landfilled or landspread are very diverse. However, to facilitate characterization of individual sites, the following broad classification of waste types may be used:

Construction wastes - consist of asphalt, concrete, and demolition rubble. A potentially hazardous component, asbestos, should not be a problem unless disturbed.

Domestic wastes - consist of paper, cans, glass, and other miscellaneous trash. Although hazardous materials may be included, they should be in minute quantities and constitute limited problems. A potential problem could be the formation of methane and hydrogen sulfide from the anaerobic decomposition of materials, particularly if garbage is present.

Industrial wastes - consist of spent acids, bases, pesticides, solvents, fuels and oils. Many of these materials are hazardous and have the potential for migration.

a. Site D-1 Landfill, East of SAC Alert Apron

This landfill site is located due east of the SAC Alert Apron. It was operated from 1949 until 1951. The only wastes dumped at this site were wood, coal ashes, broken concrete, and some vehicle parts. Analytical data from USGS samples taken in the area show no contamination.

Since there is no information or evidence of environmental contamination at this site, Site D-1 was not rated using the HARM model.

b. Site D-2 Landfill, South of the Center of the SAC Instrument Runway

The site is located in the central southern base area adjacent to a marshy area which discharges to creeks feeding to the Au Sable River. The site, which covers approximately 6.5 acres, was active from 1950 to 1972. Coal ash and landfill material generated during disposal and construction projects are the principal known wastes. Most of the landfill consisted of coal ash from a coal-fired central heating plant. Concrete, asphalt, wood, and metal from construction and base clean-up efforts made up another portion.

This site was not rated using HARM since all available evidence suggests that no hazardous wastes were disposed of at this site. There are no environmental concerns for this site since concrete, wood, asphalt, etc. are generally considered innocuous.

c. Site D-3 Landfill, Southeast of POL Bulk Storage

From 1951 to 1953, domestic waste from the base residential area was buried in an approximately 0.6-acre area in the southeastern part of the base. The waste also included wood debris, automotive parts, and small quantities of oils and solvents. However, no documentation was found that identified the types and quantities of oils and solvents discarded.

A shallow observation well at this site was sampled by the USGS in 1980. Sample results indicated no groundwater contamination. For these reasons, the site is not considered a hazardous waste disposal area and does not require a HARM rating.

d. Site D-4 Landfill, East of Eastern SAC Runway Overrun

The site is a one-acre area due east of the SAC Instrument Runway and received both domestic and industrial wastes. This landfill was operated from 1953 until 1958. Drums of various liquid organic materials and solvents were disposed of in the landfill, although the specific chemicals and quantities are not known. The fill material was spread in trenches, then burned and compacted daily. Documented sample results from a USGS shallow well at this site indicate no ground-water contamination (USGS Ground-water Contamination report, 1983).

Since environmental contamination at this site is undocumented, Site D-4 was not rated using the HARM model.

e. Site D-5 Landfill, Northern Area of SAC Alert Apron

A disposal area existed from 1958 to 1959 at the northern area of the current SAC Alert Apron. The site received mostly domestic wastes with some base cleanup refuse (metal, wood, asphalt, etc.) as well. Prior to construction of the Alert Apron, all material within the landfill and four feet below the trash line was excavated and removed. The relocation site for the fill is not certain. One interviewee reported that it was taken off-base. Another person stated that the fill was disposed in the landfill used for ashes and concrete (Site D-2). No written documentation of the relocation site was found during this records search.

Since the potential sources of hazardous waste contamination have been removed from the site, rating with the HARM model is not required.

f. Site D-6 Landfill, Northern (Perimeter Road) Area

A landfill site used from 1960 to 1973 is located in the north central area of the base. The site occupies approximately 25 to 30 acres. The landfill was a disposal site for domestic and industrial wastes (about 10 percent industrial waste based on a statement from a former base employee). The industrial wastes included drums of solvents, although most drums were turned over to DPDO. The refuse was buried in trenches approximately 10 feet wide by eight feet deep by 400 feet long. The trenches were dug to a depth just above the water table. Three feet clearance was left between trenches and the refuse was covered each night with three to four feet of dirt and sand. The landfill site is now covered with red pine trees (five to eight feet tall).

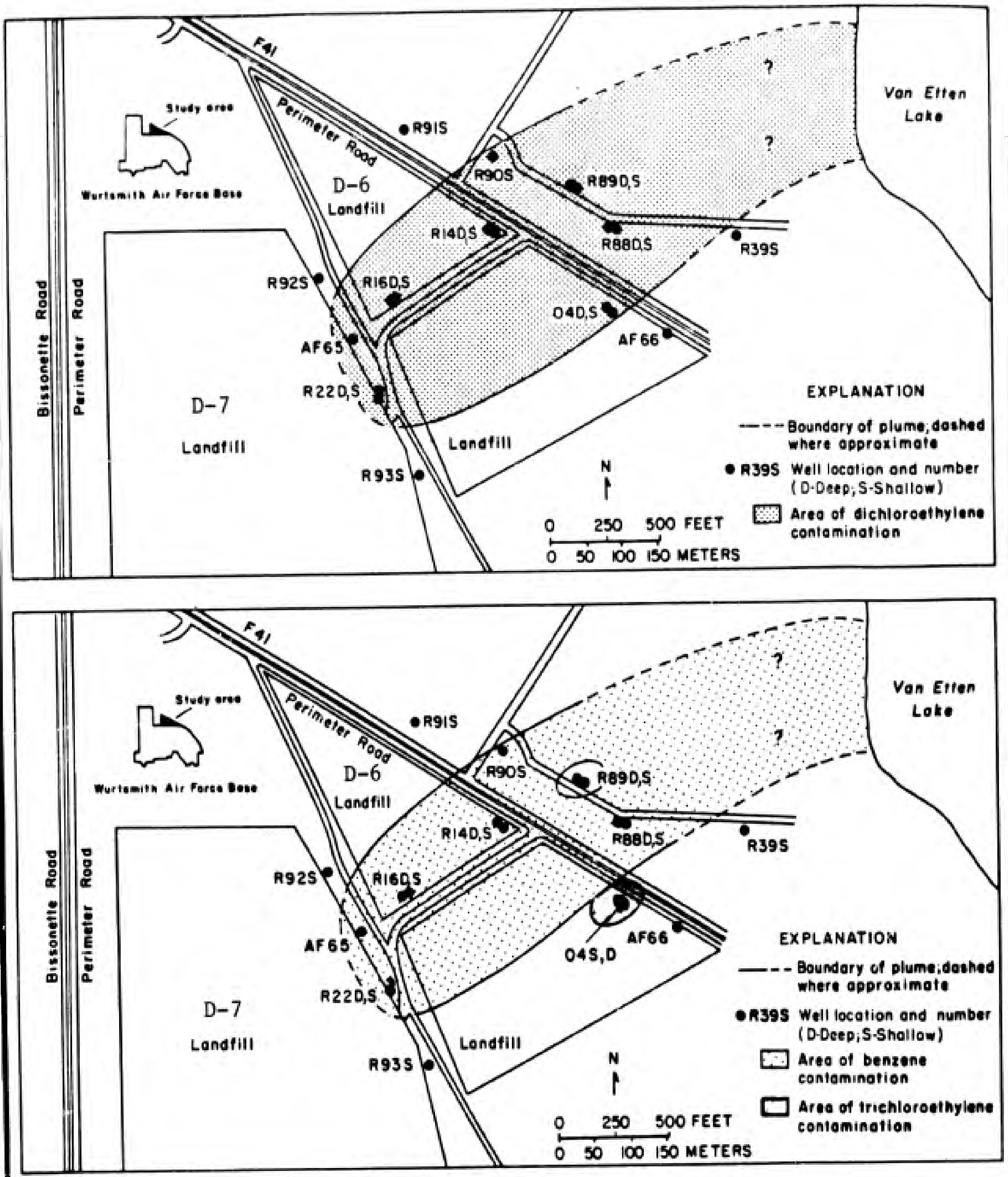
In 1971, two 6,000-gallon tank trailers were buried in the center of this site just north of the dirt access road that divides the landfill (Figure IV-2). The burial of the tank trailers was an attempt to establish a central solvent disposal area. Shop personnel emptied drums of wastes, including solvents, TCE, thinners, and oils, directly into the tanks. Periodically a contractor would pump out the tanks for disposal. Interviews with present and former base personnel indicate that spillage of wastes around the tanks was common. Personnel could not estimate the quantity of each waste spilled. The tank trailers were excavated and tested for leaks in 1979. No leaks were found.

The USGS studied the northern landfill area with the possibility that the landfills were a source of TCE found in well water near Pierce's Point (on Van Ettan Lake). TCE, dichloroethylene (DCE), and benzene were found in wells drilled in this area. Contaminant plume boundaries and monitoring well locations are shown in Figure IV-2. Based on the analytical data (Appendix F), the source of TCE seems to be in this landfill (Site D-6). The source of benzene and DCE is probably in the landfill area located south-southwest of DPDO (Site D-7).

Due to the confirmation of contamination and the reports of disposal and spillage of solvents at the site, Site D-6 was rated using the HARM model. The site received a HARM score of 80.

g. Site D-7 Landfill, South-southwest of DPDO

A 20 to 25 acre landfill was maintained from 1973 to October, 1979 south of the DPDO. This landfill was monitored for unauthorized wastes (solvents, oils, etc.) more closely than previous landfills. Operating procedures banned the dumping of sewage, drums, solvents, oils, and metal. However, some metal and paint cans did get buried according to base personnel. Hardfill, such as concrete and asphalt was also dumped and occasionally is



Source: U.S. Geological Survey Ground-water Contamination Report, 1983.

Figure IV-2. Dichloroethylene, Trichloroethylene, and Benzene in Wells in the Northern Landfill Area (Site D-6) still disposed of in this area. The most recently used area of the landfill was capped in 1982. The cap consists of two feet of ground cover over the waste, a 50-mil impervious cap, overlain by one foot of ground cover with grass. The landfill is unlined.

Since no evidence of environmental contamination was uncovered during the data review and in interviews, Site D-7 was not rated using the HARM model.

2. Fire Training Areas

Fire fighting experience is gained by having installation personnel routinely extinguish purposely set fires. These fires are started using waste fuel and other flammables from the base. Waste JP-4 is currently the material used. Waste solvents were also used in the past. Two fire training sites have been identified and are shown in Figure IV-3. The sites are discussed below along with typical fire training exercises conducted at each of the sites.

a. Site FT-1, Inactive Fire Training Area

From 1951 to 1958, a fire training area was located north-northwest of Building 60. Drums of waste fuel and solvents were poured on the ground and burned. A large fire used about 400 to 500 gallons of fuel. The fires were extinguished with water and foam.

Two water-supply wells, AF4 and AF5 are due east of this area, directly downgradient of this site. TCE was detected in water from both of these wells in late 1977 by USGS. USGS assumed that this contamination was attributable to a TCE spill that occurred near Building 43 (Site SP-1, discussed later in this section). However, it is believed that USGS was not aware of this fire training site in the area. Benzene was not detected in samples from AF4 and AF5 taken in December, 1979 and January 1980. Additional USGS wells in the area sampled in 1984 did not show any contamination.

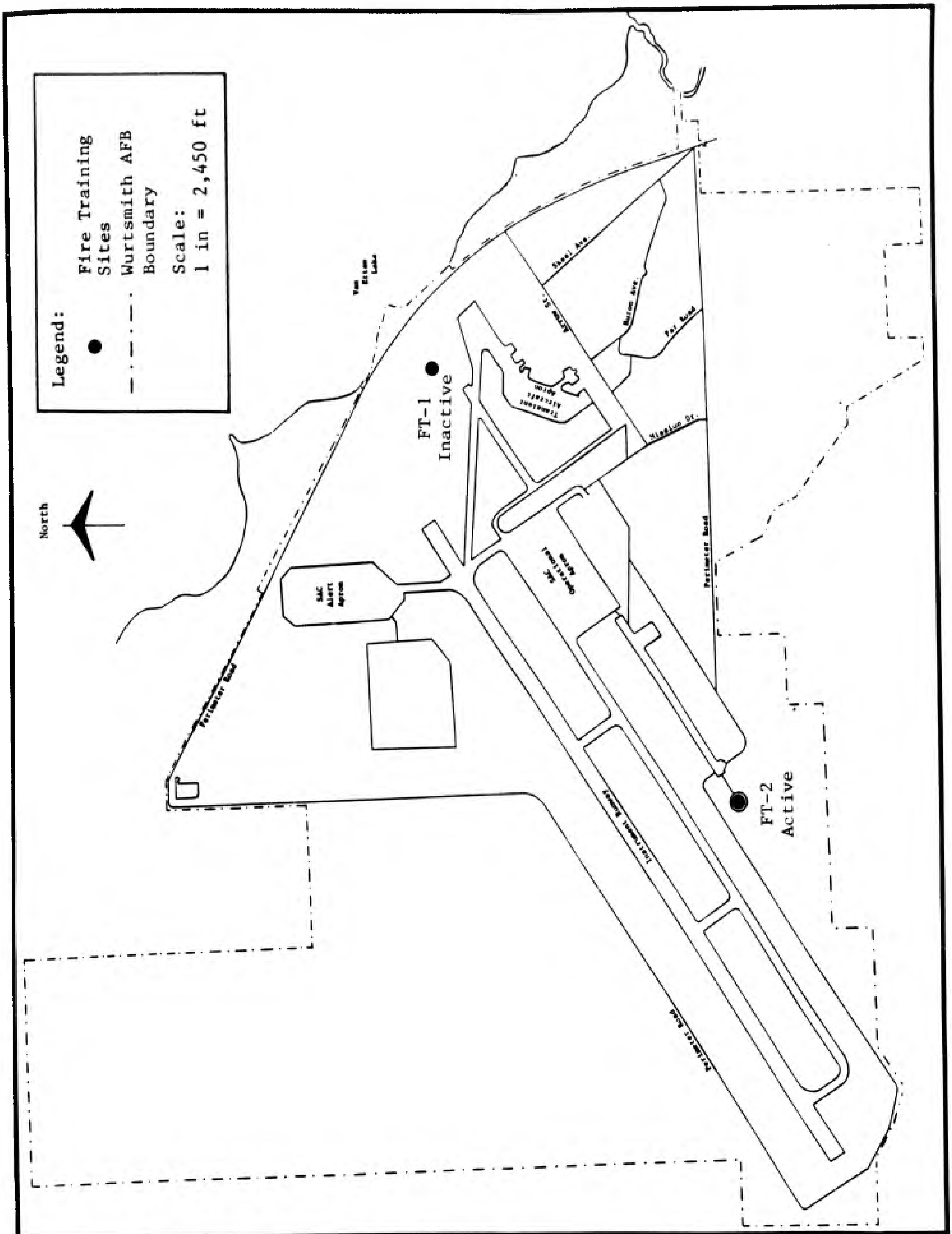


Figure IV-3. Locations of Fire Training Areas, Wurtsmith AFB, Michigan

This page left blank intentionally.

This site was rated using the HARM model because of the evidence of contamination with hazardous materials and their potential for migration into the subsurface water. The HARM score for this site is 61.

b. Site FT-2, Active Fire Training Area

The active fire training area is located south of the center of the SAC Instrument Runway since 1958. Prior to 1982, the area consisted of a gravel and dirt pit. Jet fuel from a tank truck was dumped in the pit and burned. Water, protein foam (mechanical foam), and bromochloromethane were typically used to extinguish the fires. Sometimes the fires would escape the pit and spread into a gully south of the training area. The unburned fuels and extinguishing agents would be allowed to evaporate, percolate into the ground, or run off. Fire training was held almost every weekend over a period of years.

In 1982, a concrete pit, sloped to the center, was constructed to contain training fires. The pit drains into a holding tank which discharges to a separator and skimmer. The aqueous phase is drained into the sanitary sewer system. The nonaqueous phase is pumped out and disposed off-base by a contractor. During a typical training exercise, 2,000 gallons of jet fuel is dumped on the concrete pad in old dumpsters to simulate an aircraft structure and is set on fire. The fire is extinguished with water and the fuel is allowed to rise to the surface of the water. The fuel is reignited and put out with water about four or five times before foam or dry chemical is used to finally extinguish the fire.

Chemicals currently used include aqueous film forming foam (AFFF), multipurpose dry chemical, a potassium bicarbonate based soda, and Halon 1211, a liquified gas that dissipates leaving no residue. Fire training is now conducted about once per month.

This site was rated using the HARM model since it is known to be a source of hazardous materials contamination and because of the potential for contaminant migration. The HARM score for this site is 71.

3. Hazardous Material Storage and Hazardous Waste Accumulation Sites

Four active hazardous material storage sites are located on Wurtsmith AFB. These sites are locations where new product drums are stored. Eleven active hazardous waste accumulation sites are located on Wurtsmith AFB. These sites are locations where spent product is accumulated in 55-gallon drums or bowsers to be turned in to DPDO. No leaks or spills were reported from any of these areas.

Wurtsmith AFB also maintains 78 POL tanks, 21 waste storage tanks, and numerous heating oil tanks in the housing areas (see Appendix E for tank inventory). No leaks or spills were reported from any of these areas.

Since no major spills were reported for any of these sites and no evidence of environmental contamination was uncovered during the data review and in interviews, none of these sites were rated using HARM.

4. Chemical Spill Sites

Small spills have occurred at various shops and facilities on Wurtsmith AFB. These spills are generally cleaned up quickly and do not have significant environmental impact. Typical of these are small shop spills which are wiped up with rags or absorbent material. Small spills can also be expected from routine engine maintenance, accidental overfilling of tanks, off-loading of fuel trucks and as a consequence of fuel expansion in the aircraft fuel tanks.

Eighteen large chemical spills were reported during interviews with base personnel. The locations of spill sites SP-1 through SP-17 are illustrated in Figures IV-4 and IV-4. The exact location of spill site SP-18

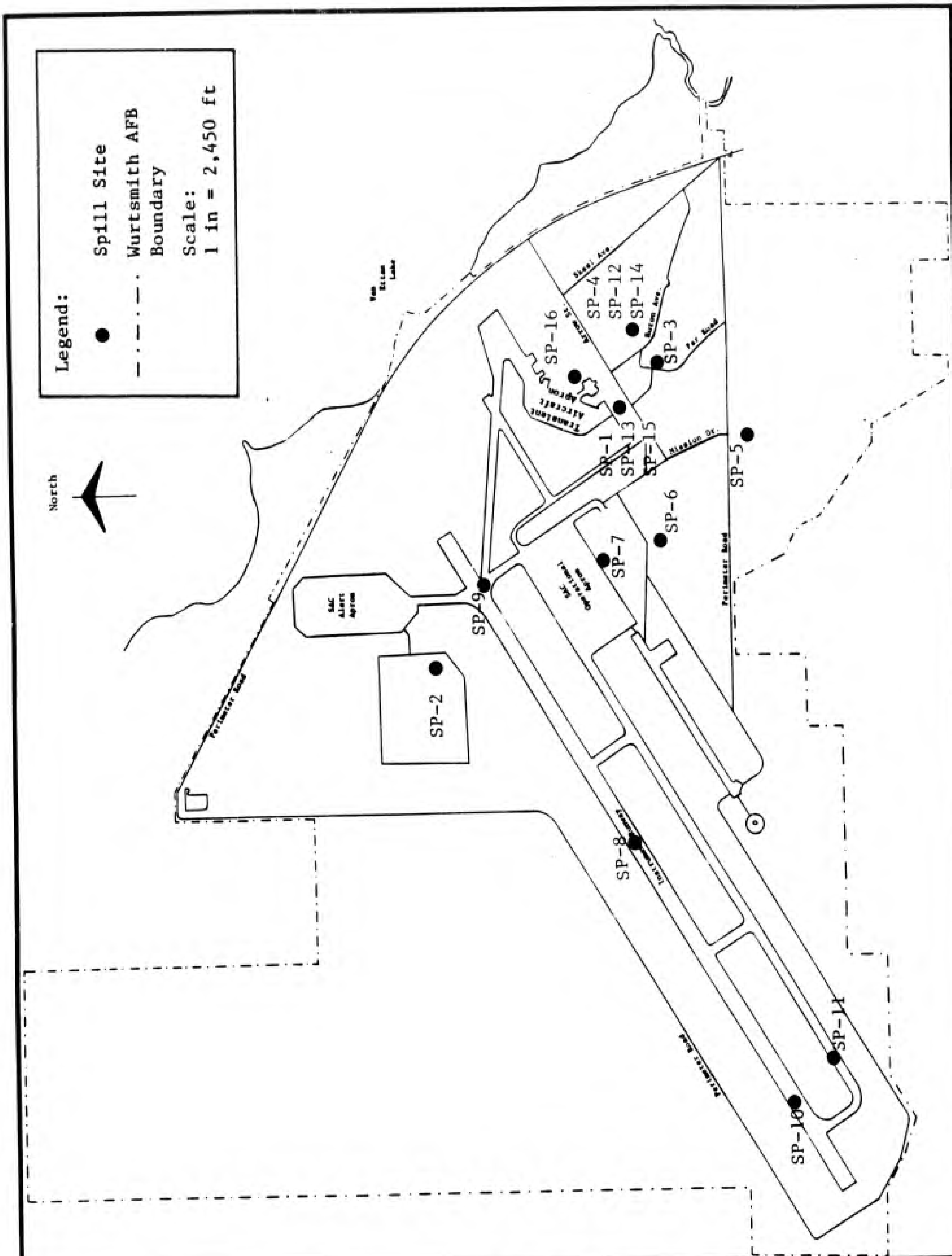
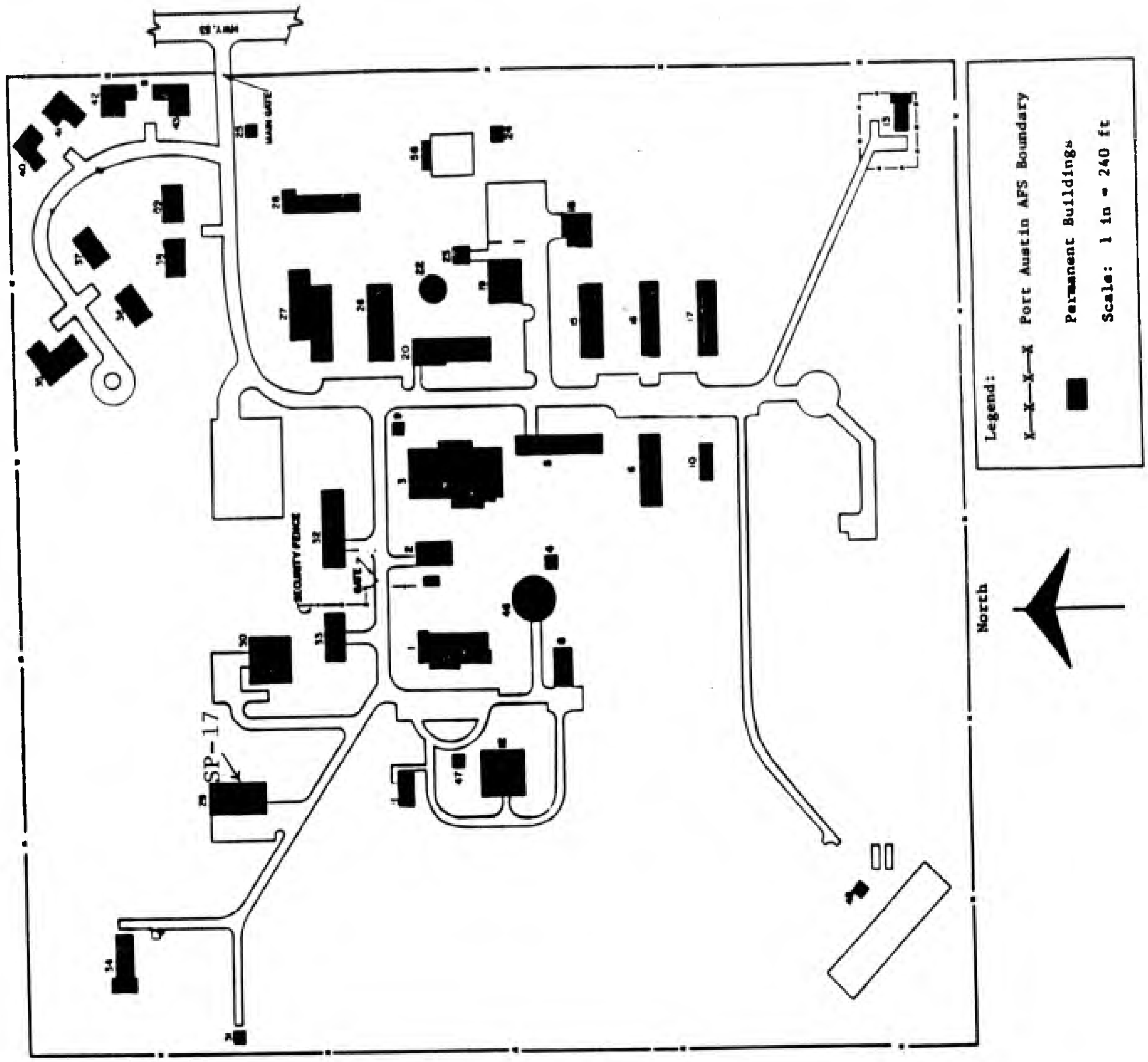
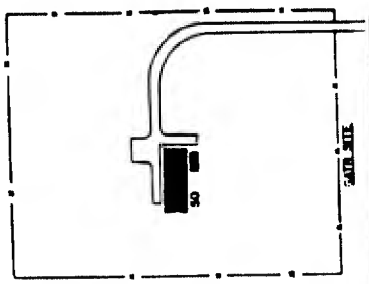


Figure IV-4. Locations of All Identified Spill Sites, Wurtsmith AFB, Michigan



Source: Port Austin AFS, Dwg. PTA-810-040, Revised May 1984



Source: Port Austin AFS, Dwg. PTA-810-040, Revised May, 1984.

Figure IV-5. Location of Fuel Spill at Port Austin AFS, Michigan

Table IV-7. IDENTIFIED AREAS OF POTENTIAL ENVIRONMENTAL CONTAMINATION FROM CHEMICAL SPILLS AT WURTSMITH AFB, MICHIGAN

Site Number	Description
SP-1	TCE spill, northeast of Building 43
SP-2	TCE spill, southwest of SAC Alert Apron
SP-3	Fuel spill, POL Bulk Storage area
SP-4	JP-4 spill, Building 393 (Motor Pool) area
SP-5	Fuel spill, northwest base housing area
SP-6	JP-4 spill, Test Cell area (Building 5001)
SP-7	TCE and fuel spill, SAC Nose Dock and Operational Apron area
SP-8	JP-4 spill, center of SAC Instrument Runway
SP-9	JP-4 spill, northeast end of SAC Instrument Runway
SP-10	JP-4 spill, southwest end of SAC Instrument Runway
SP-11	JP-4 spill, southwest to south-central part of Taxiway A
SP-12	MOGAS spill, Building 394 (Motor Pool) area
SP-13	JP-4 spill, southwest of Building 43
SP-14	JP-4 spill, southwest of Building 3029
SP-15	Fuel oil spill, near Building 25
SP-16	Pesticide spill, near Building 140
SP-17	Fuel spill, in power plant at Port Austin AFS
SP-18	PCB spill, Port Austin AFS

could not be determined. All of the spill sites are described briefly in Table IV-7.

a. Site SP-1, TCE Spill, Northeast of Building 43

A taste and odor problem was reported by base housing residents in October, 1977. Water samples were taken on Wurtsmith AFB and analyzed by the Occupational and Environmental Health Laboratory (OEHL) at Brooks AFB, Texas. The source of TCE contamination was discovered to be the Building 43 jet engine shop underground holding tank.

In 1962, a 500-gallon storage tank for waste TCE was installed underground just northeast of Building 43. The tank was pumped out for disposal by a contractor when it became filled. Base officials estimate that about 5,000 gallons of TCE may have been added to the tank from the time of installation until it was excavated in 1977. It is not known when the TCE first entered the ground water or how much TCE was removed from the tank, thus no estimate can be made of the amount of TCE that entered the ground water. When removed from the ground and tested, the tank itself did not leak, but a leak where the filler pipe joined the tank was found, suggesting that TCE may have escaped during times when the tank was filled or when TCE was added to or pumped from the tank.

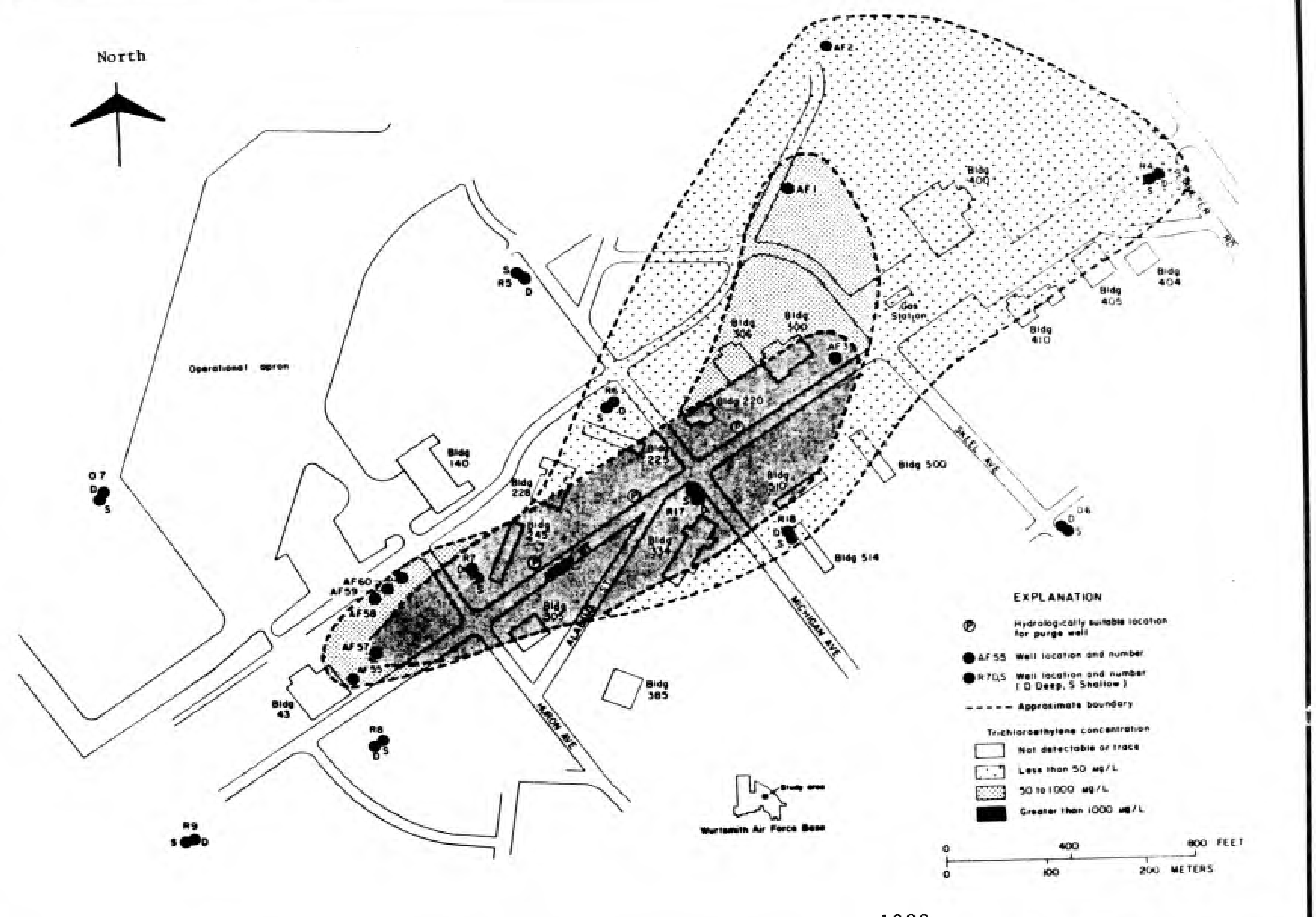
After discovery of TCE in base drinking wells in late 1977, the Air Force closed the affected wells and began purging the ground water by pumping the existing wells and new purge wells installed near Building 43. Concentrations of TCE as high as 46,800 μg/l were found in the purge well water. Purge water was aerated and discharged to the sanitary sewer. The sanitary wastes were treated in the base waste treatment plant, which provided primary and secondary treatment. The final effluent was discharged into seepage lagoons. In 1979, an activated carbon filtration system was installed to reduce the TCE levels. Effluent from the activated carbon system was discharged to the sanitary sewer until 1981 when the Michigan Department of Natural Resources (MDNR) issued a direct discharge permit allowing the effluent to be discharged to the storm sewer.

The USAF contracted with the U.S. Geological Survey (USGS) in 1979 to conduct a hydrological study of Wurtsmith AFB. USGS characterized the TCE plume (Figures IV-6 and IV-7) and recommended a revised purge plan. The Air Force installed a new activated carbon filtration system and an air stripping system. In 1981, discharge from the activated carbon system to a storm sewer was permitted by MDNR. The air strippers were shut down by MDNR pending resolution of air emissions and permit requirements.

Purging of the Building 43 TCE plume is continuing using an air sparger followed by an activated carbon system consisting of three sets of carbon columns operated in parallel. Each set consists of two carbon columns in series. The entire system operates at about 800 gal/min. After aeration by sparging, the purge water is treated by injecting liquid carbon dioxide to adjust the pH to a suitable level for control of hardness, which causes fouling of the carbon. Base personnel estimate that this purge system will be operated for 20 years before the TCE concentration in the purge water is reduced to the MDNR requested level of 1.5 ppb. The USAF has gained permission from MDNR to reactivate the air stripping system and has purchased a four-column carbon system.

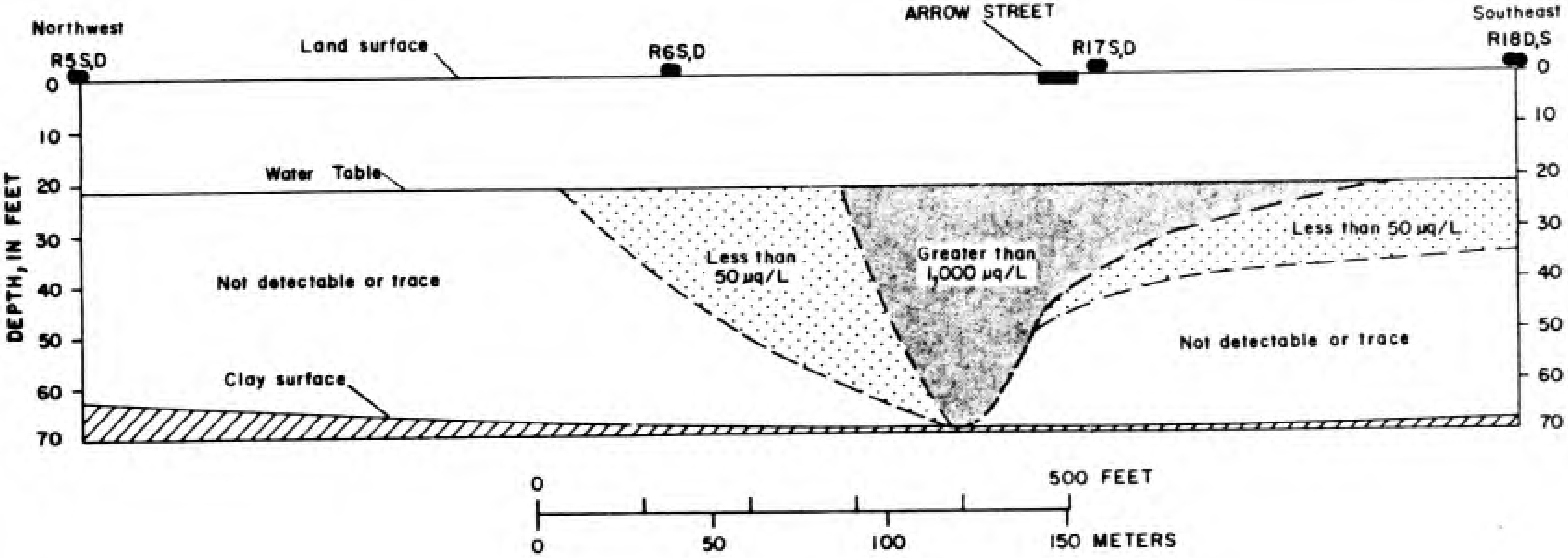
The tank has been excavated along with the surrounding sand, which was shipped to an MDNR approved disposal site in Wayne County, Michigan.

There is documented evidence for environmental contamination and contaminant migration for this site. This site would normally be rated using the HARM model. However, the site is also currently in a Phase IV remedial action program. Since clean-up activities are already underway at this site, there is no further need for additional data gathering or supplemental IRP action. The on-going clean-up is under constant supervision and review by the Air Force and is monitored for compliance by the MDNR. For these reasons, Site SP-1 was not rated using the HARM model.



Source: U.S. Geological Survey Ground-water Contamination Report, 1983.

Figure IV-6. Building 43 Trichloroethylene Plume, 1979-1980.



Note: This cross section runs along Michigan Ave. shown in Figure IV-6.

Source: U.S. Geological Survey Ground-water Contamination Report, 1983.

Figure IV-7. Cross Section Showing Generalized Vertical Distribution of Trichloroethylene in Building 43 Plume Between Wells R5D,S and R18D,S, 1979-1980

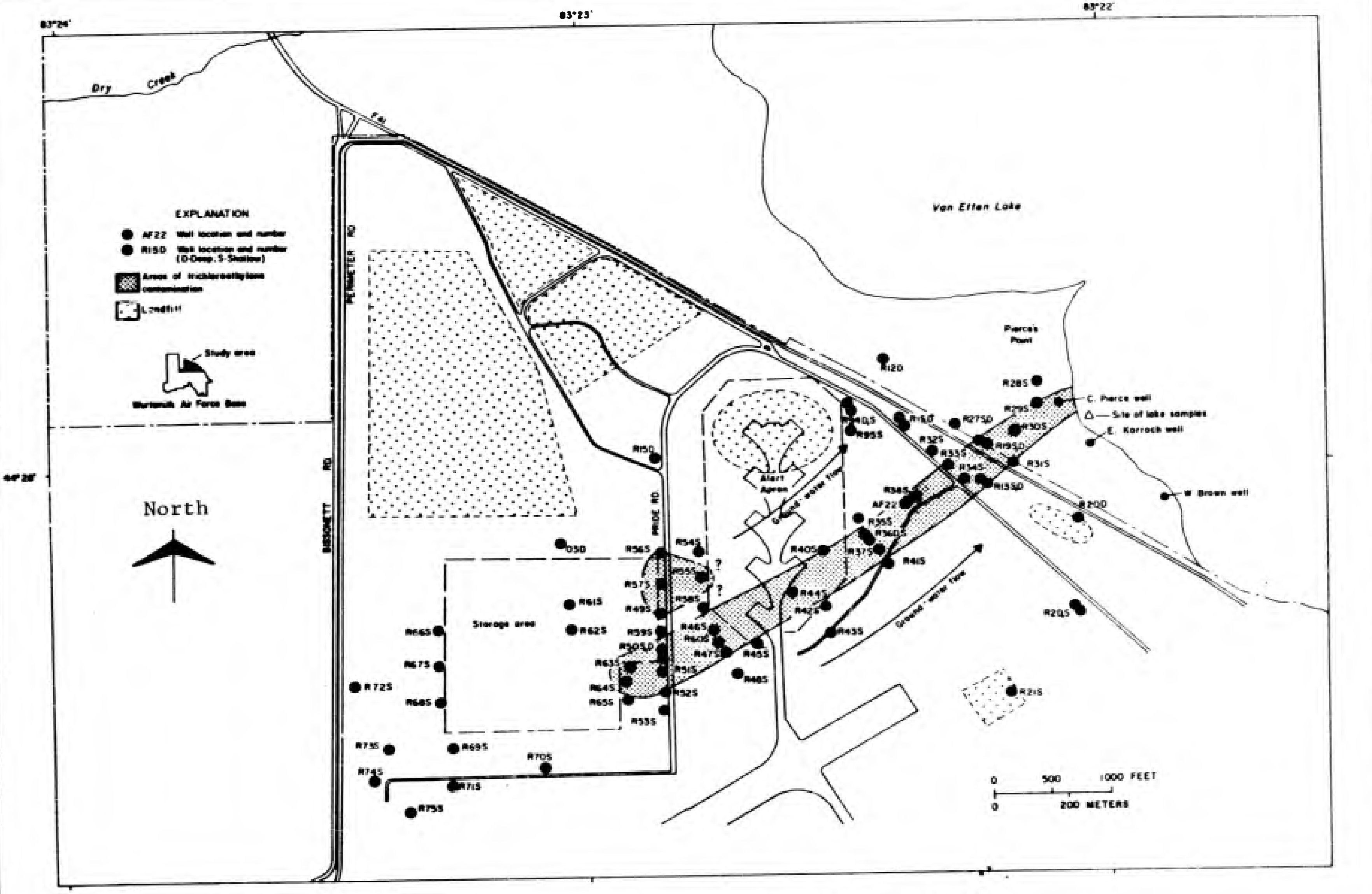
b. Site SP-2, TCE Spill, Southwest of SAC Alert Apron

Samples of water were taken in 1980 by USAF from the domestic well of Charles Pierce, off-base near Van Ettan Lake. The samples contained trichloroethylene (TCE) in excess of 700 μg/l. The USGS study confirmed the presence of TCE and characterized two plumes, or areas of contamination, emanating from the Weapons Storage Area. Figure IV-8 shows a generalized boundary of the main plume and a probable second plume immediately north of it.

A precise northeastern boundary could not be established by USGS for the small northern plume because of restricted drilling conditions near the Alert Apron area. To determine if TCE had moved east of the Alert Apron, wells R94D, R94S and R95S were drilled near the eastern fence line at locations shown on Figure IV-8. TCE was not detected in water from these wells. This indicates that the northeastern boundary of the plume probably terminates somewhere under the Alert Apron. However, the exact location cannot be determined.

In January 1980, USGS sampled Van Ettan Lake at the shore line near the Pierce well. A sample taken from under the ice contained TCE at 20 μg/l. However, samples taken by the Air Force during October/November 1980, when no ice was present, at various depths and distances from shore (near the Pierce property) revealed no trace of TCE.

Interviews with base personnel did not uncover information about TCE spills in the Weapons Storage Area. It is known that the area was used in the late 1950's and the early 1960's as a jet fighter maintenance area for the Aerospace Defense Command (ADC). TCE may have been used at this time. According to USGS, TCE found near Pierce's Point may have entered the aquifer about 20 years ago, a period of time that coincides with the possible use of TCE in the Weapons Storage Area.



Source: U.S. Geological Survey Ground-water Contamination Report, 1983.

Figure IV-8. Alert Apron Trichloroethylene Plume, 1980

USGS suggested a ground-water purge and monitoring system consisting of three wells for the Alert Apron plumes. The Air Force believes the environmental impact of this plume area to be minimal and has chosen to let the contamination be purged by the natural ground-water flow to Van Ettan Lake. The Air Force provides Charles Pierce with an alternate water source (bottled water). Other private wells in the vicinity of the Pierce well have been tested and no TCE has been detected.

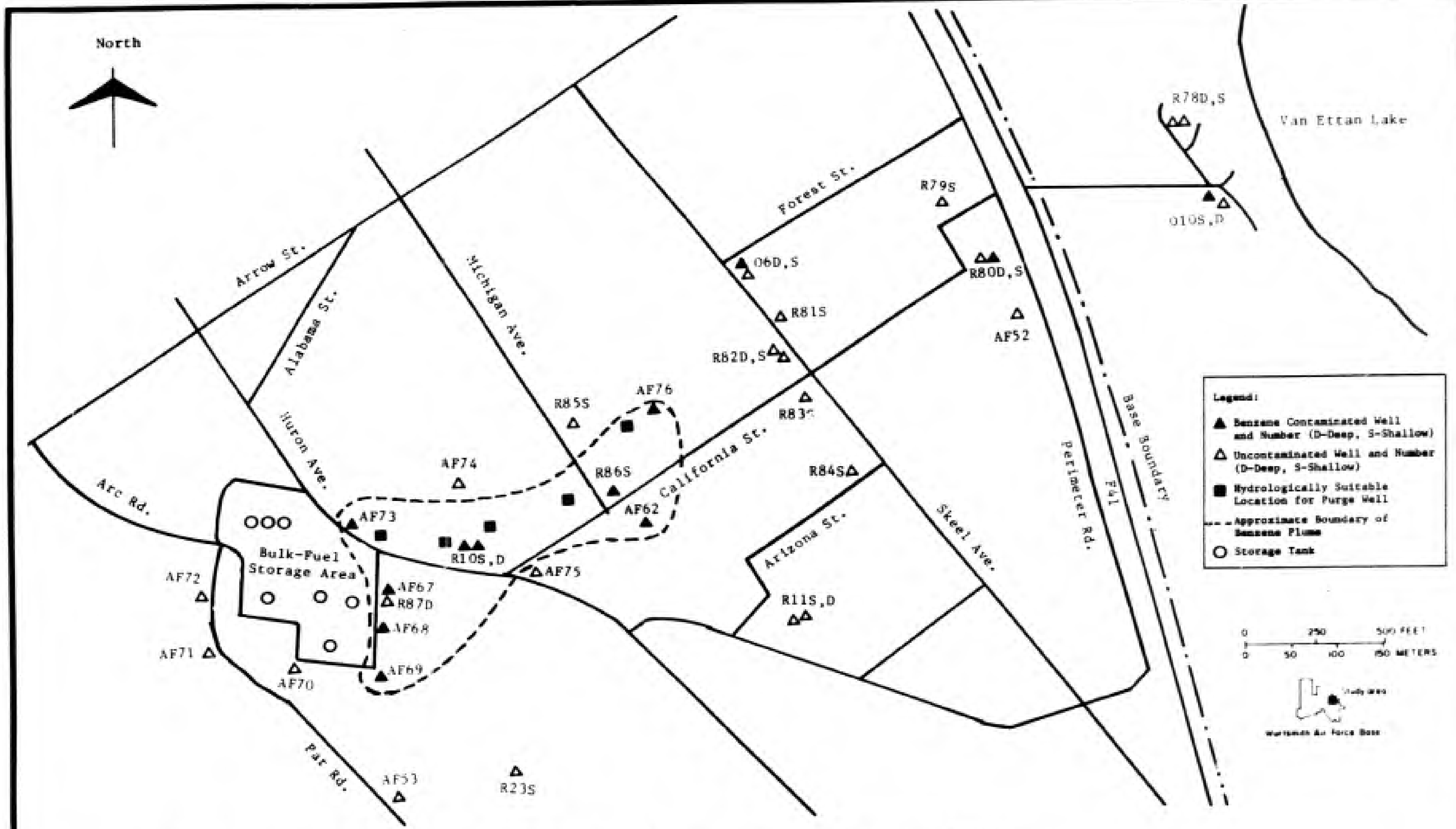
Since environmental contamination and contaminant migration is confirmed for this site, Site SP-2 was rated and received a HARM score of 77.

c. Site SP-3, Fuel Spill, POL Bulk Storage Area

The USGS study revealed in December 1979 that wells near the POL Bulk Storage area contained benzene and traces of toluene, as well as other not easily identifiable organic compounds (Appendix F). The spill plume is characterized in Figure IV-9. MOGAS, JP-4, deicing fluid, heating fuel (#2 and #6), and diesel fuel (#2) are all stored in the area. Comparison of analyses of these fuels and the substance found in the wells strongly suggests that JP-4 is the contaminant.

As recently as February 1984, USGS has observed high benzene concentrations and a marked difference in the color of samples. Samples from some wells have the appearance of "fresh" JP-4, while samples from other wells have a yellowish cast as if the water has been in contact with the soils for a longer period. An active leak in the contractor-owned JP-4 supply line from off-base (Harrisville) is a possibility because the USGS reported an increase of fuel on the surface of some wells. The pipeline has been visually inspected and the tanks have been checked. No pipeline or tank leaks have been reported.

Although minor spills have occurred at the storage area over the years, no major spill was reported. The fuel and deicer tanks were diked at the same time that the heating oil and JP-4 tanks were diked and lined and had



Source: U.S. Geological Survey Ground-water Contamination Report, 1983.

Figure IV- 9. Concentrations of Benzene and Location of Wells Near the Bulk-fuel Storage Area new bottoms installed in 1983. An underground slop waste tank is used to collect any spillage or rainwater that drains from the diked areas. The fuel from this tank is either contract hauled or used in training fires by the Fire Department. The water portion from the slop waste tank is pumped to an oil/water separator. The separator was designed with a level indicator (float) to allow only water to be discharged to the ground. However, the float has not been installed and the waste fuel or oil could be pumped out with the water, possibly causing ground-water contamination.

The Air Force is hiring an engineering consultant to design a purge and treatment scheme for this contaminated area. The purge system will consist of five wells, two of which already exist. The treatment of purge water will probably consist of activated carbon filtration or air stripping. The system will be designed to handle about 250 gpm (gal/min).

The plume at this site is currently moving in the direction of the existing purge well system at Site SP-1 discussed above. However, the contaminant migration has not yet reached the purge wells. The planned purge well system for this site should stop the further migration of the plume and clean it up.

Due to the direct evidence of environmental contamination and contaminant migration, Site SP-3 was rated with HARM and received a score of 79.

d. Site SP-4, JP-4 Spill, Building 393 (Motor Pool) Area

Around 1974 or 1975, approximately 400 to 500 gallons of JP-4 was spilled in the POL Vehicle Maintenance area (Building 393). The spill originated from a POL tank truck being serviced and was flushed down a floor drain with water to the sanitary sewer. No evidence of environmental contamination was reported. The work area drains have been equipped with an oil/water separator to reduce the impact of spills on the sanitary waste treatment plant.

Since no evidence of environmental contamination was uncovered during the data review or in interviews, Site SP-4 was not rated using HARM.

e. Site SP-5, TCE Spill, Northwest Base Housing Area

The USGS study has determined that plumes of TCE and dichloroethylene (DCE) exist in the ground water south of Perimeter Road in the northwest area of base housing. Details of the USGS findings have not yet been published and were not provided. Interviews with base personnel revealed that the plume appears to have originated in the Nose Dock area, but USGS has not located the source. A possible source of the contamination, such as a leaking tank or spill, was not determined during the data review or in interviews. A purge plan will be implemented by Civil Engineering to contain and eliminate the contamination. Five new purge wells will be drilled. The treatment of purge water will probably consist of activated carbon filtration or air stripping. The planned purge well system for this site should stop the migration of the plume and clean it up.

Since evidence of environmental contamination and contaminant migration exists, Site SP-5 was rated using the HARM model. A score of 72 was given to the site.

f. Site SP-6, JP-4 Spill, Building 5001

In 1971, a spill of JP-4 (250 gallons) occurred in the old Test Cell shop (now Building 5001). The spill was contained inside the building and no evidence of environmental contamination was found. Building 5001 is currently used for storage of transformers awaiting testing for PCBs in the fluid. No spills of the transformer fluid were reported in this area.

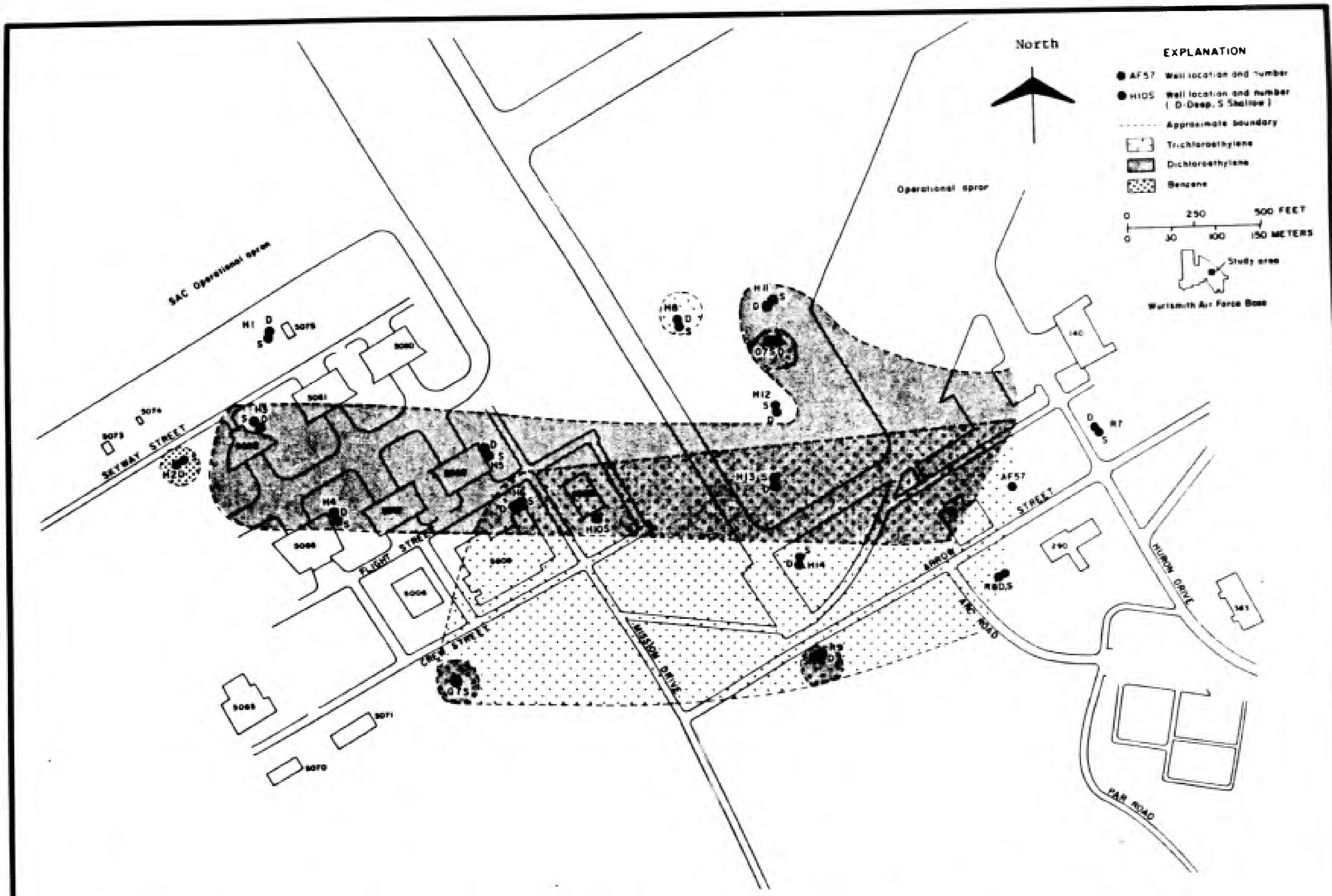
Since no evidence of environmental contamination was uncovered during the data review or in interviews, Site SP-6 was not rated using HARM.

g. Site SP-7, TCE and Fuel Spills, SAC Nose Dock and Operational Aprons

The USGS study has identified the presence of TCE, DCE, and benzene in ground water near the SAC Nose Dock and Operational Aprons. The distribution of plumes is shown in Figure IV-10. Interviews with base personnel did not identify any major spills in the area. Several interviewees reported that waste solvents and oils have been dumped in small quantities behind the blast fences at the SAC Operational Apron. Small spills of JP-4, the probable source of benzene, have also occurred over the years. Prior to the use of JP-4, the use of aviation gas (AVGAS) was common on Air Force installations. AVGAS also has a benzene component and past AVGAS spills are another possible source of the benzene contamination. Many times these fuels were simply washed off the apron into the grass. Based on the path of ground-water flow, spillage near Building 5073, which is a JP-4 pumphouse, may have occurred.

Although TCE is not currently used extensively in the Nose Dock area, it was a common solvent in the past. Building 5008 is currently the only facility where TCE is used. The TCE plume appears to originate near this building. No major spills were identified in interviews but the practice of dumping small quantities of solvents near the buildings for "weed control" may have occurred. Spent and new product drums have also been stored outside this area, although no major leaks were reported.

The USGS report indicates that DCE is a decomposition product of 1,1,1-trichloroethane. Although records do not show the use of DCE on base, trichloroethane is used in small amounts (by the NDI laboratory and PMEL) and was a common solvent used at all Air Force installations in the 1950's and 1960's.



Source: U.S. Geological Survey Ground-water Contamination Report, 1983.

Figure IV-10. Nose Dock/SAC Apron TCE, DCE and Benzene Plumes

The USGS estimates that the Nose Dock plumes will be purged from the ground water through the Building 43 plume purge system (Site SP-1) when the contaminant migration reaches the purge wells. Therefore, no specific remedial action for the site SP-7 plumes is being planned by the Air Force.

Due to the confirmed evidence of environmental contamination and contaminant migration, Site SP-7 was rated using HARM. The site received a score of 79.

h. Site SP-8, JP-4 Spill, Center of SAC Instrument Runway

In November 1978, a KC-135 tanker plane lost an engine before take-off on the SAC Instrument Runway, spilling JP-4 fuel. The exact quantity of fuel spilled is not known and some of it was burned off when the plane caught fire. The spill was not contained and was washed off the runway.

Due to the potential for environmental contamination, Site SP-8 was rated using the HARM model. The site received a score of 62.

i. Site SP-9, JP-4 Spill, Northeast End of SAC Instrument Runway

In 1978, a B-52 bomber blew a fuel vent on Taxiway E, spilling 400 to 500 gallons of JP-4. The spill was not contained, but washed off the runway.

Due to the proximity of the spill to drinking water wells and Van Ettan Lake, Site SP-9 was rated using the HARM model. The site received a score of 62.

j. Site SP-10, JP-4 Spill, Southwest End of SAC Instrument Runway

In May 1984, an A7 training plane crashed at the south end of the SAC Instrument Runway and burned. Some of the fuel was spilled, although an exact quantity is not known.

Due to the potential for environmental contamination, Site SP-10 was rated using the HARM model. The site received a score of 59.

k. Site SP-11, JP-4 Spill, Southwest to South-central Part of SAC Instrument Runway

In March 1982, a B-52 bomber hit a snowbank at Taxiway B after landing, breaking open fuel tanks on one wing. The pilot, unaware of the accident, taxied to the SAC Operational Apron, spilling JP-4 along the way. The amount of fuel spilled is not known. The spill was not contained and was washed off the taxiway by rain and absorbed by the snow.

Due to the proximity of the spill to drinking water wells and the evidence of environmental contamination, Site SP-11 was rated using the HARM model. The site received a score of 59.

l. Site SP-12, MOGAS Spill, Building 394 (Motor Pool) Area

In the mid-1970s, an unknown quantity of MOGAS was spilled at Building 394 in the motor pool yard. Attempts to excavate the contaminated ground were hampered by the low ambient temperature which froze the surface. Fire hydrants were opened to dilute the spill for fire prevention. The spill was never contained or removed from the ground.

The plume at this site is currently moving in the direction of the existing purge well system at Site SP-1 discussed above. However, the contaminant migration has not yet reached the purge wells.

Due to the evidence of environmental contamination, Site SP-12 was rated using the HARM model. The site received a score of 60.

m. Site SP-13, JP-4 Spill, Southwest of Building 43

In the 1956-1957 time frame, the Refueling Maintenance Shop routinely drained the bottoms of tank trucks near Building 43. Although the total amount of JP-4 spilled is not known, about 50 gallons per truck was dumped. It is not known how long this practice continued.

This spill site is located in the same area as the Building 43 tank spill (Site SP-1) discussed above. Since the spill occurred approximately 28 years ago the contaminants have probably already moved into Van Ettan Lake or have been or will be picked up by the existing purge wells. This site would normally be rated using the HARM model. However, the site is also currently in a Phase IV remedial action program. Since clean-up activities are already underway at this site, there is no further need for additional data gathering or supplemental IRP action. The on-going clean-up is under constant supervision and review by the Air Force and is monitored for compliance by the MDNR. For these reasons, Site SP-13 was not rated using the HARM model.

n. Site SP-14, JP-4 Spill, Southwest of Building 3029

In the 1956-1957 time frame, the Refueling Maintenance Shop drained the bottoms of tank trucks near Building 3029 (see Site SP-13). The JP-4 was spilled on the ground near a coal pile next to the base supply warehouse. It is not known how long the practice continued or how much fuel was spilled.

Since there is evidence of environmental contamination, Site SP-14 was rated using the HARM model. The site received a score of 57.

o. Site SP-15, Fuel Oil Spill, Near Building 25

In 1978, approximately 100 gallons of heating fuel oil was spilled near Building 25. The oil was not contained and was absorbed directly into the ground.

Since this spill site is located near the same area as the Building 43 tank spill (Site SP-1), the contaminants have probably already moved into Van Ettan Lake or have been or will be picked up by the existing purge wells operating in the area. This site would normally be rated using the HARM model. However, the site is also currently in a Phase IV remedial action program. Since clean-up activities are already underway at this site, there is no further need for additional data gathering or supplemental IRP action. The on-going clean-up is under constant supervision and review by the Air Force and is monitored for compliance by the MDNR. For these reasons, Site SP-15 was not rated using the HARM model.

p. Site SP-16, Pesticide Spill, Near Building 140

Pesticide sprayer trucks are rinsed down outside Building 140. The wash water is absorbed directly into the ground. The quantity of waste associated with this practice is not known, nor is the period over which this procedure has been practiced.

Since no evidence of environmental contamination was uncovered at the site, Site SP-16 was not rated using the HARM model.

q. Site SP-17, Diesel Fuel Spill, Power Plant at Port Austin AFS

In 1982, 500 gallons of diesel oil were spilled in the basement of the Power Plant (Building 29) at Port Austin AFS. The spill occurred above ground and was localized in the power plant basement. However, some of the oil seeped into the shale layer beneath the building. Occasionally, the basement will take on water from rain and snow melt and the oil will rise to the surface. This water is pumped to an oil/ water separator and the oil disposed. To date, about 150 gallons of the oil has been recovered. Samples of well water were tested every month for one year for hydrocarbons but none were detected.

Since there is evidence of environmental contamination and due to the proximity of the spill to a well, Site SP-17 was rated using the HARM model. The site received a score of 59.

r. Site SP-18, PCB Spill, Port Austin AFS

In 1982, the oil from a pulse transformer at Port Austin was spilled onto the ground. The exact location or volume of the spill was not reported. Since the transformer had not been tested for PCBs, the spill was handled as a PCB spill. The entire spill was cleaned up, including the soil, and taken off-site.

Since there is no evidence of environmental contamination at the site, Site SP-18 was not rated using the HARM model.

5. Miscellaneous Sites

The locations of the four miscellaneous sites of potential environmental contamination are shown in Figure IV-11. These sites are described briefly in Table IV-8.

a. Site SB-1, Sludge Drying Beds

The USGS study confirmed Air Force data showing TCE contamination just east of the inactive waste treatment plant. Figure IV-12 shows the location of monitoring wells, soil samples, sludge bed samples, and well core samples in the area. The USGS (1983) report suggests that the source of TCE may have been the waste treatment plant. That report also suggests that sludge placed in the waste treatment drying beds was suspected of having adsorbed TCE at a time before water pumped to the plant was passed through carbon filters (before 1979). TCE was not detected on the sludge bed soils, in surface sludge material, or on soils collected east of the treatment plant. This strongly suggests that TCE has not been adsorbed on soils or underlying materials and that release of TCE to the ground-water system is not occurring.

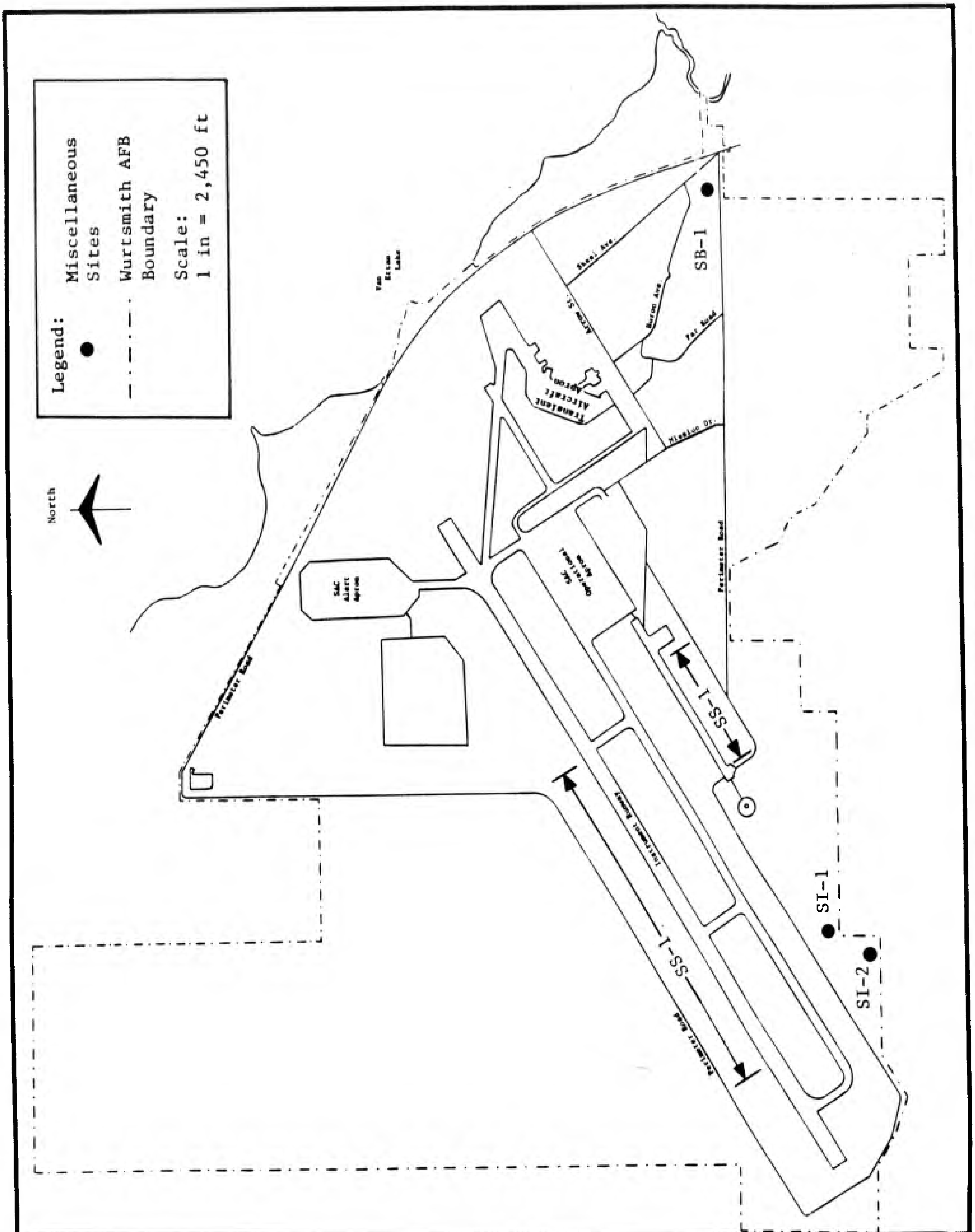
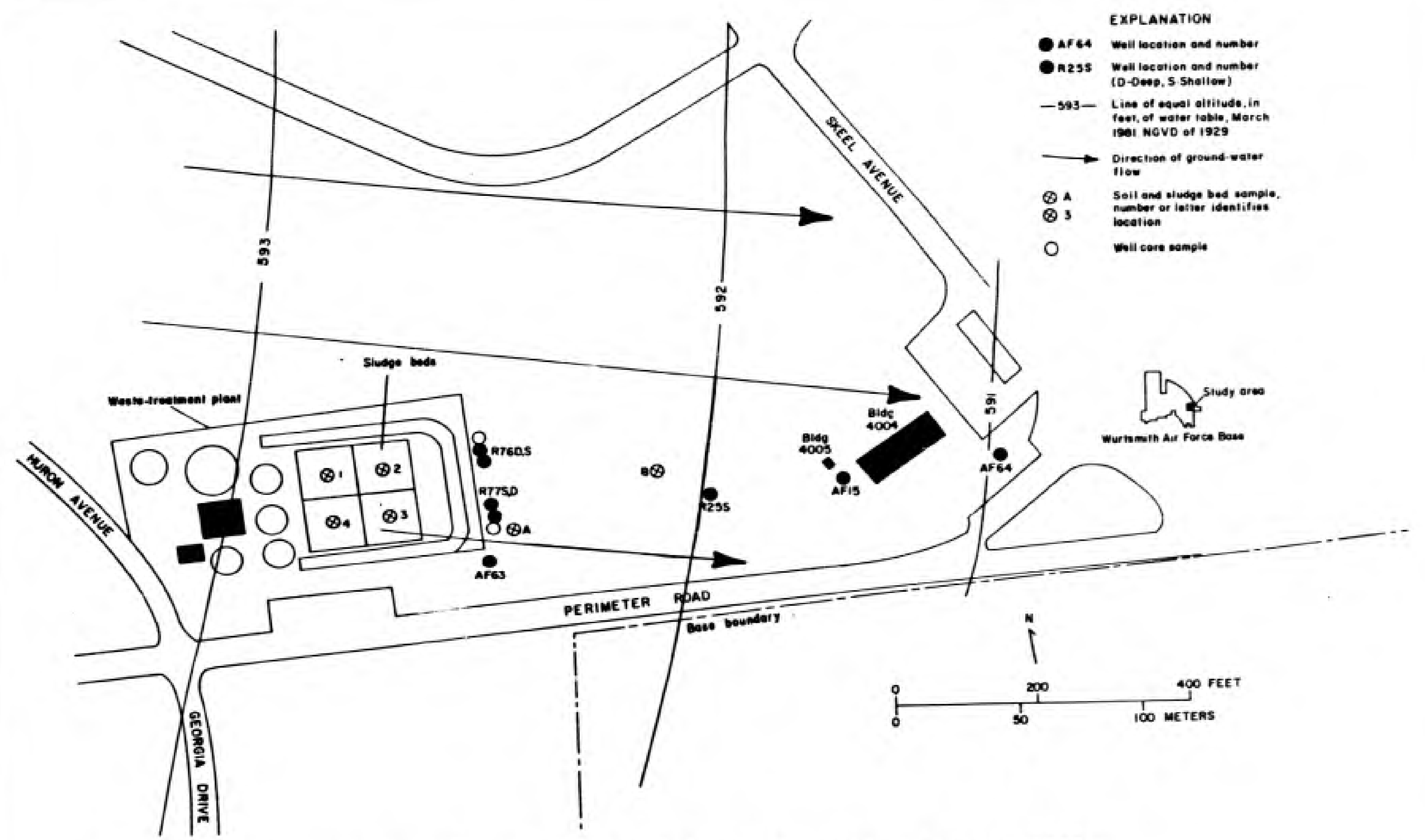


Figure IV-11. Miscellaneous Sites at Wurtsmith AFB, Michigan

Table IV-8. LISTING OF MISCELLANEOUS AREAS OF POTENTIAL ENVIRONMENTAL CONTAMINATION IDENTIFIED AT WURTSMITH AFB, MICHIGAN

Site Number	Description	Site Status*
I-1	Incinerator, base hospital	A
SB-1	Sludge drying beds, inactive wastewater treatment plant	I
SI-1	Surface impoundments, aeration lagoons	A
SI-2	Surface impoundments, seepage lagoons	A
SS-1	Sludge spreading area	I

*A = active; I = inactive



Source: U.S. Geological Survey Ground-water Contamination Report, 1983.

Figure IV-12. Location of Monitoring Wells, Soil, Sludge Bed and Well Core Samples Near the Inactive Waste Treatment Plant Area

The TCE in the sludge probably moved downward to the ground water beneath the drying beds, without significant adsorption.

The piping of purge water to the waste treatment system was discontinued in 1982, when a permit for direct discharge of the carbon filtration effluent was obtained. Analyses of water from well AF15 suggest TCE concentrations are decreasing slowly, which is consistent with the use of carbon filtration of purge water before piping to the treatment plant and the eventual discontinued use of the sludge beds in 1982.

Hydrocarbons other than TCE have not been detected in water from wells east of the treatment plant, suggesting that these compounds are tightly bound to the soil and underlying material. Therefore, hydrocarbon compounds other than TCE do not seem to be potential ground-water contaminants in the waste treatment plant area.

Currently, there are no plans to purge the ground water from this site. Natural flushing of the system in the waste treatment plant area is expected as ground water moves eastward.

Since there is direct evidence of environmental contamination at this site, Site SB-1 was rated using the HARM model. The site received a score of 73.

b. Site SI-1, Surface Impoundment, Aeration Lagoons

A new sanitary waste treatment system was put on-line in 1982. The old system is now used as a lift station to the new plant. The new system is located in the southwest corner of the base and consists of three aerated lagoons in series, followed by seepage lagoons. The system design capacity is 1.5 MGD, but is currently operating at about 0.5 MGD. Two of the aeration lagoons are lined with 50-mil plastic liners. The third lagoon has a bentonite clay liner. Small quantities of solvents and oils may enter the treatment system through dumping of wastes into the sanitary sewer. However, no evidence of environmental contamination at the lagoons was discovered.

Since no evidence of environmental contamination was uncovered during the data review or in interviews, Site SI-1 was not rated using the HARM model.

c. Site SI-2, Surface Impoundment, Seepage Lagoons

Eight seepage lagoons were constructed to handle effluent from the sanitary waste aeration lagoons. Generally, the seepage lagoons are used independently, but occasionally two are used in parallel. The seepage lagoons allow the wastewater to trickle into the ground. Some residual solids accumulate and about once per year the solids are excavated and graded to the sides of the lagoon.

Since no evidence of environmental contamination was uncovered during the data review or in interviews, Site SI-2 was not rated using HARM.

d. Site SS-1, Sludge Spreading Area

From the 1960s until 1982, sludge from the waste treatment plant was spread at various areas at the west end of the SAC Instrument Runway, both north and south of the runway. Sludge was also spread near the Burkhart Lodge, just east of the SAC Alert Apron. During the final cleaning of the waste treatment plant digesters, the last few batches of sludge were injected directly into the soil. Special ground loading rates were established for the injection. A private contractor hired by the Air Force tested the sludge for EP Toxicity but the sludge did not exceed any of the indicator parameters.

Since no evidence of environmental contamination was uncovered during the data review or in interviews, Site SS-1 was not rated using HARM.

V. CONCLUSIONS

The goal of the IRP Phase I Records Search is to identify sites where there is the potential for environmental contamination resulting from past waste disposal practices and to assess the probability of contaminant migration from these sites. The conclusions given below are based on the assessment of information collected from the project team's field inspection, review of records and files, review of the environmental setting, and interviews with base personnel, past employees, and state and local government officials. A listing of all interviewees and outside agency contacts is provided in Appendix B.

Table V-1 is a ranking of the 15 potential contamination sites identified at Wurtsmith AFB by their final HARM scores. HARM subscores for those sites are also provided. The meteorology, geology and population characteristics for several of the sites are very similar, so some effort was made to emphasize the differences among the sites. The HARM rating forms for each site are presented in Appendix D. The locations of each of the sites are shown in Figures V-1 and V-2.

A. General Conclusions

The receptors subscores for all the sites at Wurtsmith AFB were very similar. Different factor ratings were applied to sites due to population within 1,000 feet and the distance to the reservation boundary. Sites which are located within one mile of Van Ettan Lake were given a high factor rating for critical environments because the lake is a known habitat of two species of threatened flora. All of the on-base sites received the same factor ratings for the water quality of the nearest surface water body, the groundwater use of the uppermost aquifer, the population served by a surface water supply within three miles downstream, and the population served by a groundwater supply within three miles.

TABLE V-1. SUMMARY OF HARM SCORES FOR THE RATED SITES, WURTSMITH AFB, MICHIGAN

Site Number	Site Description	Rank	Receptors Subscore	Waste Characteristics Subscore	Pathways Subscore	Gross Total Score	Final Score
D-6	Landfill, northern (Perimeter Road) area	1	79	60	100	80	80
SP-3	Fuel spill, POL Bulk Storage Area	2	78	72	100	83	79
SP-7	TCE and fuel spill, SAC Nosedock and Operational Apron	3	69	80	100	83	79
SP-2	TCE spill, southwest of SAC Alert Apron	4	80	50	100	77	77
SB-1	Inactive waste treatment plant sludge drying beds	5	81	38	100	73	73
SP-5	TCE spill, northwest base housing area	6	67	50	100	72	72
FT-2	Active fire training area	7	64	90	69	74	71
SP-8	JP-4 spill, center of SAC Instrument Runway	8	78	54	54	62	62
SP-9	JP-4 spill, northeast end of SAC Instrument Runway	9	78	54	54	62	62
FT-1	Inactive fire training area	10	78	45	61	61	61

TABLE V-1. SUMMARY OF HARM SCORES FOR THE RATED SITES, WURTSMITH AFB, MICHIGAN (Continued)

Site Number	Site Description	Rank	Receptors Subscore	Waste Characteristics Subscore	Pathways Subscore	Gross Total Score	Final Score
SP-12	MOGAS spill, Building 394 (motor pool)	11	80	54	54	63	60
SP-11	JP-4 spill, southwest to south-central taxiway	12	63	54	61	59	59
SP-17	Diesel fuel spill, Power Plant at Port Austin AFS	13	83	54	39	59	59
SP-10	JP-4 spill, southwest end of SAC Instrument Runway	14	63	54	61	59	59
SP-14	JP-4 spill, southwest of Building 3029	15	80	36	54	57	57

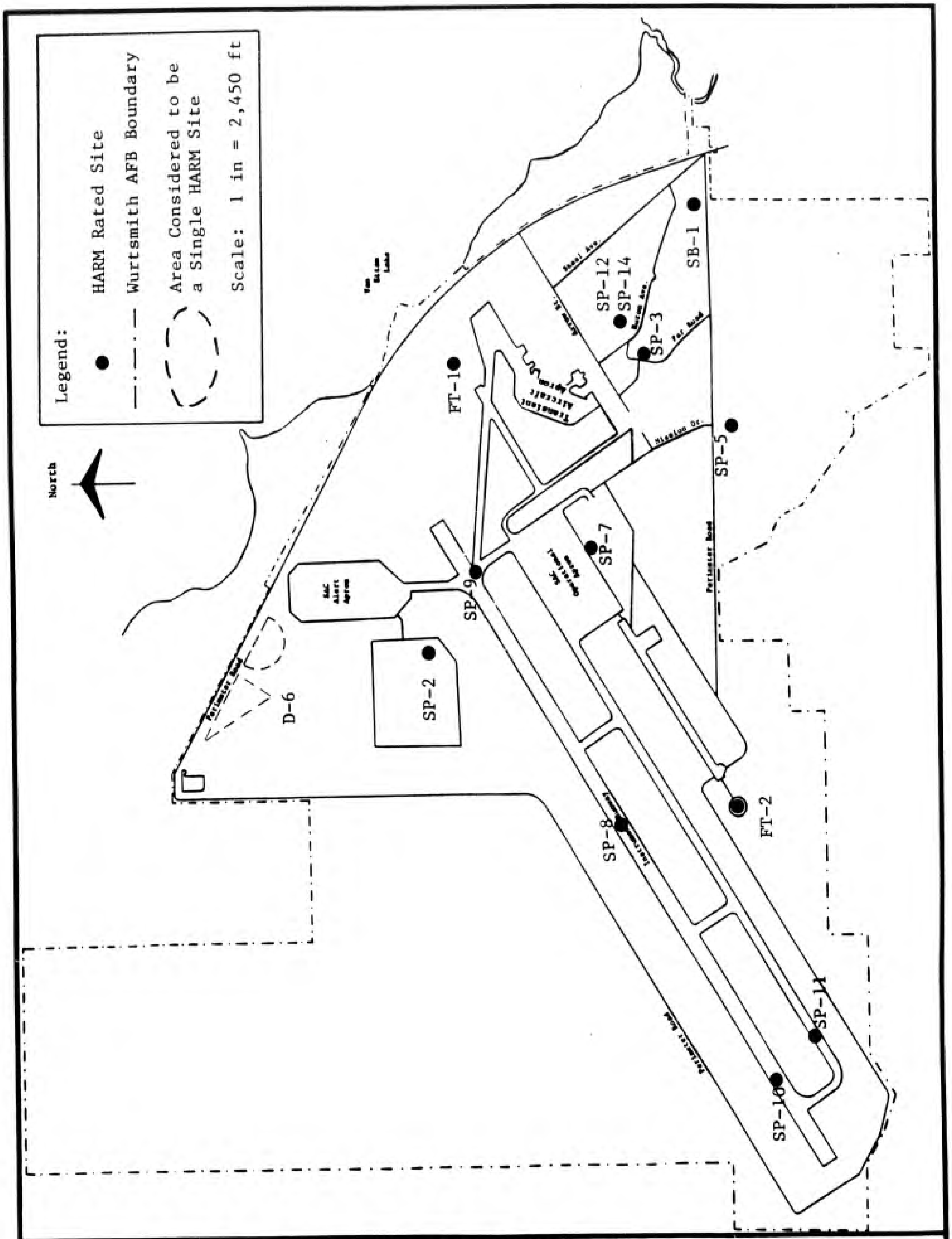
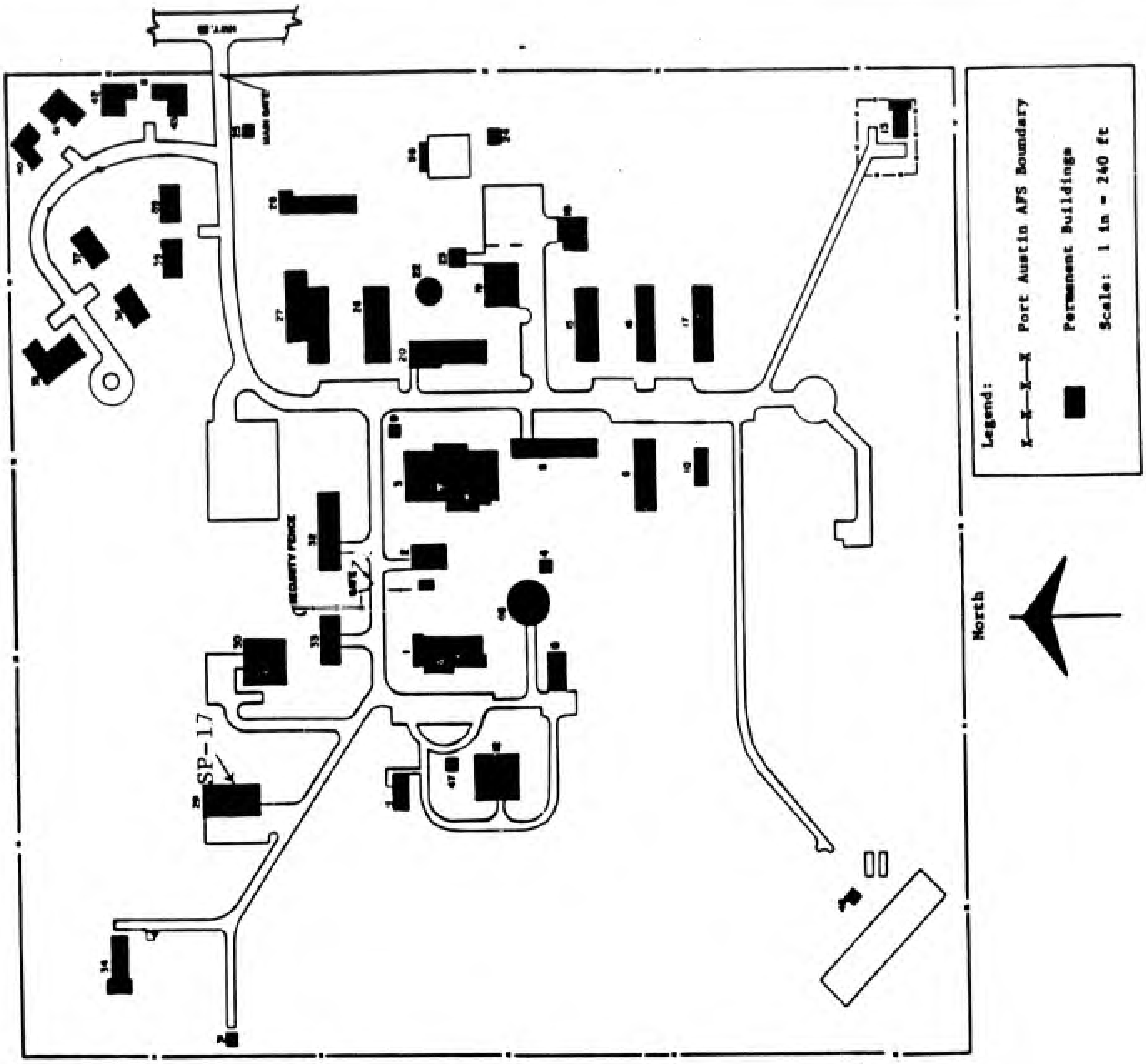
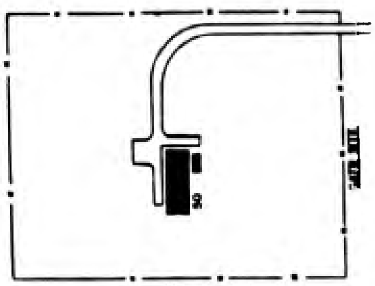


Figure V-1. Locations of HARM Rated Sites, Wurtsmith AFB, Michigan



Source: Port Austin AFS, Dwg. PTA-810-040, Revised May 1984



Source: Port Austin AFS, Dwg. PTA-810-040, Revised May, 1984.

Figure V-2. Location of HARM Rated Site, Port Austin AFS, Michigan

The waste characteristics subscores varied considerably for the rated sites. For sites where fuels are present a high hazard rating was given because of the high score for the ignitability for benzene which is a component of the fuels. The fuels did receive a reduced persistence factor. For sites where TCE is present a medium hazard rating was given because TCE has a Sax Level of 2. For solvents a persistence factor of 1.0 was applied.

B. Site Specific Conclusions

1. Site D-6, Landfill, northern (Perimeter Road) area

This site received a HARM score of 80. Only small quantities of waste were reportedly put in the landfill. The site was given a high hazard rating and a persistence factor of 1.0 because both benzene and TCE plumes are present at the site. The potential pathways were not rated for this site because analytical data from ground-water monitoring wells provided direct evidence for migration of hazardous contaminants. The gross total score for this site was not reduced because no waste management practices were in-place.

2. Site SP-3, Fuel Spill, POL Bulk Storage Area

This site received a HARM score of 79. Since no specific spill or leak incidents could be identified to account for the contamination at the site a medium waste quantity was assigned. Small spills or leaks have likely occurred over the history of the installation which would add up to a medium quantity. The potential pathways were not rated for this site because analytical data from ground-water monitoring wells provided direct evidence for migration of hazardous contaminants. The gross total score for this site was reduced by five percent because the plume is currently moving towards an existing treatment system (Building 43 purge system). In addition, a new purge system is planned for this site.

3. Site SP-7, TCE and fuel spill, SAC Nosedock and Operational Apron

This site received a HARM score of 79. A medium waste quantity factor score was applied for this site. The rationale is similar to Site SP-3 discussed above. The site was given a high hazard rating and a persistence factor of 1.0 because both benzene and TCE plumes are present at the site. The potential pathways were not rated for this site because analytical data from ground-water monitoring wells provided direct evidence for migration of hazardous contaminants. The gross total score for this site was reduced by five percent because the plumes are currently moving towards an existing treatment system (Building 43 purge system).

4. Site SP-2, TCE spill, southwest of SAC Alert Apron

This site received a HARM score of 77. Since the exact source of the TCE is not known, it is difficult to estimate the waste quantity. A small factor score was applied because it is believed that solvent use in the Weapons Storage Area in the 1960s was low. The potential pathways were not rated for this site because analytical data from ground-water monitoring wells provided direct evidence for migration of hazardous contaminants. The gross total score for this site was not reduced because no waste management practices were in-place.

5. Site SB-1, Inactive waste treatment plant sludge drying beds

This site received a HARM score of 73. The cause of the contamination at this site is believed to be wastewater treatment sludge which had adsorbed TCE. A small waste quantity factor score was assigned. The potential pathways were not rated for this site because analytical data from ground-water monitoring wells provided direct evidence for migration of hazardous contaminants. The gross total score for this site was not reduced because no waste management practices were in-place.

6. Site SP-5, TCE spill, northwest base housing area

This site received a HARM score of 72. The exact source of this spill is unknown and the exact quantity of spilled solvent is unknown. It is estimated that only a small quantity was spilled. The potential pathways were not rated for this site because analytical data from ground-water monitoring wells provided direct evidence for migration of hazardous contaminants. A new purge system is planned for this site.

7. Site FT-2, Active fire training area

This site received a HARM score of 71. A large waste quantity was assigned because residual unburned fuel, which may only be a small quantity for each fire training episode, will be a large quantity over the history of the installation. The potential pathways for migration of hazardous contaminants for surface water, flooding and ground water were evaluated for this site. The surface water pathway received the highest subscore because of high net precipitation and high rainfall intensity. The gross total score for this site was reduced by five percent because the pits were lined with concrete in 1982.

8. Site SP-8, JP-4 spill, center of SAC Instrument Runway

This site received a HARM score of 62. A small waste quantity factor score was applied since some of the fuel spilled was burned off. The potential pathways for migration of hazardous contaminants for surface water, flooding, and ground water were evaluated for this site. The surface water pathway received the highest subscore because of high net precipitation and high rainfall intensity. The gross total score for this site was not reduced because no waste management practices were in-place.

9. Site SP-9, JP-4 spill, northeast end of SAC Instrument Runway

This site received a score of 62. Only a small quantity of fuel was spilled. The potential pathways for migration of hazardous contaminants for surface water, flooding, and ground water were evaluated for this site. The surface water pathway received the highest subscore because of high net precipitation and high rainfall intensity. The gross total score for this site was not reduced because no waste management practices were in-place.

10. Site FT-1, Inactive fire training area

This site received a HARM score of 61. A medium waste quantity was assigned because fire training only occurred at this site for seven years. Although the amount of residual unburned fuel may only be a small quantity for each fire training episode, it will add up over the seven year period. The potential pathways for migration of hazardous contaminants for surface water, flooding, and ground water were evaluated for this site. The surface water pathway received the highest subscore because of high net precipitation and high rainfall intensity. The gross total score for this site was not reduced because no waste management practices were in-place.

11. Site SP-12, MOGAS spill, Building 394 (motor pool)

This site received a HARM score of 60. No exact quantity of this spill is known. A small waste quantity factor score was assigned. The potential pathways for migration of hazardous contaminants for surface water, flooding, and ground water were evaluated for this site. The surface water pathway received the highest subscore because of high net precipitation and high rainfall intensity. The gross total score for this site was reduced by five percent because the plume is currently moving towards an existing treatment system (Building 43 purge system).

12. Site SP-11, JP-4 spill, southwest to southcentral taxiway

This site received a HARM score of 59. Although the exact quantity of fuel spilled is unknown a small factor rating was assigned. The potential pathways for migration of hazardous contaminants for surface water, flooding, and ground water were evaluated for this site. The surface water pathway received the highest subscore because of the proximity of the site to Allen Lake, high net precipitation and high rainfall intensity. The gross total score for this site was not reduced because no waste management practices were in-place.

13. Site SP-17, Diesel fuel spill, Power Plant at Port Austin AFS

This site received a HARM score of 59. A small quantity of fuel was spilled at the site. The potential pathways for migration of hazardous contaminants for surface water, flooding, and ground water were evaluated for this site. The surface water and ground water pathways received the same subscore. The gross total score for this site was not reduced because no waste management practices were in-place.

14. Site SP-10, JP-4 spill, southwest end of SAC Instrument Runway

This site received a HARM score of 59. Only a small quantity of the fuel was not burned off. The potential pathways for migration of hazardous contaminants for surface water, flooding, and ground water were evaluated for this site. The surface water pathway received the highest subscore because of the proximity of the site to Allen Lake, high net precipitation and high rainfall intensity. The gross total score for this site was not reduced because no waste management practices were in-place.

15. Site SP-14, JP-4 spill, southwest of Building 3029

This site received a HARM score of 57. There is no information available on the amount of fuel spilled at this site. It is estimated to be a small quantity and the spill itself has not been confirmed. The potential pathways for migration of hazardous contaminants for surface water, flooding, and ground water were evaluated for this site. The surface water pathway received the highest subscore because of high net precipitation and high rainfall intensity. The gross total score for this site was not reduced because no waste management practices were in-place.

VI. RECOMMENDATIONS

The final HARM scores for each of the 15 rated sites (a total of 31 sites were screened) were compared and a relative scale of potential risk was developed which is presented in Table VI-1. Of greatest concern are the seven high risk sites. Four sites received a moderate potential risk rating. Recommendations for Phase II activities at these sites are described below. Four sites are considered to pose a low potential risk and no further actions are recommended.

Three additional sites were not rated using the HARM model because Phase IV remedial actions are already in-place at these sites. These sites were discussed in detail in Section IV B. It is recommended that those Phase IV activities and associated monitoring be continued as planned.

A. Recommended Phase II Activities

Since 1979, when USAF contracted with the U.S. Geological Survey (USGS) to investigate geologic and hydrologic conditions at Wurtsmith AFB, there has been extensive ground-water and soil boring sample collection and analysis to assess environmental contamination. This characterization study is still on-going. Table VI-2 presents the wells that are currently being monitored by the Air Force, the monitoring frequency and the pollutants quantified. In addition, other wells are scheduled to be added to this list. These wells are presented in Table VI-3. It is recommended that all of these planned wells be monitored. Additionally, it is recommended that the monitoring plan be reviewed semi-annually and revised if necessary based on the most recent sample results. As a result of this Phase I study additional sampling efforts are recommended for some sites. The rationale for ground-water and soil sampling is discussed below.

Ground water samples are recommended because of the sensitive nature of aquifers: they may be easily contaminated but are difficult to clean up and residual contamination may affect the use of an aquifer for decades.

TABLE VI-1. POTENTIAL RISK RANKING BASED ON FINAL HARM SCORES

Site Number	Description	Final HARM Score	Potential Risk
D-6	Landfill, northern (Perimeter Road) area	80	High
SP-3	Fuel spill, POL Bulk Storage area	79	
SP-7	TCE and fuel spill, SAC Nose Dock and Operational Apron	79	
SP-2	TCE spill, southwest of SAC Alert Apron	77	
SB-1	Inactive waste treatment plant sludge drying beds	73	
SP-5	TCE spill, northwest base housing area	72	
FT-2	Active fire training area	71	
SP-8	JP-4 spill, center of SAC Instrument Runway	62	Moderate
SP-9	JP-4 spill, northeast end of SAC Instrument Runway	62	
FT-1	Inactive fire training area	61	
SP-12	MOGAS spill, Building 394 (motor pool)	60	
SP-11	JP-4 spill, southwest to south-central taxiway	59	Low
SP-17	Diesel fuel spill, Power Plant at Port Austin	59	
SP-10	JP-4 spill, southwest end of SAC Instrument Runway	59	
SP-14	JP-4 spill, southwest of Building 3029	57	

TABLE VI-2. EXISTING WELLS CURRENTLY MONITORED BY THE USAF WURTSMITH AFB, MICHIGAN

Site Number	Well Number	Monitoring Frequency	Pollutants Quantified
D-6	AF65*	Quarterly	TCE, DCE, Benzene
D-6	04S	Quarterly	TCE, DCE, Benzene
D-6	R88S	Quarterly	TCE, DCE, Benzene
D-6	R88D	Quarterly	TCE, DCE, Benzene
D-6	R90S	Quarterly	TCE, DCE, Benzene
SP-3	R10S	Quarterly	Benzene
SP-7	H6S	Quarterly	TCE, DCE
SP-7	H10S	Quarterly	TCE, DCE
SP-7	H13S	Quarterly	TCE, DCE
SP-7	07D	Quarterly	TCE, DCE
SP-7	H4S	Quarterly	Benzene
SP-7	H4D	Quarterly	DCE
SP-7	H2S	Quarterly	Benzene
SP-7	H14S	Semi-Annually	TCE, DCE
SP-7	H11D	Semi-Annually	TCE, DCE
SP-7	H13D	Semi-Annually	TCE, DCE
SP-2	R36S	Quarterly	TCE
SP-2	R34	Quarterly	TCE
SP-2	R12	Quarterly	TCE
SP-2	R19S	Quarterly	TCE

TABLE VI-2. EXISTING WELLS CURRENTLY MONITORED BY THE USAF WURTSMITH AFB, MICHIGAN (Continued)

Site Number	Well Number	Monitoring Frequency	Pollutants Quantified
SP-2	R49	Quarterly	TCE
SP-2	R59	Quarterly	TCE
SP-2	R95S	Quarterly	TCE
SP-2	Pierce Well	Monthly (Summer Only)	TCE
SB-1	AF15	Monthly	TCE
SB-1	R77S	Quarterly	TCE
SP-5	AF19	Monthly	TCE, DCE, Benzene
SP-5	AF18	Quarterly	TCE
FT-1	AF4	Monthly**	TCE, DCE, Benzene
FT-1	AF5	Monthly**	TCE, DCE, Benzene
FT-1	AF23	Monthly (Except Winter)	TCE
SP-1	AF1	Monthly	TCE
SP-1	AF2	Quarterly (When Running)	TCE, Benzene
SP-1	AF3	Quarterly	TCE†
SP-1	R18S	Quarterly	TCE†
SP-1	R4S	Quarterly	TCE
SP-1	R4D	Quarterly	TCE, DCE, Benzene
SP-1	H30	Quarterly	TCE
SP-1	P4	Quarterly	TCE, Benzene

TABLE VI-2. EXISTING WELLS CURRENTLY MONITORED BY THE USAF WURTSMITH AFB, MICHIGAN (Continued)

Site Number	Well Number	Monitoring Frequency	Pollutants Quantified
SP-1	P2	Quarterly	TCE, Benzene
SP-1	P3	Quarterly	TCE, Benzene

*AF65 will be changed to R16 for sampling convenience in the near future.

**Sampling frequency will be changed to quarterly in the near future.

†Benzene will be added in the near future.

TABLE VI-3. EXISTING WELLS THAT WILL BE MONITORED IN THE NEAR FUTURE BY THE USAF, WURTSMITH AFB, MICHIGAN

Site Number	Well Number	Planned Monitoring Frequency	Pollutants to be Quantified
D-6	H33	Quarterly	TCE, DCE, Benzene
D-6	H35	Quarterly	TCE, DCE, Benzene
D-6	H75	Quarterly	TCE, DCE, Benzene
SP-3	R85	Quarterly	Benzene
SP-2	R20	Quarterly	TCE
SP-5	H69S	Quarterly	TCE, DCE
SP-5	H69D	Quarterly	TCE, DCE
SP-5	H53S	Quarterly	TCE, DCE
SP-5	H53D	Quarterly	TCE, DCE
SP-5	H27S	Quarterly	TCE, DCE
SP-5	H27D	Quarterly	TCE, DCE
SP-1	H29	Quarterly	Benzene
SI-2	O2	Semi-Annually	TCE

Recommendations for locations of wells generally include one well upgradient of the site and multiple wells in the expected direction of ground-water flow. Well depths specified are predominantly shallow to characterize the quality of the aquifer nearest the suspected sources of contamination. However, a deep well was recommended adjacent to a shallow well at two sites to compare the characteristics of deep and shallow ground water and determine if selective contamination of the shallow or deep ground water exists.

Soil borings are recommended to assess the extent of soil contamination in areas where spills have occurred. Soil contamination indicates that ground-water contamination resulting from a spill is likely to have occurred. Additionally, soil borings provide a comparison of contaminant levels at various depths throughout the soil column.

The locations of recommended sampling points and a description of their locations are presented in Figure VI-1 and Table VI-4, respectively. Specific recommendations for each site are discussed below. Recommendations for pollutants to be analyzed are presented at the end of this section.

1. Recommended Activities at High Potential Risk Sites

There are seven sites at Wurtsmith AFB which received a high potential risk rating when the HARM model was applied. At two of the sites, new purge systems are currently planned. At these two and four of the other high risk sites existing sampling locations are sufficient for determining the magnitude and extent of contaminant migration. Only continued monitoring is recommended for these six sites. At one of the high risk sites (FT-2) additional wells and one soil boring sample are recommended.

a. Site D-6

Site D-6 received the highest rating (80). This site is the Northern Landfill Area. Benzene, DCE, and TCE plumes have been identified in

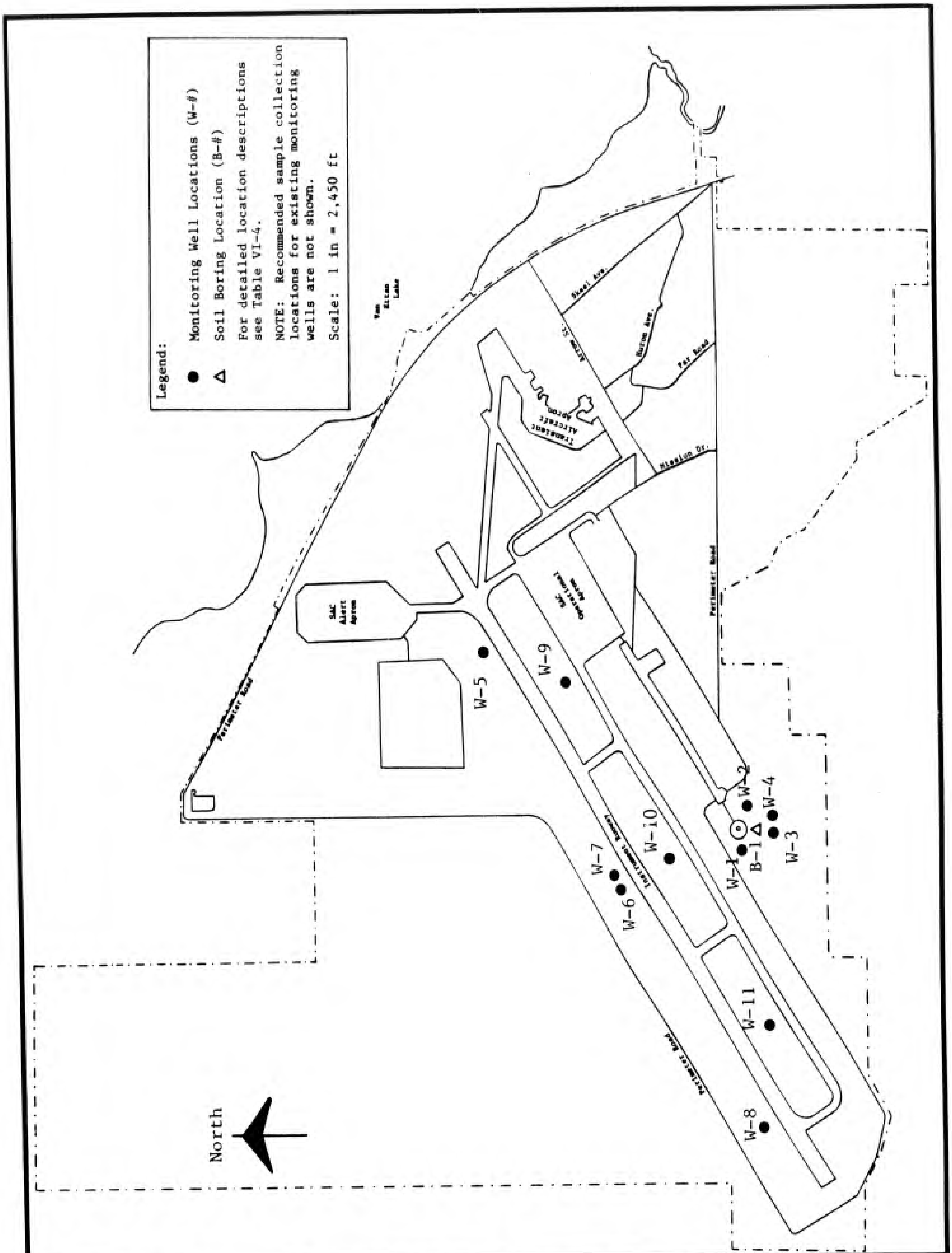


Figure VI-1. Recommended Sample Collection Locations at Wurtsmith AFB, Michigan

TABLE VI-4. RECOMMENDED SAMPLING LOCATIONS AT WURTSMITH AFB, MICHIGAN

GROUND WATER SAMPLING LOCATIONS

Monitoring Well Number	Site Number	Monitoring Well Location	Monitoring Well Depth*
W-1	FT-2	Approximately 200 feet NW of the center of the active fire training pit	S
W-2	FT-2	Approximately 200 feet E of the center of the active fire training pit	S
W-3	FT-2	Approximately 300 feet S-SE of the center of the active fire training pit	S
W-4	FT-2	Adjacent to W-4	D
W-5	SP-8, SP-9	NE end of SAC Instrument Runway, approximately 400 feet N of the center line	S
W-6	SP-8, SP-9	Center of SAC Instrument Runway, approximately 400 feet N of the center line	S
W-7	SP-8, SP-9	Adjacent to W-6	D
W-8	SP-8, SP-9	SW end of SAC Instrument Runway, approximately 400 feet N of the center line	S
W-9	SP-8, SP-9	NE-center of SAC Instrument Runway, approximately 400 feet S of the center line	S
W-10	SP-8, SP-9	Center of SAC Instrument Runway, approximately 400 feet S of the center line	S
W-11	SP-8, SP-9	SW-center of SAC Instrument Runway, approximately 400 feet S of the center line	S

TABLE VI-4. RECOMMENDED SAMPLING LOCATIONS AT WURTSMITH AFB, MICHIGAN (Continued)

SOIL BORING LOCATION

Soil Boring Number	Site Number	Soil Boring Location	Soil Boring Depth (feet)	Sampling Interval (feet)
B-1	FT-2	Approximately 150 feet south of the center of the active fire training pit	15	3

*S - Shallow; D - Deep

the Perimeter Road landfill (Site D-6) and points east. The extent of the contamination is shown in Figure IV-2. Since 1983 sixteen additional wells have been placed to the northeast and east of the landfill to characterize the movement of the plume. No wells are located in the adjacent landfill (Site D-7).

The existing configuration of monitoring wells is sufficient to determine the extent and movement of the plumes. No new well implacements are recommended. It is recommended that samples continue to be collected from key wells in order to continue characterization of the plumes as they migrate toward Van Ettan Lake. In addition to the wells that are currently monitored or planned to be monitored (see Tables VI-2 and VI-3), it is recommended that wells R92 and R93 be monitored semi-annually for TCE, DCE and benzene. These wells are expected to be outside the plumes.

b. Site SP-3

Site SP-3 received the second highest score (79). This site is near the POL storage area. The extent of the benzene contamination is shown in Figure IV-9. Since 1983 seven additional wells have been placed in the area. A new purge system is currently planned for this site. The wells that are currently monitored or planned to be monitored are sufficient at the present time (see Tables VI-2 and VI-3). It is recommended that the selection of key monitoring wells be reviewed when the purge system is installed.

c. Site SP-7

Site SP-7 also received the second highest rating (79). This site is the SAC Nosedock Area in the central part of the base. Benzene, DCE, and TCE plumes have been identified that are migrating towards the existing Building 43 purge system. The extent of the contamination is shown in Figure IV-10. Since 1983 eight additional wells have been placed in the southeastern portion of the plume near Mission Drive and Arrow Street to characterize the movement of the plumes.

The existing configuration of monitoring wells is sufficient to determine the extent and movement of the plumes. No new well implacements are recommended. It is recommended that samples continue to be collected from key wells in order to continue characterization of the plume as it moves towards the Building 43 purge system. In addition to the wells that are currently monitored (see Table VI-2), it is recommended that wells H72S and H72D be monitored quarterly for benzene and well H8D be monitored semi-anually for TCE.

d. Site SP-2

Site SP-2 received the third highest rating (77). This site is the TCE plume which extends to the notheast from the weapons storage area to Pierce's Point. The extent of the contamination is shown in Figure IV-8. No new wells have been placed in the area since 1983.

The existing configuration of monitoring wells is sufficient to determine the extent and movement of the plume. No new well implacements are recommended. It is recommended that samples continue to be collected from key wells in order to continue characterization of the plume as it migrates toward Van Ettan Lake. The wells that are currently monitored or planned to be monitored are sufficient (see Tables VI-2 and VI-3).

e. Site SB-1

Site SB-1 received the fourth highest rating (73). This site is the abandoned sludge drying beds near the inactive waste treatment plant. TCE contamination has been detected in the ground water to the east of the site. Since 1983 no additional wells have been placed in the area and no new soil borings have been collected.

The existing configuration of monitoring wells is sufficient to determine the extent and movement of the contamination. No new well implacements are recommended. It is recommended that samples continue to be collected from key wells in order to continue characterization of the contamination as it moves toward Van Ettan Lake. The wells that are currently monitored are sufficient (see Table VI-2).

f. Site SP-5

Site SP-5 received the fifth highest rating (72). This site is in the Northwest Base Housing area south of Perimeter Road. DCE and TCE plumes have been identified. A new purge system is currently planned for this site. Since 1983 forty-nine additional wells have been placed in the area to characterize the movement of the plumes.

The existing configuration of monitoring wells is sufficient to determine the extent and movement of the plumes. No new well implacements are recommended. It is recommended that samples continue to be collected from key wells in order to continue characterization of the plume. The wells that are currently monitored or planned to be monitored are sufficient at the present time (see Tables VI-2 and VI-3). It is recommended that the selection of key monitoring wells be reviewed when the purge system is installed.

g. Site FT-2

Site FT-2 received the sixth highest rating (71). This site is the active fire training area. USGS has not extensively studied this area of the base. Ground water in the area will flow to the south-southwest toward the Au Sable River.

It is recommended that four ground-water monitoring wells be placed at the site (see Figure VI-1). One is to be placed upgradient of the fire training pit, and three are to be placed at downgradient locations. Three of the wells are to be shallow and one downgradient deep well should be placed adjacent to a shallow well.

In addition, it is recommended that one soil boring sample be collected near the downgradient edge of the concrete pit (see Figure VI-1). The boring shall be approximately 15 feet deep with samples collected at three foot intervals.

2. Recommended Activities at Moderate Potential Risk Sites

There are four sites at Wurtsmith AFB which received a moderate potential risk rating when the HARM model was applied. At two of these sites, existing sampling locations are sufficient for determining the magnitude and extent of contaminant migration. Only continued monitoring is recommended for these sites. At the other two sites (SP-8 and SP-9) additional wells are recommended.

a. Site SP-8 and Site SP-9

Site SP-8 and Site SP-9 both received a HARM score of 62. These sites are JP-4 spill sites along the SAC Instrument Runway. Since the two sites are in the same area of the base and similar types and quantities of contaminants would be expected at both sites, it is useful to take an "integrated" approach to data collection in these areas. Thus, the two sites will be considered as a single area for Phase II recommendations.

USGS has not extensively studied this area of the base. It is recommended that seven ground-water monitoring wells be placed along the runway (see Figure VI-1). Four wells are to be placed on the north side of the runway and three on the south side. Six of the wells are to be shallow and one deep well should be placed adjacent to a shallow well on the north side of the runway. In addition, it is recommended that a sample be collected from existing monitoring well R43.

b. Site FT-1

Site FT-1 received a HARM score of 61. This site is the inactive fire training area.

The existing configuration of monitoring wells is sufficient to determine the extent and movement of the contamination. No new well implacements are recommended. It is recommended that samples continue to be collected from key wells in order to continue characterization of any contamination. The wells that are currently monitored are sufficient (see Table VI-2).

c. Site SP-12

Site SP-12 received a HARM score of 60. This site is the Motor Pool Building 394.

The existing configuration of montioring wells in-place for the Building 43 purge system (Site SP-1) is sufficient to determine the extent and movement of the contamination from Site SP-12. No new well implacements are recommended. It is recommended that a sample be collected from existing monitoring well H42.

B. Additional Phase II Activities

The Phase II sample collection program described above should provide adequate data to determine the presence and/or migration of contaminants from the 11 sites. However, it is possible that inconclusive results may be obtained or the extent of migration from a particular site may not be fully defined. If this occurs, additional Phase II testing may be required. In order to minimize the number of permanent wells required for such sampling, soil vapor monitoring techniques would be recommended. Surface spills and underground leaks of hydrocarbon liquids result in soil contamination by liquid and vapor. Just as a spilled hydrocarbon liquid can result in an expanding zone of contamination, vapors from the spill can migrate through the ground to the land surface. Like the liquid, the vapor migration rate depends on a number of variables including volume of liquid released, depth to ground water, soil characteristics, and conduits for transport. Soil vapor monitoring techniques, measuring fugitive gas emissions, along with a minimum number of soil borings and observation wells can be used to characterize a spill plume. The direct emissions measurement techniques have been successfully used to assess soil hydrocarbon vapor contamination from leaking storage tanks, pipelines, ponds, surface spills and from hydrocarbon liquid on ground water to depths of approximately 90 feet. The principle advantage of soil vapor monitoring is the ease in which samples can be obtained. Since the ground probes are portable, they are easily inserted and removed from the ground, generally without the use of an auger. After sampling, holes left by the probe can be immediately back-filled.

C. Recommended Pollutants for Analysis

At each of the 11 sites, the same types of contaminants are likely to be present. These include industrial solvents and fuel types, including JP-4, heating oil, and AVGAS, which was used commonly at Air Force Installations in the 1950s and 1960s. The major components of all of these contaminants fall into one of two types of compounds: volatile organics and semi-volatile organics. For this reason it is recommended that all ground water and soil boring samples be analyzed for these two classes of compounds. In addition, ground water samples should be analyzed for oil and grease and total organic carbon (TOC).

All of the organic analysis should be done in accordance with the specifications of EPA SW-846 (U.S. EPA, 1982). Method 8240, including the purge and trap, should be performed for the volatile organics. A list of pollutant parameters detected and quantified by this method is presented in Table VI-5.

Method 8270 should be performed for the semi-volatile organics. Only the base/neutral semi-volatile organics would be present in solvents and fuel types, so an analysis for acid extractable semi-volatile organics would not be required. Method 8270 requires specific sample preparation steps prior to analysis. For the ground water samples a separatory funnel extraction (Method 3510) or a continuous extraction (Method 3520) can be performed. For the soil boring samples a soxhlet extraction (Method 3540) or a sonication

TABLE VI-5. LIST OF VOLATILE ORGANICS DETECTED USING EPA SW-846 METHOD 8240

Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon tetrachloride
Chlorobenzene
Chloroethane
2-Chloroethyl vinyl ether
Chloroform
Chloromethane
Dibromochloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
trans-1,2-Dichloroethene
1,2-Dichloropropane
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Ethyl benzene
Methylene chloride
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Trichlorofluoromethane
Vinyl chloride

Source: U.S. Environmental Protection Agency, "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, 2nd Edition, 1982.

(Method 3550) can be performed. A list of pollutant parameters detected and quantified by this method is presented in Table VI-6.

The oil and grease analysis on the aqueous samples should be performed in accordance with the specifications of EPA Method 413.2 (U.S. EPA, 1979). The TOC analysis should be performed in accordance with the specifications of EPA SW-846 Method 9060 (U.S. EPA, 1982).

TABLE VI-6. LIST OF BASE/NEUTRAL SEMI-VOLATILE ORGANICS DETECTED USING EPA SW-846 METHOD 8270

1,3-Dichlorobenzene	Phenanthrene	Indeno(1,2,3-c,d)pyrene
1,4-Dichlorobenzene	Anthracene	Dibenzo(a,h)anthracene
Hexachloroethane	β-BHC	Benzo(ghi)perylene
Bis(2-chloroethyl) ether	Heptachlor	N-Nitrosodimethyl amine
1,2-Dichlorobenzene	δ-BHC	Chlordane
Bis(2-chloroisopropyl) ether	Aldrin	Toxaphene
N-Nitrosodi-n-propyl amine	Dibutyl phthalate	PCB 1016
Nitrobenzene	Heptachlor epoxide	PCB 1221
Hexachlorobutadiene	Endosulfan I	PCB 1232
1,2,4-Trichlorobenzene	Fluoranthene	PCB 1242
Isophorone	Dieldrin	PCB 1248
Naphthalene	4,4'-DDE	PCB 1254
Bis(2-chloroethoxy) methane	Pyrene	PCB 1260
Hexachlorocyclopentadiene	Endrin	
2-Chloronaphthalene	Endosulfan II	
Acenaphthylene	4,4'-DDD	
Acenaphthene	Benzidine	
Dimethyl phthalate	4,4'-DDT	
2,6-Dinitrotoluene	Endosulfan sulfate	
Fluorene	Endrin aldehyde	
4-Chlorophenyl phenyl ether	Butyl benzyl phthalate	
2,4-Dinitrotoluene	Bis(2-ethylhexyl) phthalate	
Diethylphthalate	Chrysene	
N-Nitrosodiphenylamine	Benzo(a)anthracene	
Hexachlorobenzene	3,3'-Dichlorobenzidine	
α-BHC	Di-n-octyl phthalate	
4-Bromophenyl phenyl ether	Benzo(b)fluoranthene	
γ-BHC	Benzo(k)fluoranthene	
	Benzo(a)pyrene	

Source: U.S. Environmental Protection Agency, "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, 2nd Edition, 1982.

APPENDIX A

Resumes of Key Project Personnel
for the Phase I Records Search
at Wurtsmith AFB

FRANCIS J. SMITH

EDUCATION:

M.S., Sanitary Engineering, Massachusetts Institute of Technology, 1954.

B.S., Civil Engineering, University of Michigan, 1950.

EXPERIENCE:

Program Manager, Research and Engineering Operations, Radian Corporation, McLean, Virginia, 1981-Present.

Senior Associate, Occupational Health and Safety, Environmental Engineering, A.T. Kearney Management Consultants, Alexandria, Virginia, 1980-1981.

Acting Chief Environmental Planning, Logistics and Engineering, Headquarters USAF, Washington, D.C., 1979-1980.

Chief Environmental Policy, Logistics and Engineering, Headquarters USAF, Washington, D.C., 1976-1979.

Director Environmental Protection, Air Force Systems Command (AFSC), Andrews AFB, Maryland, 1972-1976.

Chief Bioenvironmental Engineering, Headquarters Pacific Air Force, Hickam AFB, Hawaii, 1968-1972.

Similar assignments at Headquarters Alaskan Air Command, Headquarters Tactical Air Command and at Subcommands of Strategic Air Command, 1951-1968.

Junior Industrial Waste Engineer, Lederle Division, American Cyanamide, Pearl River, New York, 1950-1951.

RELEVANT EXPERIENCE:

Mr. Smith is the program manager for the Radian Basic Ordering Agreement (BOA) with the Air Force Engineering and Services Center (AFESC). It includes provision of a broad range of environmental engineering and hazardous waste management services. He is also responsible for coordinating Radian marketing to the Department of Defense. Among the areas of concern are: all aspects of the environment, occupational safety and health, hazardous wastes, analytical services and robotics.

He was the certified industrial hygienist and consultant for A.T. Kearney Management Consultants. In addition to the routine occupational safety and health activities he specialized in the interpretation of the EPA RCRA regulations. He coordinated the preparation of the proposal to EPA which brought Kearney the award of the first contract to provide RCRA technical assistance to EPA.

While at Kearney, he also participated in a health and safety evaluation of cement plants that sought to burn chemical wastes. He co-authored a feasibility study on "Assessment of Waste Fuel Use in Cement Kilns." In the same area of concern, he prepared a Draft Environmental Impact Statement (DEIS) on the burning of chemical wastes at a cement kiln. For the National Highway Safety Transportation Agency, he prepared the technical portions of a report on the testing of truck tire noise.

For three of the last four years in his assignment with Headquarters USAF, he was responsible for the air, land and water pollution abatement programs. This included programming an average of $19 million per year. Also included were: the implementation of RCRA hazardous waste management; the first USAF installation restoration program (equivalent of CERCLA-superfund); management of 17 million acres of natural resources; and the NEPA environmental impact analysis program.

In addition to these activities, he assumed responsibility for one year for the rest of Environmental Planning. This included: comprehensive base planning; the Air Installation Compatibility Use Zone (AICUZ) plans for acquiring land near bases with high noise or accident potential; and development of environmental methodologies.

At the Air Force Systems Command (AFSC), Mr. Smith organized an office to address effects of the new Federal environmental laws on the Research, Development and Acquisition programs. This office, which reported to the AFSC Chief of Staff was the highest level environmental activity ever established at a USAF major command. He directed almost all of the environmental impact statements (EIS) issued by the Air Force in this period. As part of implementation of the National Environmental Policy Act, Mr. Smith implemented a computerized system for all Research and Development projects, programs, and tasks. The program is still used. On two occasions, he was an expert witness for the Federal government. One was a suit over the health hazards associated with the siting of new type radar stations in California and Massachusetts. The other pertained to the environmental impact statement (EIS) for new facilities at Colorado Springs, Colorado.

Additionally, he was responsible for advising on the industrial hygiene and environmental needs of government owned contractor operated (GOCO) industrial plants. In this assignment and all that follow, a part of each was spent in conducting health and environment compliance inspections and audits at military installations.

During his assignment to the Pacific Air Force, Mr. Smith provided environmental and industrial hygiene guidance to USAF activities in Korea, Japan, Taiwan, Vietnam, Thailand, Philippine Islands, Guam, Trust Territories and Hawaii. This included the traditional areas of sanitary engineering (water supply, treatment and distribution; waste collection, treatment and disposal; and pest control). It also included more modern problems, such as LASER equipment calibration, maintenance and use; handling of large volumes of herbicides; noise control; industrial hygiene; and heat and cold extremes; decontamination and quarantine of equipment to prevent introduction of foreign fauna or flora into the U.S.A. from Asia. For four years, Mr. Smith was a member of the United States delegation to the South East Asia Treaty Organization (SEATO) Military committee. He represented the U.S.A. with regard to public health engineering policies. Mr. Smith also evaluated USAF civic action programs to provide basic water and waste disposal to rural Thai villages.

The earlier USAF assignments in various commands provided environmental engineering and industrial hygiene support for the combat Air Force. Many of the previously mentioned activities were carried out as well as support for the current priority preventive medical activities. Some examples of the latter would be: defense against accidental release or delivery and use of chemical agents; improved water treatment plant operations; improved wastewater facilities and operations; conversion of dumps to sanitary fills; substitution of less toxic materials; engineering control of working exposures.

Mr. Smith worked for American Cyanamide on improving the industrial wastewater treatment of the flows from penicillin production.

CERTIFICATIONS/REGISTRATIONS AND PROFESSIONAL SOCIETIES:

Certified Industrial Hygienist by the American Board of Industrial Hygiene, 1971, No. 690.

Certified Safety Professional by the Board of Certified Safety Professionals of the Americas, 1972, No. 2103.

Registered Professional Engineer, State of Massachusetts, 1963, No. 19021.

Diplomate, American Academy of Environmental Engineers.

American Industrial Hygiene Association (National and Baltimore-Washington).

American Conference of Government Industrial Hygienists.

National (and Maryland) Society of Professional Engineers.

Federal Water Quality Association.

American Defense Preparedness Association.

Air Force Association.

MICHAEL A. ZAPKIN

EDUCATION:

M.Eng., Environmental Engineering, Rensselaer Polytechnic Institute, 1982.

M.S., Biology, Rensselaer Polytechnic Institute, 1979.

B.S., Biology, Rensselaer Polytechnic Institute, 1977.

EXPERIENCE:

Staff Environmental Engineer, Radian Corporation, McLean, Virginia, 1983-Present.

Environmental Engineer, Radian Corporation, McLean, Virginia, 1981-1983.

Research Associate, Department of Chemical Engineering and Environmental Engineering, Rensselaer Polytechnic Institute, Troy, New York, 1979-1981.

RELEVANT EXPERIENCE:

Mr. Zapkin is currently the Project Director for three USAF Record Searches which are Phase I's of the DOD Installation Restoration Program (IRP). As Project Director he is responsible for planning and coordinating all of the efforts of the Record Search Teams; schedule and budget control; and interfacing with the AFESC, MAJCOM, and installation representatives. His dual background as an environmental engineer and ecologist combined with his research on hazardous wastes from the organic chemical manufacturing industries have been of great value in this role.

Mr. Zapkin's work at Radian has primarily been in the areas of effluent guidelines development, process analysis, waste control technology analysis, and field sampling activities. Mr. Zapkin has served as Task Leader on a large multi-task contract with EPA's Effluent Guidelines Division to develop effluent limitations guidelines and standards for the nonferrous metals industry. In this capacity, he has directed efforts to propose regulations for the Nonferrous Metals Forming Point Source Category. Some of the activities under Mr. Zapkin's direction included: development of questionnaires to gather flow, production, and concentration data from industrial plants and an industry mailing list; development of an industry subcategorization scheme; engineering site visits and sampling trips at 23 industrial facilities; evaluation of end-of-pipe wastewater treatment technologies and in-process flow reduction technologies; developing compliance costs on a plant-by-plant basis; collecting, documenting, and analyzing additional technical data; preparation of a development document and rulemaking package; and numerous quick-response efforts. Prior to directing the effort for nonferrous metals forming, Mr. Zapkin served as Task Leader for the development of proposed regulations for the Aluminum Forming Point Source Category.

Mr. Zapkin has participated in a project for the Office of Solid Waste in developing engineering analysis documents for several processes in the industrial organic chemicals manufacturing industry. Waste stream sources were identified and characterized, with particular emphasis towards hazardous waste sources. Mr. Zapkin was involved with the literature search, process analysis, draft report writing, and identification of data gaps phases of the program.

On a project for the California Air Resource Board, Mr. Zapkin served as a Sampling Crew Chief for the field testing of 59 cyclic steam injected wells in a program to monitor emissions for these wells. Various sampling and analytical methods were employed to determine VOC emission factors from well vents associated with thermally enhanced oil recovery.

While at Rensselaer Polytechnic Institute, Mr. Zapkin worked on developing an adjuvant to enhance the disinfection efficiency of chlorine at high pH. He also worked on an EPA-funded project to study microbial populations at different points within a water treatment plant using activated carbon for organic removal, and along its distribution system.

PROFESSIONAL/TECHNICAL SOCIETIES:

Water Pollution Control Federation.

Virginia Water Pollution Control Association.

American Water Works Association.

Society for Industrial Microbiology.

Sigma Xi, The Scientific Research Society.

ANDREW M. OVEN

EDUCATION:

M.S., Environmental Engineering, University of California, Berkeley, 1983.

B.S., Civil Engineering, Santa Clara University, Santa Clara, California, 1982.

EXPERIENCE:

Environmental Engineer, Radian Corporation, McLean, Virginia, 1983-Present.

RELEVANT EXPERIENCE:

Mr. Oven is currently involved in supporting three Record Searches for USAF installations. They are Phase I's of the DOD Installation Restoration Program (IRP) which is concerned with the scoping and alleviation of hazardous waste site problems on military bases.

During the past year, Mr. Oven has worked on a program for EPA's Effluent Guidelines Division (EGD) to develop effluent limitations guidelines for plants in the nonferrous metals manufacturing category. This task involved compilation of information on nonferrous metal manufacturing processes from literature, analyzing industry response to questionnaires, and evaluating available sampling data from selected individual facilities for 21 subcategories. He was involved with drafting technical supplements supporting proposed effluent limitations guidelines and standards for several of these subcategories. Finally, Mr. Oven was responsible for compiling the public record in support of the nonferrous metals manufacturing phase II regulation.

PROFESSIONAL/TECHNICAL SOCIETIES:

American Society of Civil Engineers.

THOMAS G. GROME

EDUCATION:

B.S., Chemical Engineering, University of Cincinnati, 1982.

EXPERIENCE:

Chemical Engineer, Radian Corporation, McLean, Virginia, 1982-Present.

Lead Operator, Research Assistant, University of Cincinnati/U.S. Environmental Protection Agency, Cincinnati, Ohio, 1981.

Plant Engineer (co-op), Central Soya, Inc., Ft. Wayne, Indiana, 1980.

RELEVANT EXPERIENCE:

Mr. Grome is currently the chemical engineer for one USAF Phase I Record Search. This analyzes past hazardous waste disposal practices and their potential for release and/or migration of pollutants at USAF bases and properties.

Mr. Grome also is providing technical support to EPA's Effluent Guidelines Division (EGD) in response to litigation against effluent limitations guidelines for the nonferrous metals manufacturing point source category.

Prior work performed by Mr. Grome for EGD included participation in the development of effluent limitations guidelines for the nonferrous metals manufacturing point source category. His responsibilities included evaluation of industry process information and data analysis of sampling efforts. He was responsible for writing and revising portions of the development document supporting the regulation. Mr. Grome also evaluated plant wastewater treatment systems and discharge practices as groundwork for determination of the nonferrous metals industry costs of compliance, using a computer model developed by Radian.

Additionally, Mr. Grome participated in verification sampling efforts for EGD at nonferrous metals manufacturing and nonferrous metals forming plants. He also revised supplements to the proposed general development document for the secondary lead, secondary aluminum, and secondary silver industries within the nonferrous metals manufacturing category.

Mr. Grome has participated in a project sponsored by EPA's Office of Solid Waste (OSW) to characterize solid wastes at 20 primary aluminum and ferroalloys facilities. His responsibilities included conducting engineering site visits and sampling, data analysis, and trip report preparation.

Mr. Grome worked for the University of Cincinnati as a research assistant on the support staff at the U.S. Environmental Protection Agency Test and Evaluation Facility in Cincinnati, Ohio. As Lead Operator, Mr. Grome supervised the operation of pilot-scale municipal sewage and industrial waste treatment plants and managed the wet chemistry laboratory. He also assisted in preparing Facility and Laboratory Operating Procedures Manuals and developed a training program for newly hired research assistants.

Mr. Grome worked as a co-op plant engineer for Central Soya at the Marion, Ohio soybean processing plant. Involved with project work for capital improvements, his duties included drafting, equipment cost estimating and ordering, and contractor supervision. He also compiled a hazardous and toxic substances spill prevention and control program for the Marion plant.

PROFESSIONAL/TECHNICAL SOCIETIES:

American Institute of Chemical Engineers.

APPENDIX B

List of Interviewees

(Base Personnel and Outside Agency Contacts)

BASE PERSONNEL

Organization	Shop Affiliation	Years at Wurtsmith AFB
379 AMS	ECM	15
379 AMS	Fire Control	7
379 AMS	PMEL	2
379 FMS	NDI	1
379 FMS	Environmental Systems	9
379 FMS	Wheel and Tire	11
379 FMS	Propulsion	10
379 FMS	Pneudraulics	6
379 FMS	AGE	6
379 MMS	Integrated Maintenance	12
379 MMS	Munitions Maintenance	7
379 OMS	Tanker	8
379 OMS	Bomber	4
379 OMS	Support	22
379 CES	Entomology	16
379 CES	Real Property	7
379 CES	Fire Department	3
379 CES	Fire Department	14
379 CES	Environmental Coordinator	8
379 CES	Exterior Electric	18
379 CES	Interior Electric	18
379 CES	Roads and Grounds	12
379 CES	Roads and Grounds	19
379 CES	Civil Engineering	1
379 CES	Central Heating	10
379 CES	Water and Wastewater Treatment Plant	10
379 CES	Operations	22
379 Supply	Liquid Fuels	19
379 Supply	Bulk Fuels	2
379 Trans	Fire Department Maintenance	1
379 Trans	Vehicle Maintenance	8
379 Trans	Heavy Equipment	26
Personnel	Auto Hobby Shop	2
USAF Hospital	Bioenvironmental Engineering	5
DLA	DPDO	16
Retired	Roads and Grounds	29
Retired	Civil Engineering	30
Port Austin AFS	Commander	2
Port Austin AFS	Environmental	6
Empire AFS	Commander	1
Bay Shore AFS	Commander	21

OUTSIDE AGENCY CONTACTS

Name	Affiliation/Location
Larry Thornton	Michigan Department of Natural Resources, District Office, Roscommon, Michigan
Thomas Polasek	Michigan Department of Natural Resources, District Office, Roscommon, Michigan
Dennis Hall	Michigan Department of Natural Resources, Land Resource Programs Division, Lansing, Michigan
Glenn Hendrix	East Central Michigan Planning and Development Commission, Saginaw, Michigan
Ed Thompson	U.S.D.A. Soil Conservation Service, Lansing, Michigan
Rodney Petteys	Iosco County Cooperative Extension Office, Tawas City, Michigan

APPENDIX C

Hazard Assessment Rating Methodology (HARM) Used on Wurtsmith AFB

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with representatives from USAF Occupational Environmental Health Laboratory (OEHL), Air Force Engineering Services Center (AFESC), Engineering Science (ES) and CH_2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for six months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering Science, and CH_2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Record Search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

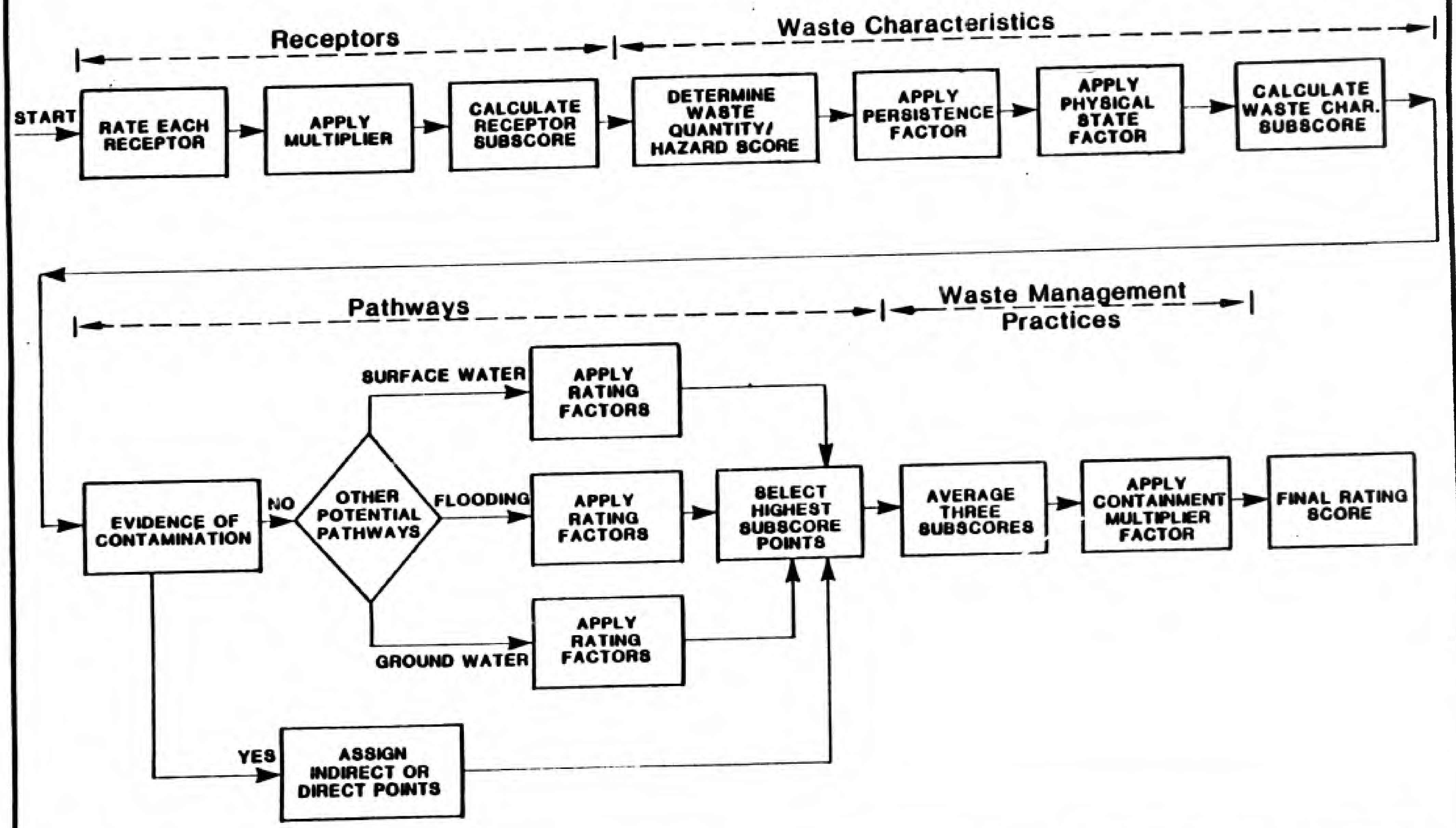
The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and groundwater migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by five percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART



HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE ____________________

LOCATION ____________________

DATE OF OPERATION OR OCCURRENCE ____________________

OWNER/OPERATOR ____________________

COMMENTS/DESCRIPTION ____________________

SITE RATED BY ____________________

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to reservation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Ground water use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by ground-water supply within 3 miles of site		6		
Subtotals			______	______

Receptors subscore (100 X factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) ______
2. Confidence level (C = confirmed, S = suspected) ______
3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points fc direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
Subtotals			______	______

Subscore (100 X factor score subtotal/maximum score subtotal) ______

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
Subtotals			______	______

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = ______

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES

1. **RECEPTORS CATEGORY**

Rating Factors	Rating Scale Levels: 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1-25	26-100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1-mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or Industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1-mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands	10
F. Water quality/use designation of nearest surface water body	Agricultural or Industrial use	Recreation, propagation and management of fish and wildlife	Shellfish propagation and harvesting	Potable water supplies	6
G. Ground-water use of uppermost aquifer	Not used, other sources readily available	Commercial, industrial, or irrigation, very limited other water sources	Drinking water, municipal water available	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1-15	51-1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1-50	51-1,000	Greater than 1,000	6

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records
- o Knowledge of types and quantities of wastes generated by shops and other areas on base

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site

A-3 Hazard Rating

Rating Factors	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

II. WASTE CHARACTERISTICS--Continued

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
	L	S	M
50	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:

Confidence Level
- o Confirmed confidence levels (C) can be added.
- o Suspected confidence levels (S) can be added.
- o Confirmed confidence levels cannot be added with suspected confidence levels.

Waste Hazard Rating
- o Wastes with the same hazard rating can be added.
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Multiply Point Rating Persistence Criteria	From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 Potential for Surface Water Contamination

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to +20 inches	Greater than +20 inches	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1-year 24-hour rainfall (Thunderstorms)	<1.0 inch	1.0 to 2.0 inches	2.1 to 3.0 inches	>3.0 inches	8

B-2 Potential for Flooding

Floodplain	Beyond 100-year floodplain	In 100-year floodplain	In 10-year floodplain	Floods annually	1

B-3 Potential for Ground-Water Contamination

Depth to ground water	Greater than 500 feet	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to + 20 inches	Greater than +20 inches	6
Soil permeability	Greater than 50% clay ($<10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($>10^{-2}$ cm/sec)	8

B-3 Potential for Ground-Water Contamination--Continued

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence, fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. Waste Management Practices Factor

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Fire Protection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1, or III-B-3, then leave blank for calculation of factor score and maximum possible score.

APPENDIX D

HARM Form for Rated Sites, Wurtsmith AFB

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site D-6 Landfill

LOCATION Northern Perimeter Road

DATE OF OPERATION OR OCCURRENCE 1960-1973

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION Tank trailers buried 1971-1974

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			142	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 78.9

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

60 x 1.0 = 60

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 100

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
Subtotals				

Subscore (100 X factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
Subtotals				

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 100

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78.9
Waste Characteristics	60
Pathways	100

Total 238.9 divided by 3 = 79.6 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

79.6 x 1.0 = 79.6

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-3 Fuel Spill

LOCATION Bulk Fuel Storage Area

DATE OF OPERATION OR OCCURRENCE 1960s to 1980

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			140	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 77.8

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

80 x 0.9 = 72

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

72 x 1.0 = 72

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points fo direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 100

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
Subtotals				

Subscore (100 X factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
Subtotals				

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 100

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	77.8
Waste Characteristics	72
Pathways	100

Total 249.8 divided by 3 = 83.3 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

83.3 x 0.95 = 79.1

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-7 TCE and Fuel Spill

LOCATION SAC Nosedock and Operational Apron Area

DATE OF OPERATION OR OCCURRENCE 1960s to Present

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			124	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 68.9

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

80 x 1.0 = 80

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

80 x 1.0 = 80

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 100

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
Subtotals			____	____

Subscore (100 X factor score subtotal/maximum score subtotal) ____

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ____

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
Subtotals			____	____

Subscore (100 x factor score subtotal/maximum score subtotal) ____

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 100

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	68.9
Waste Characteristics	80
Pathways	100

Total 248.9 divided by 3 = 83.0 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

83.0 x 0.95 = 78.9

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-2 TCE Spill

LOCATION Southwest of SAC Alert Apron

DATE OF OPERATION OR OCCURRENCE 1960s

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION Plume extends to Pierce's Point

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			144	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 80.0

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

50 x 1.0 = 50

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

50 x 1.0 = 50

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 100

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
		Subtotals		

Subscore (100 X factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
		Subtotals		

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 100

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	80.0
Waste Characteristics	50
Pathways	100

Total 230.0 divided by 3 = 76.7 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

76.7 x 1.0 = 76.7

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SB-1 Inactive Sludge Drying Beds

LOCATION Corner of Huron Ave and Perimeter Road

DATE OF OPERATION OR OCCURRENCE 1960s to 1982

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	146	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 81.1

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

50 x 1.0 = 50

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

50 x 0.75 = 37.5

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 100

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
Subtotals				

Subscore (100 X factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
Subtotals				

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 100

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	81.1
Waste Characteristics	37.5
Pathways	100

Total 218.6 divided by 3 = 72.9 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

72.9 x 1.0 = 72.9

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE: Site FT-2 Active Fire Training Area

LOCATION: South of center of SAC Instrument Runway

DATE OF OPERATION OR OCCURRENCE: 1958 to Present

OWNER/OPERATOR: Wurtsmith AFB

COMMENTS/DESCRIPTION: Concrete pit installed 1982

SITE RATED BY: MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	116	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 64.4

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

100 x 0.9 = 90

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

90 x 1.0 = 90

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	3	6	18	18
Surface erosion	2	8	16	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
Subtotals			74	108

Subscore (100 X factor score subtotal/maximum score subtotal) 68.5

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0.0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			58	114

Subscore (100 x factor score subtotal/maximum score subtotal) 50.9

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 68.5

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	64.4
Waste Characteristics	90
Pathways	68.5

Total 222.9 divided by 3 = 74.3 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

74.3 x 0.95 = 70.6

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-5 TCE Spill

LOCATION Northwest base housing area

DATE OF OPERATION OR OCCURRENCE 1960s to present

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			120	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 66.7

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

50 x 1.0 = 50

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

50 x 1.0 = 50

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 100

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
Subtotals			______	______

Subscore (100 X factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
Subtotals			______	______

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 100

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	66.7
Waste Characteristics	50
Pathways	100

Total 216.7 divided by 3 = 72.2 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

72.2 x 1.0 = 72.2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-8 JP-4 Spill

LOCATION Center of SAC Runway

DATE OF OPERATION OR OCCURRENCE November 1978

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION KC-135 lost engine

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			140	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 77.8

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 0.9 = 54

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

54 x 1.0 = 54

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
		Subtotals	58	108

Subscore (100 X factor score subtotal/maximum score subtotal) 53.7

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0.0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	58	114

Subscore (100 x factor score subtotal/maximum score subtotal) 50.9

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	77.8
Waste Characteristics	54
Pathways	53.7
Total 185.5 divided by 3 =	61.8 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

61.8 x 1.0 = 61.8

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-9 JP-4 Spill

LOCATION Northeast end of SAC runway

DATE OF OPERATION OR OCCURRENCE 1978

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION B52G blown fuel vent

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			140	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 77.8

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 0.9 = 54

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

54 x 1.0 = 54

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points fo direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
Subtotals			58	108

Subscore (100 X factor score subtotal/maximum score subtotal) 53.7

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0.0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			58	114

Subscore (100 x factor score subtotal/maximum score subtotal) 50.9

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	77.8
Waste Characteristics	54
Pathways	53.7

Total 185.5 divided by 3 = 61.8 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

61.8 x 1.0 = 61.8

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site FT-1 Inactive Fire Training Area

LOCATION North-northwest of Building 60

DATE OF OPERATION OR OCCURRENCE 1951-1958

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			140	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 77.8

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

50 x 0.9 = 45

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

45 x 1.0 = 45

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points fc direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
Subtotals			66	108

Subscore (100 X factor score subtotal/maximum score subtotal) 61.1

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0.0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			58	114

Subscore (100 x factor score subtotal/maximum score subtotal) 50.9

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 61.1

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	77.8
Waste Characteristics	45
Pathways	61.1

Total 183.9 divided by 3 = 61.3 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

61.3 x 1.0 = 61.3

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-12 MOGAS Spill

LOCATION Motor pool area (Building 394)

DATE OF OPERATION OR OCCURRENCE Mid 1970s

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			144	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 80.0

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 0.9 = 54

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

54 x 1.0 = 54

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
Subtotals			58	108

Subscore (100 X factor score subtotal/maximum score subtotal) 53.7

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0.0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			58	114

Subscore (100 x factor score subtotal/maximum score subtotal) 50.9

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	80.0
Waste Characteristics	54
Pathways	53.7

Total 187.7 divided by 3 = 62.6 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

62.6 x 0.95 = 59.5

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-11 JP-4 Spill

LOCATION Southwest end of SAC Taxiway

DATE OF OPERATION OR OCCURRENCE March 1982

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION B-52G hit snowbank

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	113	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 62.8

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 0.9 = 54

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

54 x 1.0 = 54

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
Subtotals			66	108

Subscore (100 X factor score subtotal/maximum score subtotal) 61.1

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0.0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			58	114

Subscore (100 x factor score subtotal/maximum score subtotal) 50.9

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 61.1

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	62.8
Waste Characteristics	54
Pathways	61.1

Total 177.9 divided by 3 = 59.3 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

59.3 x 1.0 = 59.3

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-17 Diesel fuel spill

LOCATION Port Austin AFS

DATE OF OPERATION OR OCCURRENCE 1982-present

OWNER/OPERATOR Port Austin AFS

COMMENTS/DESCRIPTION

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	2	6	12	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			150	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 83.3

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 0.9 = 54

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

54 x 1.0 = 54

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability		6		
Rainfall intensity		8		
Subtotals			26	66

Subscore (100 X factor score subtotal/maximum score subtotal) 39.4

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0.0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation	3	6	18	18
Soil permeability		8		
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			26	66

Subscore (100 x factor score subtotal/maximum score subtotal) 39.4

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 39.4

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	83.3
Waste Characteristics	54
Pathways	39.4

Total 176.7 divided by 3 = 58.9 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

58.9 x 1.0 = 58.9

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-10, JP-4 Spill

LOCATION Southwest end of SAC Instrument Runway

DATE OF OPERATION OR OCCURRENCE May 1984

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION A-7 Training plane crash

SITE RATED BY MAZ,

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	113	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 62.8

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

60 x 0.9 = 54

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

54 x 1.0 = 54

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points fo direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
Subtotals			66	108

Subscore (100 X factor score subtotal/maximum score subtotal) 61.1

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0.0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			58	114

Subscore (100 x factor score subtotal/maximum score subtotal) 50.9

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 61.1

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	62.8
Waste Characteristics	54
Pathways	61.1
Total 177.9 divided by 3 =	59.3 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

59.3 x 1.0 = 59.3

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site SP-14 JP-4 Spill

LOCATION Southwest of Building 3029

DATE OF OPERATION OR OCCURRENCE 1956-1957

OWNER/OPERATOR Wurtsmith AFB

COMMENTS/DESCRIPTION

SITE RATED BY MAZ, AMO, TGG

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	3	10	30	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			144	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 80.0

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

40 x 0.9 = 36

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

36 x 1.0 = 36

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points fo direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	3	6	18	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
Subtotals			58	108

Subscore (100 X factor score subtotal/maximum score subtotal) 53.7

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0.0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			58	114

Subscore (100 x factor score subtotal/maximum score subtotal) 50.9

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 53.7

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	80.0
Waste Characteristics	36
Pathways	53.7

Total 169.7 divided by 3 = 56.6 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

56.6 x 1.0 = 56.6

APPENDIX E

Inventory of Storage Tanks and Oil/Water Separators on Wurtsmith AFB

FUEL STORAGE TANKS OF LESS THAN 1,000 GALLONS CAPACITY[1]

Material	Facility	Volume (gal)	Type Storage[2,3]
Fuel Oil #2	288	750	B.G. Tank
Fuel Oil #2	302	550	B.G. Tank
Fuel Oil #2	385	500	B.G. Tank
Fuel Oil #2	3025	550	B.G. Tank
Fuel Oil #2	4004	550	B.G. Tank
Fuel Oil #2	5096	550	B.G. Tank
Fuel Oil #2	5328	550	B.G. Tank
Fuel Oil #2	5335	550	B.G. Tank
Fuel Oil #2	8260	500	B.G. Tank
Fuel Oil #2	5338	550	B.G. Tank
Fuel Oil #2	5346	550	B.G. Tank
Fuel Oil #2	5305	550	A.G. Tank
MOGAS (Leaded)	5076	275	A.G. Tank

[1]Does not include heating oil tanks at base housing areas.

[2]All tanks constructed of steel.

[3]B.G. - Below ground; A.G. - Above ground

Source: Wurtsmith AFB Civil Engineering Squadron

FUEL STORAGE TANKS OF 1,000 - 10,000 GALLONS CAPACITY[1]

Material	Facility	Volume (gal)	Type Storage[2,3]
JP-4 (Jet Fuel)	5011	2,000	B.G. Tank
JP-4 (Jet Fuel)	5011	2,000	B.G. Tank
Fuel Oil #2	16	2,000	A.G. Tank
Fuel Oil #2	70	1,000	B.G. Tank
Fuel Oil #2	283	1,000	B.G. Tank
Fuel Oil #2	460	1,000	B.G. Tank
Fuel Oil #2	460	1,000	B.G. Tank
Fuel Oil #2	1500	1,000	B.G. Tank
Fuel Oil #2	3001	1,000	B.G. Tank
Fuel Oil #2	5045	1,500	B.G. Tank
Fuel Oil #2	5070	1,000	B.G. Tank
Fuel Oil #2	5071	1,500	B.G. Tank
Fuel Oil #2	5109	6,000	B.G. Tank
Fuel Oil #2	5334	1,000	B.G. Tank
Fuel Oil #2	5336	1,500	B.G. Tank
Fuel Oil #2	5340	1,000	B.G. Tank
Fuel Oil #2	5600	1,000	B.G. Tank
Fuel Oil #2	8252	1,000	B.G. Tank
Fuel Oil #2	8254	1,000	B.G. Tank
Fuel Oil #2	5337	2,000	B.G. Tank
Fuel Oil #2	5354	2,000	B.G. Tank
Fuel Oil #2	8253	2,000	B.G. Tank
Fuel Oil #2	5306	6,000	B.G. Tank
Fuel Oil #2	5043	6,000	A.G. Tank
JP-9 (Jet Fuel)	5306	7,000	B.G. Tank
JP-9 (Jet Fuel)	5306	7,000	B.G. Tank
JP-9 (Jet Fuel)	5306	7,000	B.G. Tank
JP-10 (Jet Fuel)	5306	7,000	B.G. Tank
Diesel #2	305	1,500	B.G. Tank
Diesel #2	1842	1,500 (2 each)	B.G. Tank
Diesel #2	5046	2,500	B.G. Tank
Diesel #2	5079	2,500	B.G. Tank
Diesel #2	5336	1,500	B.G. Tank
MOGAS (Leaded)	1115	1,000	B.G. Tank
MOGAS (Unleaded)	5011	2,000	B.G. Tank

[1]Does not include heating oil tanks at base housing areas.

[2]All tanks constructed of steel.

[3]B.G. - Below ground; A.G. - Above ground

Source: Wurtsmith AFB Civil Engineering Squadron

FUEL STORAGE TANKS WITH CAPACITY OF 10,000 GALLONS OR GREATER

Material	Facility	Volume (gal)	Type Storage[2,3]
JP-4 (Jet Fuel)	7000	1,260,000	A.G. Tank
JP-4 (Jet Fuel)	7001	630,000	A.G. Tank
JP-4 (Jet Fuel)	7005	50,000	B.G. Tank
JP-4 (Jet Fuel)	7006	50,000	B.G. Tank
JP-4 (Jet Fuel)	7007	50,000	B.G. Tank
JP-4 (Jet Fuel)	7008	50,000	B.G. Tank
JP-4 (Jet Fuel)	7009	50,000	B.G. Tank
JP-4 (Jet Fuel)	7010	50,000	B.G. Tank
JP-4 (Jet Fuel)	7011	50,000	B.G. Tank
JP-4 (Jet Fuel)	7012	50,000	B.G. Tank
JP-4 (Jet Fuel)	5011	10,000	B.G. Tank
Fuel Oil #6	7039	210,000	A.G. Tank
Fuel Oil #2	7040	315,000	A.G. Tank
Fuel Oil #6	305	25,000	B.G. Tank
Fuel Oil #2	1950	10,000	B.G. Tank
Fuel Oil #2	5350	20,000	B.G. Tank
Diesel #2	5081	50,000	B.G. Tank
MOGAS (Leaded)	460	20,000	B.G. Tank
MOGAS (Leaded)	460	10,000	B.G. Tank
MOGAS (Unleaded)	460	20,000	B.G. Tank
MOGAS (Leaded)	5081	50,000	B.G. Tank
MOGAS (Unleaded)	5081	12,000	B.G. Tank
MOGAS (Unleaded)	5339	15,000	B.G. Tank
MOGAS (Leaded)	7003	25,000	A.G. Tank
MOGAS (Leaded)	7004	25,000	A.G. Tank
MOGAS (Leaded)	7297	12,000	B.G. Tank
MOGAS (Unleaded)	7297	10,000	B.G. Tank
MOGAS (Unleaded)	7297	10,000	B.G. Tank
Deicing Fluid	7002	25,000	A.G. Tank

[1]Does not include heating oil tanks at base housing areas.

[2]All tanks constructed of steel.

[3]A.G. - Above ground; B.G. - Below ground

Source: Wurtsmith AFB Civil Engineering Squadron

INDUSTRIAL WASTE STORAGE TANKS

Name	Facility	Key Compounds	Volume (gal)	Type Storage[1]	Tank Material
Slop Waste	43	PD680, Engine Oils, Fingerprint Remover	500	A.G. Tank	Steel
Slop Waste	140	PD680, Engine Oils, MOGAS, Diesel, Lubricating Oils, Ethylene Glycol	500	B.G. Tank	Concrete
Contaminated Fuel	351	#2 Fuel Oil, #6 Fuel Oil	2,000	B.G. Tank	Steel
Contaminated Fuel	361	JP-4 (Jet Fuel), MOGAS, Diesel	2,000	B.G. Tank	Steel
Contaminated Fuel	393	JP-4 (Jet Fuel), MOGAS, Engine Oils, PD680	600	Inside Building Flows to Separator	Concrete
Hoist Pits	394	Engine Oils, Lubricating Oils, MOGAS, PD680	1,500 (5 ea)	Inside Building	Concrete
Hoist Pits	394	Engine Oils, Lubricating Oils, MOGAS, PD680	1,000 (2 ea)	Inside Building	Concrete
Contaminated Fuel	394	Engine Oils, Lubricating Oils, MOGAS, PD680	500	Inside Building Flows to Separator	Concrete
Holding Tank	5001	Abandoned	1,500	B.G. Tank	N/A
Holding Tank	5008	Trichloroethylene	300	Inside Building	Steel

INDUSTRIAL WASTE STORAGE TANKS (Continued)

Name	Facility	Key Compounds	Volume (gal)	Type Storage[1]	Tank Material
Holding Tank	5009	PD680	112	Inside Building	Concrete
Contaminated Fuel	5073	JP-4	2,000	B.G. Tank	Steel
Contaminated Fuel	5075	JP-4	2,000	B.G. Tank	Steel
Contaminated Fuel	7112	JP-4, MOGAS, #2 Fuel Oil, #6 Fuel Oil	2,000	B.G. Tank	Steel
Waste Oil	5072	Hydraulic Fluids	500	B.G. Tank	Steel
Holding Tank	5031	JP-4, AFFF Foam	550	B.G. Tank	Concrete
Contaminated Fuel	5031	JP-4 (Jet Fuel)	12,000	B.G. Tank	Steel
Contaminated Fuel	5306	JP-9, JP-10	550	B.G. Tank	Steel
Lagoon	5306	Aqueous Film Forming Foam (AFFF)		A.G. Dike	N/A
Holding Tank	5043	Hydraulic Fluids, Diesel, MOGAS, PD680	1,000	A.G. Tank	Concrete
Holding Tank	5306	Hydraulic Fluids, Engine Oils, PD680	2,000	A.G. Tank	Steel

[1] A.G. - Above ground; B.G. - Below ground

LISTING OF OIL/WATER SEPARATORS LOCATED AT WURTSMITH AFB

Facility Number	Connection	Capacity
388	Auto Hobby Shop	500 gal
393	Refueling Vehicle Maintenance	1,785 gal
394	Vehicle Maintenance Shop	1,785 gal
396	Vehicle Operations Heated Parking	1,785 gal
396	Vehicle Operations	1,775 gal
460	Service Station	500 gal
5031	Fire Training Facility	100 gpm
5043	MMS AGE	4,500 gal
5060	Aircraft Maintenance Dock	1,600 gal
5061	Aircraft Maintenance Dock	1,600 gal
5062	Aircraft Fuels Systems Maintenance Dock	1,600 gal
5066	Aircraft Corrosion Control Hangar	1,600 gal
5067	Aircraft Maintenance Dock	1,600 gal
5068	Aircraft Maintenance Dock	1,600 gal
5306	Missile Assembly Shop	1,800 gal

Source: Wurtsmith Air Force Base Spill Prevention and Response Plan, 1984.

APPENDIX F

Supplemental Environmental Data

Analyses of trichloroethylene, dichloroethylene, and benzene in ground water

[Analyses by U.S. Geological Survey. ND indicates not detected.]

Well number	Date	Trichloro-ethylene (µg/L)	Dichloro-ethylene (µg/L)	Benzene (µg/L)
AF1	January 10, 1980	235	ND	ND
	January 30, 1980	192	ND	ND
	September 18, 1980	66	ND	ND
AF2	December 20, 1979	16	1.0	ND
	January 10, 1980	6.5	ND	ND
	January 30, 1980	4.5	ND	ND
	September 18, 1980	ND	ND	ND
AF3	December 20, 1979	1,665	ND	ND
	January 10, 1980	1,194	13	13
	January 30, 1980	2,000	ND	4.9
	September 18, 1980	4,300	ND	ND
	October 7, 1980	3,000	ND	40
AF4	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	January 30, 1980	ND	ND	ND
AF5	December 20, 1979	<1	ND	ND
	January 10, 1980	3.5	ND	ND
	January 30, 1980	<1	ND	ND
AF15	December 20, 1979	23	ND	ND
	January 10, 1980	70	ND	ND
	January 30, 1980	61	ND	ND
AF18	December 20, 1979	ND	ND	ND
	January 30, 1980	ND	ND	ND
AF22	January 31, 1980	15	ND	ND
	May 22, 1980	12	ND	ND
AF52	December 16, 1980	ND	ND	ND
AF55	October 7, 1980	130	ND	ND
AF57	December 20, 1979	938	69	ND
	January 10, 1980	186	180	ND
	January 30, 1980	780	87	ND
	January 31, 1980	1,100	187	ND
AF58,59,60[1]	October 7, 1980	400	3.6	ND
AF62	December 16, 1980	ND	ND	42
	March 12, 1981	ND	ND	64
AF65	October 7, 1980	ND	16	9.9
	March 10, 1981	ND	9.4	7.6
AF66	October 7, 1980	ND	ND	ND
	March 10, 1981	ND	ND	ND
AF67[2]	December 17, 1980	ND	ND	106
AF68[3]	December 17, 1980	ND	ND	1,458
AF69	December 17, 1980	ND	ND	53
AF70	December 17, 1980	ND	ND	ND
AF71	December 17, 1980	ND	ND	ND
AF72	December 17, 1980	ND	ND	ND
AF73[4]	December 16, 1980	ND	ND	227
AF74[5]	December 17, 1980	ND	ND	ND
	March 5, 1981	ND	ND	ND
AF75	December 17, 1980	ND	ND	ND
	March 5, 1981	ND	ND	ND
AF76	December 16, 1980	ND	ND	3.0
B4D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
B5D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
B10D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
G7S	March 3, 1981	32	2.0	ND
H1S	March 3, 1981	ND	ND	ND
H1D	March 3, 1981	ND	ND	ND
H2S	March 4, 1981	ND	ND	520
	April 1, 1981	ND	ND	460
H2D	March 4, 1981	ND	ND	ND
H3S	February 6, 1981	ND	2.0	ND
	March 4, 1981	ND	ND	ND
H3D	February 6, 1981	ND	1.0	ND
	March 4, 1981	ND	ND	ND
H4S	March 3, 1981	ND	ND	ND
H4D	February 6, 1981	ND	14	ND
	March 3, 1981	ND	20	ND
H5S	March 3, 1981	ND	ND	ND
H5D	February 6, 1981	ND	4.5	ND
	March 3, 1981	ND	ND	ND
H6S	February 6, 1981	800	16	ND
	March 4, 1981	821	10	ND
H6D	February 6, 1981	3.2	7.6	ND
	March 4, 1981	ND	ND	ND
H8S	March 11, 1981	ND	ND	ND
H8D	March 11, 1981	5.1	ND	ND
H10S	March 4, 1981	33	64	ND
H11S	March 11, 1981	ND	2.0	ND
H11D	March 11, 1981	ND	11	ND
H12S	March 11, 1981	ND	ND	ND
H12D	March 11, 1981	ND	ND	ND
H13S	March 11, 1981	125	ND	ND
H13D	March 11, 1981	ND	23	ND
H14S[6]	March 11, 1981	9.6	ND	ND
H14D	March 11, 1981	ND	ND	ND
O1D	December 20, 1979	ND	ND	ND

1/ Composite of water from wells.
2/ Water also contained other undifferentiated hydrocarbons.
3/ A second sample of water also contained 1,209 µg/L benzene, 51 µg/L toluene, and 438 µg/L other undifferentiated hydrocarbons on December 17, 1980.
4/ A second sample also contained 284 µg/L benzene and other undifferentiated hydrocarbons.
5/ Water also contained 4.0 µg/L tetrachloroethylene on March 5, 1981.
6/ Water also contained 21 µg/L tetrachloroethylene and 3.0 µg/L toluene.

Analyses of trichloroethylene, dichloroethylene, and benzene in ground water--Continued

Well number	Date	Trichloro-ethylene (µg/L)	Dichloro-ethylene (µg/L)	Benzene (µg/L)
O1D (Cont.)	January 10, 1980	ND	ND	ND
O2S	December 20, 1979	9.4	13	ND
	January 10, 1980	6.6	17	ND
	October 7, 1980	1.0	ND	ND
O2D	December 20, 1979	ND	ND	4.5
	January 10, 1980	ND	ND	ND
O3D	December 20, 1979	ND	ND	7.4
	January 10, 1980	ND	ND	ND
O4S	December 20, 1979	116	41	ND
	January 10, 1980	7.1	43	ND
	January 31, 1980	317	165	ND
	March 5, 1981	152	ND	ND
O4D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
	March 5, 1981	ND	ND	ND
O5S	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
O5D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	3.9
O6S	December 20, 1979	ND	ND	ND
	January 10, 1980	<1	ND	ND
	January 30, 1980	ND	ND	ND
	January 31, 1980	<1	ND	ND
	December 17, 1980	ND	ND	ND
O6D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	January 30, 1980	ND	ND	ND
	January 31, 1980	ND	ND	3.9
	December 17, 1980	ND	ND	ND
O7S	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	January 30, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
	September 17, 1980	ND	ND	ND
	March 11, 1981	ND	ND	ND
O7D	December 20, 1979	ND	266	ND
	January 10, 1980	ND	251	ND
	January 30, 1980	ND	192	ND
	January 31, 1980	ND	180	ND
	September 17, 1980	16	175	ND
	March 11, 1981	ND	84	ND
O8S	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND

Well number	Date	Trichloro-ethylene (µg/L)	Dichloro-ethylene (µg/L)	Benzene (µg/L)
O8S (Cont.)	January 30, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
O8D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	January 30, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
O9S	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
O9D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
O10S	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	4.5
	January 31, 1980	12	ND	ND
	December 18, 1980	ND	ND	ND
O10D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
	December 18, 1980	ND	ND	ND
R1S	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	August 13, 1980	ND	ND	ND
R1D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	August 13, 1980	ND	ND	ND
R2S	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
R2D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
R3S	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	January 30, 1980	1.3	ND	ND
	January 31, 1980	14	ND	ND
R3D	December 20, 1979	<1	ND	ND
	January 10, 1980	<3	ND	ND
	January 30, 1980	4.9	ND	ND
	January 31, 1980	13	ND	ND
R4S	January 10, 1980	<3	ND	ND
	January 30, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
	May 22, 1980	ND	ND	ND
R4D	December 20, 1979	<1	ND	ND
	January 10, 1980	<3	ND	ND
	January 30, 1980	<1	ND	ND
	January 31, 1980	11	ND	ND

Analyses of trichloroethylene, dichloroethylene, and benzene in ground water--Continued

Well number	Date	Trichloro-ethylene (μg/L)	Dichloro-ethylene (μg/L)	Benzene (μg/L)
R4D (Cont.)	May 22, 1980	ND	13	ND
R5S	December 20, 1979	<1	ND	ND
	January 10, 1980	<3	ND	ND
	January 30, 1980	<1	ND	ND
	January 31, 1980	<1	ND	ND
R5D	December 20, 1979	<1	ND	ND
	January 10, 1980	<1	ND	ND
	January 30, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
R6S	December 20, 1979	23	ND	ND
	January 10, 1980	34	ND	ND
	January 30, 1980	27	ND	ND
	January 31, 1980	22	ND	ND
	May 22, 1980	23	ND	ND
R6D	December 20, 1979	<1	ND	ND
	January 10, 1980	11	ND	ND
	January 30, 1980	<1	ND	ND
	January 31, 1980	6.2	ND	ND
	May 22, 1980	ND	ND	ND
R7S	December 20, 1979	1,652	40	ND
	January 10, 1980	1,780	50	ND
	January 30, 1980	2,380	ND	ND
	January 31, 1980	990	28	ND
	September 18, 1980	4,600	ND	ND
R7D	December 20, 1979	1,700	ND	ND
	January 10, 1980	1,600	ND	ND
	January 30, 1980	1,500	ND	ND
	January 31, 1980	1,200	ND	ND
R8S	December 20, 1979	<1	ND	ND
	January 10, 1980	<3	ND	ND
	January 30, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
R8D	December 20, 1979	<1	ND	ND
	January 10, 1980	<3	ND	ND
	January 30, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
R9S	December 20, 1979	4.9	ND	ND
	January 10, 1980	<5	ND	ND
	January 30, 1980	<1	ND	ND
	January 31, 1980	3.7	ND	ND
	March 3, 1981	ND	ND	ND
R9D	December 20, 1979	7.8	ND	ND
	January 10, 1980	<5	ND	ND
	January 30, 1980	ND	ND	ND
R9D (Cont.)	January 31, 1980	<1	ND	ND
	March 3, 1981	ND	6.0	ND
R10S 1/2/3/	December 20, 1979	ND	ND	1,000
	January 10, 1980	<5	ND	837
	January 30, 1980	ND	ND	75
	January 31, 1980	ND	ND	1,100
	December 17, 1980	ND	ND	1,309
R10D 2/	December 20, 1979	ND	ND	197
	January 10, 1980	71	ND	185
	January 30, 1980	ND	ND	96
	January 31, 1980	ND	ND	104
	December 17, 1980	ND	ND	319
R11S	December 20, 1979	<1	ND	ND
	January 10, 1980	<3	ND	ND
	January 30, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
R11D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	January 30, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
R12D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
R13S 4/	June 11, 1980	13	ND	ND
	August 13, 1980	12	ND	ND
R13D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	January 31, 1980	ND	ND	ND
	August 13, 1980	ND	ND	ND
R14S 5/	May 2, 1980	ND	29	13
	March 5, 1981	ND	23	9.1
R14D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	May 2, 1980	ND	ND	ND
	March 5, 1981	ND	ND	ND
R15D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
R16S	May 2, 1980	<1	37	5.9
	May 22, 1980	<1	ND	ND
	March 5, 1981	ND	39	4.8
R16D	December 20, 1979	ND	ND	ND
	January 10, 1980	ND	ND	ND
	May 2, 1980	ND	6.0	ND
	March 5, 1981	ND	ND	9.8
R17S	April 29, 1980	1,848	22	ND

1/ Water also contained toluene on January 31, 1980.
2/ Water also contained other undifferentiated hydrocarbons on December 17, 1980.
3/ Water also contained 21 mg/L total organic carbon on December 17, 1980.
4/ Water also contained a trace amount of tetrachloroethane on June 11, 1980; a second sample also contained 12 μg/L of trichloroethylene on June 11, 1980.
5/ Water also contained 3.8 μg/L toluene on March 5, 1981.

Analyses of trichloroethylene, dichloroethylene, and benzene in ground water--Continued

Well number	Date	Trichloro-ethylene (µg/L)	Dichloro-ethylene (µg/L)	Benzene (µg/L)
R17S (Cont.)	May 22, 1980	1,000	ND	ND
	September 17, 1980	2,100	ND	ND
R17D	April 29, 1980	<5	ND	ND
	May 22, 1980	ND	ND	ND
R18S	April 29, 1980	68	5.4	ND
	May 22, 1980	47	ND	ND
R18D	April 29, 1980	6.5	4.0	ND
	May 22, 1980	1.9	ND	ND
R19S	April 30, 1980	291	ND	ND
	May 22, 1980	247	ND	ND
	June 11, 1980	282	ND	ND
	August 13, 1980	250	ND	ND
R19D	April 30, 1980	10	ND	ND
	May 22, 1980	6.1	ND	ND
	August 13, 1980	ND	ND	ND
R20D	May 2, 1980	ND	ND	ND
R21S	May 2, 1980	ND	ND	ND
R22S	May 2, 1980	<1	29	28
	May 22, 1980	ND	31	8.9
	March 10, 1981	ND	17	3.1
R22D	March 10, 1981	ND	ND	ND
R23S	May 2, 1980	<1	ND	ND
R24D	May 1, 1980	<1	ND	ND
R25S	May 2, 1980	40	ND	ND
	May 22, 1980	65	ND	ND
R26D	May 1, 1980	<1	ND	ND
R27S	June 11, 1980	2.0	ND	ND
	August 13, 1980	ND	ND	ND
R27D	April 30, 1980	<1	ND	ND
	May 22, 1980	ND	3.0	ND
	August 13, 1980	2.0	ND	ND
R28S	June 11, 1980	ND	ND	ND
	August 13, 1980	ND	ND	ND
R29S	June 11, 1980	169	ND	ND
	August 13, 1980	265	ND	ND
R30S1/	June 11, 1980	13	ND	ND
	August 13, 1980	64	ND	ND
R31S	June 11, 1980	ND	ND	ND
	August 13, 1980	ND	ND	ND
R32S	June 11, 1980	ND	ND	ND
	August 13, 1980	ND	ND	ND
R33S	June 11, 1980	9.0	ND	ND
	August 13, 1980	ND	ND	ND
R34S	June 11, 1980	215	ND	ND
R34S (Cont.)	August 13, 1980	217	ND	ND
R35S	June 11, 1980	ND	ND	ND
	August 13, 1980	ND	ND	ND
R36S	June 11, 1980	387	ND	ND
	August 13, 1980	323	ND	ND
R36D	August 13, 1980	372	ND	ND
R37S2/	June 11, 1980	127	ND	ND
	August 13, 1980	169	ND	ND
R38S3/	June 11, 1980	3.3	ND	ND
	August 13, 1980	11	ND	ND
R39S	June 11, 1980	ND	ND	ND
	August 13, 1980	ND	ND	ND
	March 13, 1981	ND	ND	ND
R40S	August 13, 1980	30	ND	ND
R41S	August 13, 1980	ND	ND	ND
R42S	August 13, 1980	ND	ND	ND
R43S	August 13, 1980	ND	ND	ND
R44S	August 13, 1980	64	ND	ND
R45S	August 13, 1980	ND	ND	ND
R46S	August 13, 1980	186	ND	ND
R47S	August 13, 1980	33	ND	ND
R48S	August 13, 1980	ND	ND	ND
R49S	August 13, 1980	1,000	ND	ND
	September 17, 1980	526	ND	ND
R50S	August 13, 1980	1,074	ND	ND
	September 17, 1980	1,150	ND	ND
	October 30, 1980	867	ND	ND
R50D	October 30, 1980	1.0	ND	ND
R51S	August 13, 1980	21	ND	ND
R52S	August 13, 1980	19	ND	ND
R53S	August 13, 1980	ND	ND	ND
R54S	October 29, 1980	ND	ND	ND
R55S	October 29, 1980	274	ND	ND
R56S	October 28, 1980	6.7	ND	ND
R57S	October 28, 1980	2.4	ND	ND
R58S	October 28, 1980	ND	ND	ND
R59S	October 28, 1980	ND	ND	ND
R60S	October 28, 1980	12	ND	ND
R61S	October 28, 1980	ND	ND	ND
R62S	October 28, 1980	ND	ND	ND
R63S	October 29, 1980	10	ND	ND
R64S	October 29, 1980	5.5	ND	ND
R65S	October 29, 1980	ND	ND	ND
R66S	October 29, 1980	ND	ND	ND

1/ Water also contained 157 µg/L tetrachloroethylene on June 11, 1980; a second sample also contained 18 µg/L of trichloroethylene on June 11, 1980.
2/ Water also contained 16 µg/L tetrachloroethylene on August 13, 1980.
3/ A second sample also contained 3.9 µg/L trichloroethylene on June 11, 1980.

Analyses of trichloroethylene, dichloroethylene, and benzene in ground water--Continued

Well number	Date	Trichloro-ethylene (µg/L)	Dichloro-ethylene (µg/L)	Benzene (µg/L)
R67S	October 29, 1980	ND	ND	ND
R68S	October 29, 1980	ND	ND	ND
R69S	October 29, 1980	ND	ND	ND
R70S	October 29, 1980	ND	ND	ND
R71S	October 29, 1980	ND	ND	ND
R72S	October 30, 1980	ND	ND	ND
R73S	October 29, 1980	ND	ND	ND
R74S	October 30, 1980	ND	ND	ND
R75S	October 30, 1980	ND	ND	ND
R76S	March 12, 1981	3.9	ND	ND
R76D	March 12, 1981	22	ND	ND
R77S	March 12, 1981	5.0	ND	ND
R77D	March 12, 1981	53	ND	ND
R78S	December 18, 1980	ND	ND	ND
R78D	December 18, 1980	5.0	ND	ND
R79S	December 17, 1980	ND	ND	ND
R80S	December 17, 1980	17	ND	5.0
R80D	December 17, 1980	ND	ND	ND
R81S	December 17, 1980	5.0	ND	ND
R82S	December 18, 1980	ND	ND	ND
R82D	December 18, 1980	ND	ND	ND
R83S	December 18, 1980	8.0	ND	ND
R84S1/	December 18, 1980	54	ND	ND
R85S2/	December 18, 1980	ND	ND	ND
	March 5, 1981	48	ND	ND
R86S3/	December 18, 1980	ND	ND	ND
	March 5, 1981	ND	ND	40
R87D	December 18, 1980	ND	ND	ND
R88S	March 2, 1981	ND	145	3.1
R88D	March 2, 1981	ND	155	9.0
R89S	March 2, 1981	ND	ND	ND
R89D	March 2, 1981	ND	5.7	ND
R90S	March 10, 1981	ND	4.1	5.9
R91S	March 10, 1981	ND	ND	ND
R92S	March 10, 1981	ND	ND	ND
R93S	March 10, 1981	ND	ND	ND
R94S	March 10, 1981	ND	ND	ND
R94D	March 12, 1981	ND	ND	ND
R95S	March 10, 1981	ND	ND	ND
C. Pierce well4/	May 22, 1980	462	ND	ND
W. Brown well	May 22, 1980	ND	ND	ND
E. Korroch well	May 22, 1980	ND	ND	ND

1/ Water also contained 12 µg/L tetrachloroethylene.
2/ Water also contained 13 µg/L tetrachloroethylene on March 5, 1981.
3/ Water also contained 37 µg/L of other undifferentiated hydrocarbons calculated as benzene on March 5, 1981.
4/ A second sample also contained 642 µg/L trichloroethylene.

Chemical, physical, and biological characteristics of ground water

[Analyses by U.S. Geological Survey]

Well number	Date	Gross alpha, total (ug/L as U natural)a/	Gross beta, total (pCi/L as Cs 137)a/	Gross beta, total (pCi/L as Sr-90)a/	Biochemical oxygen demand, 5-day (mg/L)	Cadmium, total recoverable (ug/L as Cd)	Chemical oxygen demand (mg/L)	Chloride, dissolved (mg/L as Cl)	Chromium, total recoverable (ug/L as Cr)	Copper, total recoverable (ug/L as Cu)	Fecal coliform, 0.7 micron membrane filter (Cols./100 mL)
B4D	July 16, 1980	<2.7	<1.6	<1.5	6.1	0	0	8.8	10	20	<1
B5D	July 15, 1980	<3.6	<1.1	<1.0	7.5	0	7	.9	10	10	<1
B10D	July 16, 1980	<2.5	<1.2	<1.1	8.0	0	16	.9	10	0	<1
02S	July 14, 1980	<6.1	<3.1	<3.0	14.2 b/	0	27	21	10	10	K1 c/
03D	July 16, 1980	<3.3	<1.1	<1.0	7.5	0	4	1.0	10	10	<1
04S	July 16, 1980	<10	<4.5	<4.4	7.1	0	12	3.6	10	10	<1
06D	July 14, 1980	<8.5	<5.0	<4.8	7.4	0	39	8.5	10	0	<1
07D	July 16, 1980	<10	<6.2	<5.9	8.1	0	4	3.4	10	10	K1 c/
09D	July 15, 1980	<1.7	<.8	<.8	3.1	0	0	3.9	10	10	<1
R4D	July 15, 1980	<5.9	<2.2	<2.0	7.1	0	11	17	30	0	<1
R9S	July 15, 1980	<3.7	2.4	2.2	3.6	0	4	7.4	20	0	<1
R10S	July 15, 1980	<12	<6.2	<6.0	7.6 b/	0	66	4.3	10	0	<1
R12D	July 15, 1980	<2.9	<1.0	<.9	7.2	0	13	1.3	<10	0	<1
R14D	July 15, 1980	<9.9	<5.2	<5.0	7.8 b/	0	33	16	10	0	K2 c/
R14S	July 15, 1980	<7.9	5.8	5.6	4.8	0	20	13	10	10	<1
R15D	September 18, 1980	--	--	--	--	--	--	1.2	--	--	--
R16S	September 17, 1980	<15	<8.4	<8.1	4.8 b/	--	43	17	--	--	<1
R17S	July 15, 1980	<4.8	2.5	2.3	6.0	0	0	12	20	0	<1
R20D	July 16, 1980	<2.1	<1.3	<1.3	7.3	0	0	1.1	10	0	<1
R21S	July 16, 1980	<3.7	1.8	1.6	1.1	0	9	.9	10	0	<1
R22S	July 16, 1980	<13	11	11	13.8 b/	--	12	14	20	0	<1
R23S	July 14, 1980	<3.0	<1.0	<.9	.0	0	6	3.2	10	0	<1
R24D	July 16, 1980	<2.7	<1.3	<1.2	7.3	0	18	1.7	10	0	<1
R25S	September 18, 1980	--	--	--	4.9 b/	--	--	--	--	--	--
R27S	July 14, 1980	<5.2	<2.1	<2.0	6.8	0	1	1.1	10	10	1
R29S	July 16, 1980	<2.2	<1.2	<1.1	7.2	0	0	1.9	10	10	<1
R36S	July 16, 1980	<3.4	<1.2	<1.1	6.9	0	1	2.4	30	0	<1
R39S	September 17, 1980	<1.2	<.7	<.7	6.3 b/	--	39	1.3	--	--	<1
AF1	July 15, 1980	<5.5	<2.1	<2.1	4.7	0	6	7.0	10	0	<1
AF2	July 15, 1980	<5.8	<2.1	<2.0	7.2	0	9	7.0	<10	10	<1
AF4	July 15, 1980	<3.0	<1.8	<1.7	8.8 b/	0	21	2.8	20	0	<1
AF5	July 15, 1980	<2.3	<1.3	<1.2	[illegible]	0	7	1.7	10	10	<1
AF15	July 15, 1980	<12	9.0	8.6	7.2	0	8	18, 18d/	10	10	<1
AF18	July 15, 1980	<2.2	<1.6	<1.5	4.0	0	7	4.4	10	30	<1
AF57	July 15, 1980	<3.9	<2.2	<2.0	2.7	0	12	3.0	10	10	<1

a/ Samples collected September 17, 1980.
b/ Samples collected September 17 and 18, 1980.
c/ K - Non-ideal colony count (less than 20 colonies on filter).
d/ Samples collected September 18, 1980.

Chemical, physical, and biological characteristics of ground water--Continued

Well number	Date	Fecal streptococci, KF agar (Cols./100 mL)	Lead, total recoverable (µg/L as Pb)	Mercury, total recoverable (µg/L as Hg)	Nickel, total recoverable (µg/L as Ni)	Nitrite plus nitrate, total (mg/L as N)	Oil and grease (mg/L)	pH (units)	Phosphorus, total (mg/L as P)	Phosphorus, ortho, total (mg/L as PO_4)	Selenium, total (µg/L as Se)	Specific conductance (micromhos)	Zinc, total recoverable (µg/L as Zn)
B4D	July 16, 1980	<1	0	<0.1	0	0.02	0.0	8.0	0.01	0.03	0	346	170
B5D	July 15, 1980	<1	0	<.1	0	.01	.0	7.9	.03	.09	0	290	560
B10D	July 16, 1980	K1 a/	0	<.1	0	.00	.0	7.8	.00	.00	0	278	1,300
02S	July 14, 1980	K5 a/	0	<.1	100	.01	.0	7.7	1.2	3.7	0	616	260
03D	July 16, 1980	<1	0	<.1	0	.00	2	7.7	.01	.03	0	293	500
04S	July 16, 1980	<1	0	<.1	0	.08	1	7.7	.00	.00	0	625	200
06D	July 14, 1980	<1	0	.1	0	.01	.0	7.7	.02	.06	0	732	320
07D	July 16, 1980	<1	0	<.1	0	.01	.0	7.8	.01	.03	0	592	390
09D	July 15, 1980	<1	0	<.1	0	1.8	1	7.9	.01	.03	0	219	120
R4D	July 15, 1980	<1	0	<.1	0	.00	1	7.8	.00	.00	0	652	450
R9S	July 15, 1980	<1	0	<.1	0	4.7	1	7.8	.00	.00	0	423	110
R10S	July 15, 1980	<1	0	<.1	0	.00	3	7.4	.01	.03	0	760	510
R12D	July 15, 1980	<1	0	<.1	0	.00	1	7.8	.01	.03	0	274	580
R14D	July 15, 1980	<1	0	<.1	0	2.6	1	7.5	.03	.09	0	794	370
R14S	July 15, 1980	K10 a/	0	<.1	0	.01	1	7.4	.01	.03	0	713	80
R15D	September 18, 1980	--	--	--	--	--	--	7.7	--	--	--	298	--
R16S	September 17, 1980	<1	--	<.1	--	.03	--	7.2	--	--	0	761	--
R17S	July 15, 1980	K1 a/	0	<.1	0	7.6	2	7.6	.00	.00	0	544	30
R20D	July 16, 1980	<1	0	<.1	0	5.9	2	8.0	.01	.03	0	298	20
R21S	July 16, 1980	<1	0	<.1	0	9.3	2	7.8	.01	.03	0	315	20
R22S	July 16, 1980	<1	--	<.1	--	.04	2	7.2	.01	.03	0	360	50
R23S	July 14, 1980	<1	0	<.1	0	.82	.0	7.8	.01	.03	0	247	50
R24D	July 16, 1980	K1 a/	0	<.1	0	.00	.0	7.9	.01	.03	0	276	40
R25S	September 18, 1980	--	--	--	--	--	--	--	--	--	--	--	--
R27S	July 14, 1980	K11 a/	0	<.1	0	.03	2	7.7	.01	.03	0	472	30
R29S	July 16, 1980	<1	0	<.1	100	.48	.0	8.0	.01	.03	0	274	40
R36S	July 16, 1980	<1	0	<.1	0	10	2	7.8	.00	.00	0	338	20
R39S	September 17, 1980	<1	--	<.1	--	.53	--	7.7	--	--	0	183	--
AF1	July 15, 1980	<1	0	<.1	0	3.5	1	7.6	.00	.00	0	475	10
AF2	July 15, 1980	<1	0	.1	0	3.1	4	7.8	.03	.09	0	466	10
AF4	July 15, 1980	<1	0	<.1	0	2.2	1	7.8	.00	.00	0	413	50
AF5	July 15, 1980	<1	0	<.1	0	2.3	1	7.9	.01	.03	0	295	10
AF15	July 15, 1980	K1 a/	0	<.1	0	28, 25 b/	1	7.7	.00	.00	0	798	40
AF18	July 15, 1980	K3 a/	0	<.1	0	.02	1	8.1	.01	.03	0	287	10
AF57	July 15, 1980	<1	0	.1	0	1.8	.0	7.8	.01	.03	0	468	100

a/ K - Non-ideal colony count (less than 20 colonies on filter).
b/ Samples collected September 18, 1980.

Analyses of well cores, soils, and sludge bed material for hydrocarbons

[Analyses by U.S. Geological Survey. ND indicates not detected.]

Location	Date	Depth (feet)	Tri-chloro-ethylene (μg/kg)	Di-chloro-ehtylene (μg/kg)	Benzene (μg/kg)	Toluene (μg/kg)	Total undifferentiated hydrocarbons, calculated as benzene (μg/kg)
Sludge Bed 1	May 6, 1981	1	ND	ND	ND	ND	ND
Sludge Bed 1	May 6, 1981	5	ND	ND	ND	ND	ND
Sludge Bed 2	May 6, 1981	1	ND	ND	9.0	ND	ND
Sludge Bed 2	May 6, 1981	5	ND	ND	ND	ND	13
Sludge Bed 3	May 6, 1981	1 a/	ND	10 b/	17	ND	82
Sludge Bed 3	May 6, 1981	5	ND	6.1 b/	4.1	ND	124
Sludge Bed 4	May 6, 1981	1 c/	ND	12 b/	7.6	ND	157
Sludge Bed 4	May 6, 1981	5 d/	ND	trace	ND	ND	93
Sludge Material, Bed 3	May 6, 1981	Surface	ND	ND	ND	34	18
Site A	May 6, 1981	1	ND	ND	ND	ND	ND
Site A	May 6, 1981	5	ND	ND	29	ND	54
Site B	May 6, 1981	1	ND	ND	5.5	ND	17
Site B	May 6, 1981	5	ND	ND	ND	ND	ND
Well R76D	March 12, 1981	5	ND	ND	6.0	2.7	13
Well R76D	March 12, 1981	10	ND	ND	10	3.1	10
Well R76D	March 12, 1981	20	--	-	--	--	--
Well R76D	March 12, 1981	40	ND	ND	ND	ND	ND
Well R76D	March 12, 1981	50	ND	ND	ND	ND	ND
Well R77D	March 12, 1981	5	ND	ND	2.0	ND	8.0
Well R77D	March 12, 1981	10	ND	ND	1.0	ND	6.0
Well R77D	March 12, 1981	15	--	--	--	--	--
Well R77D	March 12, 1981	30	ND	ND	4.7	ND	ND
Well R77D	March 12, 1981	50	ND	ND	43	5.7	32

a/ Sample also contained methylene chloride (12 μg/kg).
b/ trans 1,2-Dichloroethylene
c/ Sample also contained methylene chloride (68 μg/kg), and tetrachloroethylene (11 μg/kg).
d/ Sample also contained methylene chloride (26 μg/kg).

Location and identification of wells at Wurtsmith Air Force Base

Local identifier	Altitude of measuring point (feet)	Depth of well below land surface (feet)	Casing diameter (inches)	Height of measuring point above land surface (feet)	Water level below measuring point (feet)	Date water level measured
AF OBS 4	628.88	--	4.00	--	12.33	4-22-80
AF OBS 6	629.64	23.0	4.00	--	12.95	4-22-80
AF OBS 7	629.58	--	4.00	--	16.94	4-22-80
AF 1	--	65.2	12.00	--	--	--
AF 2	--	63.7	12.00	--	--	--
AF 2A	612.8	56.0	2.00	1.7	31.04	4-22-80
AF 3	--	67.0	12.00	--	--	--
AF 3A	615.5	70.0	2.00	--	28.44	10-27-80
AF 4	--	62.0	16.00	--	--	--
AF 4A	613.9	48.9	2.00	3.0	28.01	4-22-80
AF 5	--	62.0	16.00	--	--	--
AF 5A	611.5	50.2	2.00	2.5	25.55	4-22-80
AF 7	--	21.0	1.25	--	--	--
AF 8	--	23.0	1.25	--	--	--
AF15	--	35.0	4.00	--	--	--
AF18	--	66.5	12.00	--	--	--
AF18A	617.33	52.4	1.25	1.4	17.60	4-22-80
AF19	--	70.0	12.00	--	--	--
AF22	--	47.0	--	--	--	--
AF50	616.91	32.0	1.50	1.7	21.70	1-30-80
AF51	611.77	22.0	1.50	--	22.50	1-30-80
AF52	611.30	28.0	1.25	1.5	20.14	1-30-80
AF53	612.74	22.0	1.25	1.0	17.32	1-30-80
AF54	618.68	32.7	1.25	1.8	22.57	1-30-80
AF55	--	55.0	4.00	--	--	--
AF56	--	55.0	4.00	--	--	--
AF57	--	55.0	4.00	--	--	--
AF58	--	--	--	--	--	--
AF59	--	--	--	--	--	--
AF60	--	--	--	--	--	--
AF61	618.81	22.0	1.50	--	21.42	1-30-80
AF62	612.71	32.0	1.50	--	18.37	1-30-80
AF63	611.22	32.0	1.25	--	18.95	1-30-80
AF64	610.71	27.0	1.25	--	20.01	1-30-80
AF65	619.89	28.5	1.50	1.9	--	--
AF66	618.22	28.8	1.50	2.2	--	--
AF67	614.45	22.3	1.25	1.9	18.77	3-24-81
AF68	615.39	22.2	1.25	1.7	19.56	3-24-81
AF69	615.47	21.8	1.25	2.4	19.54	3-24-81
AF70	614.48	23.0	1.25	1.1	18.06	3-24-81
AF71	615.32	22.9	1.25	1.3	18.42	3-24-81
AF72	615.26	22.8	1.25	1.3	18.38	3-24-81
AF73	615.68	22.8	1.25	1.4	19.98	3-24-81
AF74	614.56	22.5	1.25	1.7	19.58	3-24-81
AF75	614.53	22.4	1.25	1.7	19.73	3-24-81
AF76	614.30	22.4	1.25	1.8	21.03	3-24-81
B 4D	636.52	39.6	4.00	2.4	16.83	1-30-80
B 5D	627.25	64.3	4.00	3.0	7.69	1-30-80
B10D	620.30	62.7	4.00	2.3	12.76	1-30-80
G 1S	630.04	20.1	1.25	3.0	11.45	1-30-80
G 2S	628.67	22.3	1.25	3.3	16.87	1-30-80
G 3S	627.64	22.9	1.25	3.0	19.37	1-30-80
G 4S	620.57	15.4	1.25	2.7	13.05	1-30-80
G 5S	623.98	14.8	1.25	3.2	15.36	1-30-80
G 7S	619.38	22.9	1.25	2.8	18.51	1-30-80
G 8S	616.33	23.4	1.25	3.4	24.44	1-30-80
G 9S	608.63	21.5	1.25	2.2	20.76	1-30-80
G10S	614.71	25.1	1.25	1.2	26.15	12-05-79
G11S	608.02	21.5	1.25	1.3	20.12	1-30-80
G12S	613.57	22.0	1.25	2.1	23.05	1-30-80
G14S	618.11	25.3	1.25	3.0	22.80	1-30-80
G15S	617.50	25.0	1.25	3.1	22.28	1-30-80
G16S	617.97	25.0	1.25	2.9	22.63	1-30-80
G17S	618.04	25.5	1.25	2.6	22.42	1-30-80
G18S	619.09	25.3	1.25	2.8	23.18	1-30-80

Local identifier	Altitude of measuring point (feet)	Depth of well below land surface (feet)	Casing diameter (inches)	Height of measuring point above land surface (feet)	Water level below measuring point (feet)	Date water level measured
G19S	632	19.6	1.25	3.7	9.13	1-30-80
G20S	615.07	22.5	1.25	3.2	20.45	1-30-80
G21S	623.98	12.7	1.25	3.0	11.34	1-30-80
G22M	637.58	29.0	1.25	3.6	17.95	1-30-80
G22S	637.09	18.3	1.25	3.0	17.45	1-30-80
G23S	628	15.2	1.25	3.0	10.20	1-30-80
G24S	626	14.8	1.25	3.3	8.13	1-30-80
G25S	629	18.3	1.25	4.3	7.43	1-30-80
G26S	626	14.6	1.25	3.2	6.99	1-30-80
H 1D	--	65	4.00	1.9	16.91	3-03-81
H 1S	--	28	4.00	1.8	16.62	3-03-81
H 2D	620.99	65	4.00	2.0	17.70	3-23-81
H 2S	621.13	28	4.00	1.8	17.46	3-23-81
H 3D	621.46	60	4.00	2	18.09	3-23-81
H 3S	621.47	28	4.00	2	18.66	3-23-81
H 4D	621.28	65	4.00	1.9	19.08	3-23-81
H 4S	621.11	28	4.00	1.9	18.93	3-23-81
H 5D	621.32	65	4.00	1.9	20.05	3-23-81
H 5S	621.20	28	4.00	1.9	19.96	3-23-81
H 6D	620.53	65	4.00	2	19.57	3-23-81
H 6S	620.70	28	4.00	1.8	19.73	3-23-81
H 8D	617.59	65	4.00	1.8	17.75	3-23-81
H 8S	617.63	28	4.00	1.9	17.79	3-23-81
H10S	619.74	28	4.00	1.8	19.27	3-23-81
H11D	617.79	65	4.00	1.7	18.73	3-23-81
H11S	617.78	28	4.00	1.5	18.67	3-23-81
H12D	617.81	65	4.00	1.7	18.71	3-23-81
H12S	617.81	28	4.00	1.5	18.71	3-23-81
H13D	618.48	65	4.00	1.8	19.47	3-23-81
H13S	618.32	28	4.00	1.7	19.31	3-23-81
H14D	617.90	60	4.00	1.6	19.09	3-23-81
H14S	617.79	28	4.00	1.6	18.96	3-23-81
O 1D	627.48	60.5	4.00	3.0	11.42	1-30-80
O 2D	626.71	41.0	4.00	2.3	13.87	1-30-80
O 2S	626.21	29.5	4.00	2.6	13.17	1-30-80
O 3D	620.36	67.0	4.00	2.0	12.28	1-30-80
O 4D	617.70	59.9	4.00	2.6	17.73	1-30-80
O 4S	617.38	26.3	4.00	2.2	17.35	1-30-80
O 5D	616.93	65.4	4.00	3.1	19.07	1-30-80
O 5S	616.26	27.2	4.00	2.2	18.77	1-30-80
O 6D	615.43	54.8	4.00	3.0	23.24	1-30-80
O 6S	614.57	30.0	4.00	2.1	23.35	1-30-80
O 7D	618.58	63.5	4 00	3.2	19.91	1-30-80
O 7S	617.59	27.2	4.00	2.1	18.87	1-30-80
O 8D	614.58	56.5	4.00	2.3	18.73	1-30-80
O 8S	614.94	28.7	4.00	2.7	19.06	1-30-80
O 9D	611.23	50.0	4.00	2.2	19.21	1-30-80
O 9S	611.89	30.8	4.00	2.7	19.88	1-30-80
O10D	609.70	47.4	4.00	3.4	20.72	1-30-80
O10S	609.55	31.3	4.00	2.7	20.49	1-30-79
R 1D	617.67	68.8	4.00	3.0	22.41	1-30-80
R 1S	617.39	29.4	4.00	2.6	22.12	1-30-80
R 2D	616.34	67.8	4.00	2.7	21.77	1-30-80
R 2S	615.96	29.9	4.00	2.6	21.59	1-30-80
R 3D	609.22	53.9	4.00	3.1	20.33	1-30-80
R 3S	609.47	33.3	4.00	3.3	20.53	1-30-80
R 4D	612.69	57.4	4.00	3.1	23.52	1-30-80
R 4S	611.84	28.8	4.00	2.2	22.62	1-30 80
R 5D	615.53	58.5	4.00	2.0	22.12	1-30-80
R 5S	615.15	32.5	4.00	2.0	21.90	1-30-80
R 6D	616.17	60.7	4.00	2.3	23.17	1-30-80
R 6S	616.79	30.4	4.00	3.1	23.73	1-30-80
R 7D	616.12	58.3	4.00	1.7	21.16	1-30-80
R 7S	616.75	28.8	4.00	2.4	21.89	1-30-80
R 8D	616.43	57.0	4.00	3.0	20.28	1-30-80

Location and identification of wells at Wurtsmith Air Force Base--Continued

Local identifier	Altitude of measuring point (feet)	Depth of well below land surface (feet)	Casing diameter (inches)	Height of measuring point above land surface (feet)	Water level below measuring point (feet)	Date water level measured
R 8S	615.89	28.3	4.00	2.2	19.82	1-30-80
R 9D	618.80	62.9	4.00	2.1	20.68	1-30-80
R 9S	619.59	28.4	4.00	3.1	21.44	1-30-80
R10D	615.39	60.5	4.00	2.5	20.65	1-30-80
R10S	615.25	28.0	4.00	2.2	20.50	1-30-80
R11D	613.72	56.0	4.00	2.8	20.62	1-30-80
R11S	614.73	26.1	4.00	3.6	21.77	1-30-80
R12D	622.67	73.0	4.00	3.3	29.96	1-30-80
R13D	616.88	70.6	4.00	2.7	22.43	1-30-80
R13S	616.02	34.5	4.00	2.0	20.55	7-15-80
R14D	618.05	65.6	4.00	2.6	16.47	1-30-80
R14S	618.03	33.1	4.00	2.5	15.42	7-15-80
R15D	625.98	78.0	4.00	2.8	21.70	1-30-80
R16D	622.0[illegible]	61.1	4.00	2.6	17.69	1-30-80
R16S	621.55	33.4	4.00	2.4	[illegible]	7-16-80
R17D	616.60	62.2	4.00	2.7	23.89	4-16-80
R17S	616.22	33.6	4.00	2.0	23.34	4-16-80
R18D	616.42	57.3	4.00	2.1	23.33	4-15-80
R18S	616.54	36.0	4.00	2.0	23.43	4-15-80
R19D	616.74	67.6	4.00	2.8	23.74	4-15-80
R19S	616.54	38.8	4.00	2.5	23.59	4-15-80
R20D	615.09	44.0	4.00	2.4	22.81	5-02-80
R21S	617.80	32.7	4.00	2.8	19.89	5-02-80
R22D	618.69	54.9	4.00	1.6	12.89	3-11-81
R22S	618.98	32.6	4.00	2.3	13.15	3-11-81
R23S	617.22	33.7	4.00	2.1	21.99	5-02-80
R24D	626.18	43.9	4.00	2.4	17.05	5-02-80
R25S	613.38	33.7	4.00	2.3	21.21	5-02-80
R26D	632.05	44.0	4.00	2.2	10.56	5-02-80
R27D	614.94	44.0	4.00	2.5	20.18	6-10-80
R27S	614.67	34.6	4.00	1.9	19.98	6-10-80
R28S	609.20	34.7	4.00	1.8	18.32	6-09-80
R29S	613.10	34.6	4.00	1.9	21.75	6-09-80
R30S	615.60	34.4	4.00	2.1	22.65	6-09-80
R31S	612.82	34.5	4.00	2.0	19.24	6-09-80
R32S	615.99	34.6	4.00	1.9	20.13	6-10-80
R33S	614.28	34.7	4.00	1.8	18.56	6-10-80
R34S	614.57	34.7	4.00	1.8	18.95	6-10-80
R35S	616.32	34.6	4.00	1.9	16.85	6-10-80
R36D	617.06	54.0	4.00	2.0	17.00	8-13-80
R36S	616.93	34.7	4.00	1.8	17.12	6-10-80
R37S	616.79	34.6	4.00	1.9	16.92	6-10-80
R38S	615.79	34.6	4.00	1.9	18.86	6-10-80
R39S	619.77	37.4	4.00	3.1	24.08	6-10-80
R40S	621.39	34.5	4.00	2.0	19.75	8-12-80
R41S	617.32	28.9	4.00	1.8	17.13	8-13-80
R42S	626.24	34.6	4.00	1.9	23.94	8-13-80
R43S	621.44	28.8	4.00	1.7	18.71	8-13-80
R44S	624.35	34.8	4.00	1.7	21.27	8-12-80
R45S	624.54	28.9	4.00	1.6	19.96	8-12-80
R46S	619.68	23.9	4.00	1.6	14.17	8-13-80
R47S	620.04	23.7	4.00	1.8	14.75	8-13-80
R48S	621.40	28.4	4.00	2.1	14.23	8-13-80
R49S	618.93	23.7	4.00	1.8	12.55	8-13-80
R50D	621.64	52.3	4.00	2.2	14.98	10-31-80
R50S	621.57	23.6	4.00	1.9	14.74	8-13-80
R51S	621.37	23.4	4.00	2.1	14.40	8-13-80
R52S	621.63	23.8	4.00	1.7	14.57	8-13-80
R53S	621.59	23.7	4.00	1.8	14.41	8-13-80
R54S	625.04	29.2	4.00	1.6	20.46	10-31-80
R55S	622.16	23.9	4.00	1.9	17.18	10-31-80
R56S	618.84	23.6	4.00	1.9	13.36	10-31-80
R57S	623.72	23.6	4.00	1.9	16.40	10-31-80
R58S	619.63	23.7	4.00	1.8	14.30	10-31-80
R59S	620.26	23.5	4.00	2.0	13.91	10-31-80
[illegible]	620.60	23.6	4.00	1.9	15.41	10-31-80
[illegible]	619.8	24.0	4.00	1.5	11.47	10-31-80
R[illegible]2S	621.[illegible]	23.8	4.00	1.7	12.65	10-31-80
R63S	620.73	23.6	4.00	1.9	13.08	10-31-80
R64S	621.36	23.6	4.00	1.9	13.59	10-31-80
R65S	622.87	23.6	4.00	1.9	14.94	10-31-80
R66S	622.88	18.6	4.00	1.7	11.24	10-31-80
R67S	622.47	18.6	4.00	1.7	10.59	10-31-80
R68S	622.91	18.6	4.00	1.7	11.00	10-31-80
R69S	623.14	18.5	4.00	1.8	11.20	10-31-80
R70S	622.25	23.7	4.00	1.8	12.01	10-31-80
R71S	622.84	18.6	4.00	1.8	10.95	10-31-80
R72S	623.54	19.5	4.00	0.9	9.85	10-31-80
R73S	622.74	19.2	4.00	1.1	9.70	10-31-80
R74S	623.85	19.2	4.00	1.1	10.40	10-31-80
R75S	623.02	19.4	4.00	0.9	10.34	10-31-80
R76D	611.77	49	4.00	1.7	19.06	3-12-81
R76S	611.58	28	4.00	1.6	18.86	3-12-81
R77D	613.17	49	4.00	1.8	20.46	3-12-81
R77S	612.44	28	4.00	1.7	19.76	3-12-81
R78D	607.76	49.5	4.00	1.7	19.61	1-21-81
R78S	607.75	28.4	4.00	1.8	19.64	1-21-81
R79S	614.01	33.6	4.00	1.9	23.54	1-21-81
R80D	615.82	49.3	4.00	1.9	25.22	1-21-81
R80S	615.10	33.6	4.00	1.9	24.54	1-21-81
R81S	614.67	34.3	4.00	1.2	22.62	1-21-81
R82D	613.87	49.2	4.00	2.0	21.49	1-21-81
R82S	614.08	33.5	4.00	2.0	21.69	1-21-81
R83S	612.88	28.4	4.00	1.8	20.24	1-21-81
R84S	613.32	28.5	4.00	1.7	20.69	1-21-81
R85S	613.25	28.7	4.00	1.5	20.01	1-21-81
R86S	613.91	24.4	4.00	1.8	20.38	1-21-81
R87D	614.71	45.3	4.00	1.9	19.35	1-21-81
R88D	618.32	50.7	4.00	1.8	20.43	2-09-81
R88S	618.28	29.7	4.00	1.8	20.35	2-09-81
R89D	618.18	50.7	4.00	1.8	20.09	2-09-81
R89S	617.77	30.0	4.00	1.5	19.69	2-09-81
R90S	618.44	28	4.00	1.8	18.76	3-24-81
R91S	618.27	28	4.00	1.5	15.52	3-24-81
R92S	619.38	28	4.00	1.8	13.96	3-12-81
R93S	619.85	28	4.00	1.5	14.08	3-12-81
R94D	616.57	51	4.00	1.8	20.46	3-12-81
R94S	616.27	28	4.00	1.6	20.11	3-12-81
R95S	616.22	28	4.00	1.7	19.65	3-12-81
Y 1D	740	52.0	1.25	3.0	37.86	1-30-80
Y 2D	749	62.5	1.25	3.1	36.86	1-30-80
Y 3S	670	19.7	1.25	3.5	8.94	1-29-80
Y 4D	612.25	53.5	1.25	4.0	20.84	1-30-80
Y 4M	611.89	38.4	1.25	2.0	20.43	1-30-80
Y 4S	609.88	21.4	1.25	4.0	18.52	1-30-80
Y 5D	608.10	45.3	1.25	1.6	19.12	1-30-80
Y 6S	621	31.9	1.25	4.5	19.05	1-29-80
Y 7S	625	40.1	1.25	2.7	31.66	1-29-80
Y 9S	611	31.1	1.25	2.6	15.03	1-30-80
Y10S	595	15.5	1.25	2.4	6.50	1-30-80
Y11S	620	37.6	1.25	2.5	7.73	1-30-80
Y12D	596.78	39.3	1.25	1.9	8.49	1-30-80
Y12M	597.73	27.8	1.25	2.7	9.65	1-30-80
Y12S	597.79	18.0	1.25	2.8	9.70	1-30-80
Y13S	605	31.3	1.25	2.4	15.63	1-30-80
Y14S	584	10.6	1.25	2.0	5.26	1-30-80
Y15S	610	31.5	1.25	3.0	26.22	1-30-80
Y16S	608	31.0	1.25	2.4	23.38	1-30-80
Y17M	610.18	43.3	1.25	3.7	21.33	1-30-80
Y18D	607.68	49.5	1.25	2.6	18.06	1-30-80
Y18M	608.48	35.1	1.25	3.3	18.96	1-30-80
Y18S	608.22	25.2	1.25	3.2	18.63	1-30-80
Y19D	618.31	50.5	1.25	4.0	23.05	1-30-80

Local identifier	Altitude of measuring point (feet)	Depth of well below land surface (feet)	Casing diameter (inches)	Height of measuring point above land surface (feet)	Water level below measuring point (feet)	Date water level measured
G27S	608.32	17.8	2.00	3.2	19.12	10-25-83
G28S	615.11	22.2	2.00	1.8	22.21	10-26-83
G29S	607.41	30.8	2.00	1.7	19.28	1-25-84
G30S	612.44	30.8	2.00	1.7	20.48	1-25-84
G31S	614.96	41.4	2.00	1.6	20.95	1-25-84
G32S	615.83	41.0	2.00	2.0	21.35	1-25-84
G33S	616.03	36.1	2.00	2.4	20.61	1-25-84
G34S	615.43	36.6	2.00	1.9	18.71	1-25-84
G35S			2.00			

Local identifier	Altitude of measuring point (feet)	Depth of well below land surface (feet)	Casing diameter (inches)	Height of measuring point above land surface (feet)	Water level below measuring point (feet)	Date water level measured
H15S	621.07	34.0	4.00	1.8	17.36	5-12-82
H16S	618.26	34.0	4.00	2.1	15.71	5-12-82
H17S	619.66	34.0	4.00	1.9	17.16	5-12-82
H18D	619.88	65.0	4.00	1.8	17.85	5-12-82
H18S	619.81	34.0	4.00	1.8	17.75	5-12-82
H19S	618.54	34.0	4.00	1.9	16.87	5-12-82
H20S	618.89	34.0	4.00	1.8	17.88	5-12-82
H21D	618.90	65.0	4.00	1.7	18.15	5-12-82
H21S	618.86	34.0	4.00	1.9	18.31	5-12-82
H22D	617.92	56.0	4.00	1.7	21.06	4-07-83
H22S	617.56	34.0	4.00	1.9	17.12	5-12-82
H23D	633.02	62.0	4.00	1.7	25.66	4-07-83
H23S	622.93	41.0	4.00	1.7	25.59	4-07-83
H24D	619.27	56.0	4.00	1.8	22.44	4-07-83
H24S	618.81	34.0	4.00	1.7	22.18	4-07-83
H25D	619.23	56.0	4.00	1.8	23.03	4-06-83
H25S	619.02	34.0	4.00	1.8	22.87	4-06-83
H26D	617.02	56.0	4.00	1.8	20.93	4-06-83
H26S	616.74	34.0	4.00	1.7	20.73	4-06-83
H27D	616.77	56.0	4.00	1.8	20.77	4-07-83
H27S	615.57	34.0	4.00	1.8	20.57	4-07-83
H28S	618.71	38.0	4.00	1.7	28.90	4-06-83
H29S	615.66	38.0	4.00	1.8	27.30	4-06-83
H30S	611.74	32.0	4.00	1.8	21.62	4-06-83
H31S	611.91	34.0	4.00	1.8	22.24	4-08-83
H32S	613.35	34.0	4.00	1.6	27.72	4-06-83
H33S	609.78	28.0	4.00	1.7	17.13	4-08-83
H34S	610.50	34.0	4.00	1.8	18.04	4-08-83
H35S	610.52	31.0	4.00	1.8	18.54	4-08-83
H36S	607.75	34.0	4.00	1.8	19.88	4-06-83
H37S	608.23	34.0	4.00	1.9	21.13	4-06-83
H38D	626.88	59.0	4.00	1.6	30.25	9-29-83
H39D	628.64	62.0	4.00	2.0	32.12	9-29-83
H40S	614.31	34.0	4.00	1.8	23.95	11-07-83
H41S	614.85	34.0	4.00	1.7	24.58	11-07-83
H42S	614.71	34.0	4.00	1.8	22.80	11-07-83
H43D	616.68	60.0	4.00	1.9		
H43S	616.67	34.0	4.00	1.8	22.28	11-07-83
H44D	615.52	60.0	4.00	1.7	22.35	11-08-83
H44S	615.43	34.0	4.00	1.7		

Local identifier	Altitude of measuring point (feet)	Depth of well below land surface (feet)	Casing diameter (inches)	Height of measuring point above land surface (feet)	Water level below measuring point (feet)	Date water level measured
H45D	614.39	60.0	4.00	1.8	21.75	11-08-83
H45S	614.25	34.0	4.00	1.7		
H46D	614.50	59.0	4.00	1.7		
H46S	614.58	34.0	4.00	1.8	23.07	11-08-83
H47S	614.19	34.0	4.00	1.8	20.73	11-07-83
H48S	616.30	34.0	4.00	1.9	19.63	12-01-83
H49D	615.95	54.0	4.00	1.7	19.06	12-01-83
H49S	615.94	34.0	4.00	1.8	19.07	12-01-83
H50D	619.61	65.0	4.00	1.7	19.94	1-24-84
H50S	619.68	44.0	4.00	1.7		
H51D	614.96	54.0	4.00	1.6	19.67	1-24-84
H51S	615.10	34.0	4.00	1.7		
H52D	615.27	54.0	4.00	1.7	19.85	1-24-84
H52S	615.22	34.0	4.00	1.7	20.16	12-01-83
H53D	615.55	54.0	4.00	1.5	20.10	12-01-83
H53S	615.76	34.0	4.00	1.8		
H54D	622.20	54.0	4.00	1.8	26.13	1-24-84
H54S	621.75	34.0	4.00	1.3		
H55D	612.25	56.0	4.00	1.8	22.90	1-25-84
H55S	611.79	34.0	4.00	1.6	22.44	1-25-84
H56D	615.56	56.0	4.00	1.6	25.35	1-26-84
H56S	615.90	34.0	4.00	1.8	25.41	1-26-84
H57D	614.71	56.0	4.00			
H57S	614.78	34.0	4.00			
H58D	614.23	56.0	4.00			
H58S	614.20	34.0	4.00			
H59D	614.49	56.0	4.00	1.8	23.25	1-27-84
H59S	614.25	34.0	4.00	1.7	23.03	1-27-84
H60D	612.90	56.0	4.00	1.8	22.18	1-26-84
H60S	612.97	34.0	4.00	1.9	22.23	1-26-84
H61D	611.47	56.0	4.00			
H61S	611.56	34.0	4.00			
H62D	612.17	56.0	4.00	1.7	22.27	1-25-84
H62S	612.06	34.0	4.00	1.7	22.17	1-25-84
H63D		55.0	4.00			
H63M		45.0	4.00			
H63S		34.0	4.00			
H64D		49.0	4.00			
H64S		30.0	4.00			
H65D		49.0	4.00			

Local identifier	Altitude of measuring point (feet)	Depth of well below land surface (feet)	Casing diameter (inches)	Height of measuring point above land surface (feet)	Water level below measuring point (feet)	Date water level measured
H65S		30.5	4.00			
H66D		52.0	4.00			
H66S		30.0	4.00			
H67D		52.0	4.00			
H68S		33.0	4.00			

Analyses of Volatile Organic Compounds in the Benzone Plume Area

/‾Result in micrograms per liter (μg/L)_7

Well	Date	Benzene	Trichloro-ethylene	1,2 Dichloro-ethylene	Toluene	Xylene	Ethyl Benzene	Tetra-chloro-ethylene	Methylene chloride	Chloroform
AF3	September 28, 1983	ND	38.5	19.4	ND	ND	ND	6.4	ND	ND
P2	September 28, 1983	ND	206	40.5	ND	ND	ND	4.9	ND	ND
P1,2	September 28, 1983	ND	155	35.9	ND	ND	ND	3.9	ND	ND
PC	September 28, 1983	ND	162	23.0	ND	ND	ND	4.8	ND	ND
R7D	September 28, 1983	ND	30.3	3.6	ND	ND	ND	ND	ND	ND
R17D	September 28, 1983	ND	24.7	13.4	ND	ND	ND	ND	ND	ND
AF69	November 7, 1983	ND	ND	ND	ND	ND	ND	ND	16.6	ND
AF73[b]	November 7, 1983	1,046	ND	ND	ND	ND	4,019	ND	574	ND
AF74	November 8, 1983	ND	18.4	ND	ND	ND	ND	ND	42	ND
AF75	November 8, 1983	ND	ND	ND	ND	ND	ND	ND	ND	ND
AF76	November 8, 1983	ND	ND	ND	ND	ND	ND	ND	ND	ND
H28S	November 7, 1983	ND	ND	ND	ND	ND	ND	ND	ND	ND
H29S	November 7, 1983	ND	ND	ND	ND	ND	ND	ND	ND	ND
H40S	November 7, 1983	ND	23.6	ND	ND	ND	ND	52.7	ND	ND
H41S	November 7, 1983	ND	27.0	ND	ND	ND	ND	13.8	ND	ND
H42S	November 7, 1983	17.9	15.7	11.3	ND	ND	ND	ND	ND	ND
H43S[b]	November 7, 1983	2,871	ND	ND	ND	ND	ND	ND	37	25
H43D	November 7, 1983	ND	ND	ND	ND	ND	ND	ND	ND	ND
H44S	November 8, 1983	684	ND	ND	ND	ND	80	ND	ND	ND
H44D[b]	November 8, 1983	3.4	ND	ND	ND	ND	ND	ND	ND	ND
H45S	November 8, 1983	161	ND	ND	ND	1,030	284	ND	83	ND
H45D	November 8, 1983	103	ND	ND	ND	ND	ND	ND	ND	ND
H46S	November 8, 1983	ND	10.7	ND	ND	ND	ND	5.3	ND	ND
H46D	November 8, 1983	ND	ND	ND	ND	ND	ND	ND	ND	ND
H47S	November 7, 1983	ND	ND	ND	ND	ND	ND	ND	ND	ND
R10S	November 7, 1983	775	ND	ND	ND	272	363	ND	ND	ND
R10D	November 7, 1983	11.9	ND	ND	ND	ND	4.5	ND	5.3	ND
R17D	November 7, 1983	ND	40.1	ND	ND	ND	ND	ND	4.5	ND
R18S	November 8, 1983	ND	33.4	8.8	ND	ND	ND	ND	ND	ND
R18D	November 8, 1983	ND	ND	ND	3.3	ND	ND	ND	5.7	ND
R85S	November 8, 1983	ND	ND	ND	3.1	ND	ND	16.5	ND	ND
R86S	November 7, 1983	ND	ND	ND	3.4	ND	ND	ND	ND	ND
R86D	November 7, 1983	ND	ND	ND	3.3	ND	ND	ND	ND	ND
R87D	November 8, 1983	ND	ND	ND	62.2	ND	ND	ND	ND	ND
A-14[b]	December 1, 1983	8.0	ND	ND	34	ND	6.4	ND	ND	10
R17S	December 1, 1983	ND	6.3	ND	ND	ND	ND	ND	5.3	ND

[a]In addition to the compounds given in the table, analyses were also made for bromoform, carbon tetrachloride, chlorobenzene, chloroethane, 2-chloroethyl vinyl ether, dibromochloromethane, dichlorobromomethane, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, 1,2-dichloropropane, 1,3-dichloropropene, methylbromide, 1,1,2,2-tetrachloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethane, and vinyl chloride. None of these compounds were detected.

[b]Other undifferentiated hydrocarbons present.

Analyses of Water in the Benzene Plume Area

November 7-8, 1983

Well	Calcium, total (mg/L)	Iron, total (μg/L)	Lead, total (μg/L)	Manganese, total (μg/L)	Oil and grease, total (mg/L)	Specific conductance (μmhos)	Temperature (°C)
R10D	210	18,000	9	120	2	1,390	11.0
R10S	140	29,000	8	290	<1	755	14.0
H28S	89	370	1	1,300	<1	515	13.0
H29S	79	300	5	460	2	482	13.0
H40S	82	270	4	370	<1	484	11.5
H41S	130	280	3	10	<1	832	13.0
H42S	130	2,300	4	1,200	2	779	13.0
H43D	38	350	5	150	2	286	10.5
H43S	110	4,800	4	260	<1	572	13.0
H44D	66	470	5	200	<1	456	12.0
H44S	150	610	3	2,200	<1	792	13.0
H45S	79	5,000	4	490	3	481	12.0
H46S	61	320	4	30	1	383	13.0
R86S	60	350	3	<10	<1	378	14.5
R87D	98	4,600	5	170	3	559	11.0

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY WRD
CENTRAL LABORATORY, ATLANTA, GEORGIA

LABORATORY ANALYTICAL SHEET FOR LAB-ID 3320013 RECORD-# 125567

STATION_ID: R105 COLLECTED: BEGIN DATE 831107 TIME 1520 END DATE TIME LAT-LONG-SEQ#: ****** ******* **
NAME: DATA TO BE RETRIEVED FROM HEADER WHEN COMPLETE STATE: 26 USER CODE: 26 MICHIGAN COUNTY: 069 GEO.UNIT:
SAMPLE MEDIUM: 6 STATUS: H SOURCE: 9 HYD.CONDITION: SAMPLE TYPE: HYD.EVENT: PROJECT/ACCT-#: 442603200 COST: 321.55
COMMENTS:
UNIQUE NUMBER REQUESTED SCHEDULES USED 1394 0 0 0 TOTAL PARAMETERS 57
NOTE: THIS SAMPLE WAS LOGGED IN AS "X" TYPE DATA AND WILL NOT TRANSFER TO WATSTORE. "Q" IN COL(51) OF AN "A" CARD CHANGES DISP.
PRINTED ON 02/04/84 FIRST RETREIVAL "LABPRIM" 02/04/84

NAME	RMK/VALUE		UNITS	METHOD	W-CODE	LC
ACENAPHTHENE, TOTAL	<	1	UG/L	0-3021-80	34205	1066
ACENAPHTHYLENE, TOT.	<	1	UG/L	0-3021-80	34200	1067
~~ANALYZING AGENCY~~		~~80010~~		- -	28	91
ANTHRACENE, TOTAL	<	1	UG/L	0-3021-80	34220	1068
BENZIDINE, TOTAL	<	1	UG/L	0-3021-80	39120	1069
BENZO(A)ANTHRACENE,T		2	UG/L	0-3021-80	34526	1070
BENZO(A)PYRENE, TOT.	<	1	UG/L	0-3021-80	34247	1073
BENZO(B)FLUORANTHE,T	<	1	UG/L	0-3021-80	34230	1071
BENZO(GHI)PERYLENE,T	<	1	UG/L	0-3021-80	34521	1074
BENZO(K)FLUORANTHE,T	<	1	UG/L	0-3021-80	34242	1072
BUTYL BENZYL PHTHA,T	<	1	UG/L	0-3021-80	34292	1075
CALCIUM, TOTAL USGS		140	MG/L	I-3152-78	916	244
~~CENTRAL LAB-ID~~		~~3320013~~		- -	99998	1500
CHRYSENE, TOTAL	<	1	UG/L	0-3021-80	34320	1082
DI-N-BUTYL PHTHALA,T	<	1	UG/L	0-3021-80	39110	1084
DI-N-OCTYLPHTHALAT,T	<	1	UG/L	0-3021-80	34596	1093
DIBENZANTHRACENE, T	<	1	UG/L	0-3021-80	34556	1083
DIETHYL PHTHALATE, T	<	1	UG/L	0-3021-80	34336	1089
~~DIGESTION HCL-WATER~~		~~2~~		I-3485-78	0	654
DIMETHYL PHTHALATE,T	<	1	UG/L	0-3021-80	34341	1090
FLUORANTHENE, TOTAL	<	1	UG/L	0-3021-80	34376	1096
FLUORENE, TOTAL	<	1	UG/L	0-3021-80	34381	1095
HEXACHLOROBENZENE,T	<	1	UG/L	0-3021-80	39700	1097
HEXACHLOROBUTADIEN,T	<	1	UG/L	0-3021-80	39702	1098
HEXACHLOROCYCLOPEN,T	<	1	UG/L	0-3021-80	34386	1099
HEXACHLOROETHANE, T.	<	1	UG/L	0-3021-80	34396	1100
INDENO(1,2,3)PYREN,T	<	1	UG/L	0-3021-80	34403	1101
IRON, TOTAL		29000	UG/L	I-3381-78	1045	189

NAME	RMK/VALUE		UNITS	METHOD	W-CODE	LC
ISOPHORONE, TOTAL	<	1	UG/L	0-3021-80	34408	1102
LEAD, TOTAL		8	UG/L	I-3400-78	1051	257
MANGANESE, TOTAL		290	UG/L	I-3454-78	1055	41
METALS TOTAL CHE-EXT		1		- -	0	125
N-NITROSODI-N-PROP,T	<	1	UG/L	0-3021-80	34428	1107
N-NITROSODIPHENYLA,T	<	1	UG/L	0-3021-80	34433	1106
NAPHTHALENE, TOTAL		23	UG/L	0-3021-80	34696	1103
NITROBENZENE, TOTAL	<	1	UG/L	0-3021-80	34447	1104
NITROSODIMETHLYAMI,T	<	1	UG/L	0-3021-80	34438	1105
OIL AND GREASE, TOT.	<	1	MG/L	0-1555-74	556	127
PHENANTHRENE, TOTAL	<	1	UG/L	0-3021-80	34461	1108
PYRENE, TOTAL	<	1	UG/L	0-3021-80	34469	1109
SP. CONDUCTANCE FLD		755	UMHOS	I-1780-77	95	21
WATER TEMPERATURE		14.0	DEG C	- -	10	64
1,2-DICHLOROBENZEN,T	<	1	UG/L	0-3021-80	34536	1085
1,2,4-TRICHLOROBEN,T	<	1	UG/L	0-3021-80	34551	1111
1,3-DICHLOROBENZEN,T	<	1	UG/L	0-3021-80	34566	1086
1,4-DICHLOROBENZEN,T	<	1	UG/L	0-3021-80	34571	1087
2-CHLORETH METHANE,T	<	1	UG/L	0-3021-80	34278	1076
2-CHLORETHYL ETHER,T	<	1	UG/L	0-3021-80	34273	1077
2-CHLORISOPR ETHER,T	<	1	UG/L	0-3021-80	34283	1078
2-CHLORONAPHTHALEN,T	<	1	UG/L	0-3021-80	34581	1080
2-ETHLYHEXYL PHTHA,T	<	1	UG/L	0-3021-80	39100	1094
2,3,7,8-TETRACHLOR,T	<	1	UG/L	0-3021-80	34675	1110
2,4-DINITROTOLUENE,T	<	1	UG/L	0-3021-80	34611	1091
2,6-DINITROTOLUENE,T	<	1	UG/L	0-3021-80	34626	1092
3,3-DICHLOROBENZID,T	<	1	UG/L	0-3021-80	34631	1088
4-BROMOPHENYL PHEN,T	<	1	UG/L	0-3021-80	34636	1079
4-CHLOROPHENYL ETH,T	<	1	UG/L	0-3021-80	34641	1081

TENTATIVE IDENTIFICATION OF OTHER COMPOUNDS

2,4-Dimethyl phenol--17 µg/L
Phosphoric acid, triphenyl ester--7.8 µg/L
1,4-dimethyl benzene--100 µg/L
Ethyl benzene--detected, but not quantified

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY WRD
CENTRAL LABORATORY, ATLANTA, GEORGIA

LABORATORY ANALYTICAL SHEET FOR LAB-ID 3320014 RECORD-# 125570

STATION_ID: (H435) COLLECTED: BEGIN DATE 831107 TIME 1645 END DATE TIME LAT-LONG-SEQ#: ****** ******* **
NAME: DATA TO BE RETRIEVED FROM HEADER WHEN COMPLETE STATE: 26 USFR CODE: 26 MICHIGAN COUNTY: 069 GEO.UNIT:
SAMPLE MEDIUM: 6 STATUS: H SOURCE: 9 HYD.CONDITION: SAMPLE TYPE: HYD.EVENT: PROJECT/ACCT-#: 442603200 COST: 321.55
COMMENTS:
UNIQUE NUMBER REQUESTED SCHEDULES USED 1394 0 0 0 TOTAL PARAMETERS 57
NOTE: THIS SAMPLE WAS LOGGED IN AS "X" TYPE DATA AND WILL NOT TRANSFER TO WATSTORE. "O" IN COL(51) OF AN "A" CARD CHANGES DISP.
PRINTED ON 02/04/84 FIRST RETREIVAL "LABPRIM" 02/04/84

NAME	RMK/VALUE	UNITS	METHOD	W-CODE	LC
ACENAPHTHENE, TOTAL	< 1	UG/L	0-3021-80	34205	1066
ACENAPHTHYLENE, TOT.	< 1	UG/L	0-3021-80	34200	1067
ANALYZING AGENCY	80010		- -	28	91
ANTHRACENE, TOTAL	< 1	UG/L	0-3021-80	34220	1068
BENZIDINE, TOTAL	< 1	UG/L	0-3021-80	39120	1069
BENZO(A)ANTHRACENE,T	2	UG/L	0-3021-80	34526	1070
BENZO(A)PYRENE, TOT.	< 1	UG/L	0-3021-80	34247	1073
BENZO(B)FLUORANTHE,T	< 1	UG/L	0-3021-80	34230	1071
BENZO(GHI)PERYLENE,T	< 1	UG/L	0-3021-80	34521	1074
BENZO(K)FLUORANTHE,T	< 1	UG/L	0-3021-80	34242	1072
BUTYL BENZYL PHTHA,T	< 1	UG/L	0-3021-80	34292	1075
CALCIUM, TOTAL USGS	110	MG/L	I-3152-78	916	244
CENTRAL LAB-ID-#	3320014		- -	99998	1500
CHRYSENE, TOTAL	< 1	UG/L	0-3021-80	34320	1082
DI-N-BUTYL PHTHALA,T	< 1	UG/L	0-3021-80	39110	1084
DI-N-OCTYLPHTHALAT,T	< 1	UG/L	0-3021-80	34596	1093
DIBENZANTHRACENE, T	< 1	UG/L	0-3021-80	34556	1083
DIETHYL PHTHALATE, T	< 1	UG/L	0-3021-80	34336	1089
DIGESTION HCL WATER	2		I-3485-78	0	654
DIMETHYL PHTHALATE,T	< 1	UG/L	0-3021-80	34341	1090
FLUORANTHENE, TOTAL	< 1	UG/L	0-3021-80	34376	1096
FLUORENE, TOTAL	< 1	UG/L	0-3021-80	34381	1095
HEXACHLOROBENZENE,T	< 1	UG/L	0-3021-80	39700	1097
HEXACHLOROBUTADIEN,T	< 1	UG/L	0-3021-80	39702	1098
HEXACHLOROCYCLOPEN,T	< 1	UG/L	0-3021-80	34386	1099
HEXACHLOROETHANE, T.	< 1	UG/L	0-3021-80	34396	1100
INDENO(1,2,3)PYREN,T	< 1	UG/L	0-3021-80	34403	1101
IRON, TOTAL	4800	UG/L	I-3381-78	1045	189

NAME	RMK/VALUE	UNITS	METHOD	W-CODE	LC
ISOPHORONE, TOTAL	< 1	UG/L	0-3021-80	34408	1102
LEAD, TOTAL	4	UG/L	I-3400-78	1051	257
MANGANESE, TOTAL	260	UG/L	I-3454-78	1055	41
METALS TOTAL CHE-EXT	1		- -	0	125
N-NITROSODI-N-PROP,T	< 1	UG/L	0-3021-80	34428	1107
N-NITROSODIPHENYLA,T	< 1	UG/L	0-3021-80	34433	1106
NAPHTHALENE, TOTAL	3	UG/L	0-3021-80	34696	1103
NITROBENZENE, TOTAL	< 1	UG/L	0-3021-80	34447	1104
NITROSODIMETHLYAMI,T	< 1	UG/L	0-3021-80	34438	1105
OIL AND GREASE, TOT.	< 1	MG/L	0-1555-74	556	127
PHENANTHRENE, TOTAL	< 1	UG/L	0-3021-80	34461	1108
PYRENE, TOTAL	< 1	UG/L	0-3021-80	34469	1109
SP. CONDUCTANCE FLD	572	UMHOS	I-1780-77	95	21
WATER TEMPERATURE	13.0	DEG C	- -	10	64
1,2-DICHLOROBENZEN,T	< 1	UG/L	0-3021-80	34536	1085
1,2,4-TRICHLOROBEN,T	< 1	UG/L	0-3021-80	34551	1111
1,3-DICHLOROBENZEN,T	< 1	UG/L	0-3021-80	34566	1086
1,4-DICHLOROBENZEN,T	< 1	UG/L	0-3021-80	34571	1087
2-CHLORETH METHANE,T	< 1	UG/L	0-3021-80	34278	1076
2-CHLORETHYL ETHER,T	< 1	UG/L	0-3021-80	34273	1077
2-CHLORISOPR ETHER,T	< 1	UG/L	0-3021-80	34283	1078
2-CHLORONAPHTHALEN,T	< 1	UG/L	0-3021-80	34581	1080
2-ETHLYHEXYL PHTHA,T	3	UG/L	0-3021-80	39100	1094
2,3,7,8-TETRACHLOR,T	< 1	UG/L	0-3021-80	34675	1110
2,4-DINITROTOLUENE,T	< 1	UG/L	0-3021-80	34611	1091
2,6-DINITROTOLUENE,T	< 1	UG/L	0-3021-80	34626	1092
3,3-DICHLOROBENZID,T	< 1	UG/L	0-3021-80	34631	1088
4-BROMOPHENYL PHEN,T	< 1	UG/L	0-3021-80	34636	1079
4-CHLOROPHENYL ETH,T	< 1	UG/L	0-3021-80	34641	1081

TENTATIVE IDENTIFICATION OF OTHER COMPOUNDS

Phosphoric acid, triphenyl ester--8.6 ug/L

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY WRD
CENTRAL LABORATORY, ATLANTA, GEORGIA

LABORATORY ANALYTICAL SHEET FOR LAB-ID 3320012 RECORD-# 125564

STATION_ID: H445 COLLECTED: BEGIN DATE 831108 TIME 0830 END DATE TIME LAT-LONG-SEQ#: ****** ******* **
NAME: DATA TO BE RETRIEVED FROM HEADER WHEN COMPLETE STATE: 26 USER CODE: 26 MICHIGAN COUNTY: 069 GEO.UNIT:
SAMPLE MEDIUM: 6 STATUS: H SOURCE: 9 HYD.CONDITION: SAMPLE TYPE: HYD.EVENT: PROJECT/ACCT-#: 442603200 COST: 321.55
COMMENTS:
UNIQUE NUMBER REQUESTED SCHEDULES USED 1394 0 0 0 TOTAL PARAMETERS 57
NOTE: THIS SAMPLE WAS LOGGED IN AS "X" TYPE DATA AND WILL NOT TRANSFER TO WATSTORE. "O" IN COL(51) OF AN "A" CARD CHANGES DISP.
PRINTED ON 02/04/84 FIRST RETREIVAL "LARPRIM" 02/04/84

NAME	RMK/VALUE	UNITS	METHOD	W-CODE	LC
ACENAPHTHENE, TOTAL	< 1	UG/L	0-3021-80	34205	1066
ACENAPHTHYLENE, TOT.	< 1	UG/L	0-3021-80	34200	1067
ANALYZING AGENCY	80010		- -	28	91
ANTHRACENE, TOTAL	< 1	UG/L	0-3021-80	34220	1068
BENZIDINE, TOTAL	< 1	UG/L	0-3021-80	39120	1069
BENZO(A)ANTHRACENE,T	4	UG/L	0-3021-80	34526	1070
BENZO(A)PYRENE, TOT.	< 1	UG/L	0-3021-80	34247	1073
BENZO(B)FLUORANTHE,T	< 1	UG/L	0-3021-80	34230	1071
BENZO(GHI)PERYLENE,T	< 1	UG/L	0-3021-80	34521	1074
BENZO(K)FLUORANTHE,T	< 1	UG/L	0-3021-80	34242	1072
BUTYL BENZYL PHTHA,T	< 1	UG/L	0-3021-80	34292	1075
CALCIUM, TOTAL USGS	150	MG/L	I-3152-78	916	244
CENTRAL LAB-ID-#	3320012		- -	99998	1500
CHRYSENE, TOTAL	< 1	UG/L	0-3021-80	34320	1082
DI-N-BUTYL PHTHALA,T	< 1	UG/L	0-3021-80	39110	1084
DI-N-OCTYLPHTHALAT,T	< 1	UG/L	0-3021-80	34596	1093
DIBENZANTHRACENE, T	< 1	UG/L	0-3021-80	34556	1083
DIETHYL PHTHALATE, T	< 1	UG/L	0-3021-80	34336	1089
DIGESTION HCL WATER	2		I-3485-78	0	654
DIMETHYL PHTHALATE,T	< 1	UG/L	0-3021-80	34341	1090
FLUORANTHENE, TOTAL	< 1	UG/L	0-3021-80	34376	1096
FLUORENE, TOTAL	< 1	UG/L	0-3021-80	34381	1095
HEXACHLOROBENZENE,T	< 1	UG/L	0-3021-80	39700	1097
HEXACHLOROBUTADIEN,T	< 1	UG/L	0-3021-80	39702	1098
HEXACHLOROCYCLOPEN,T	< 1	UG/L	0-3021-80	34386	1099
HEXACHLOROETHANE, T.	< 1	UG/L	0-3021-80	34396	1100
INDENO(1,2,3)PYREN,T	< 1	UG/L	0-3021-80	34403	1101
IRON, TOTAL	610	UG/L	I-3381-78	1045	189

NAME	RMK/VALUE	UNITS	METHOD	W-CODE	LC
ISOPHORONE, TOTAL	< 1	UG/L	0-3021-80	34408	1102
LEAD, TOTAL	3	UG/L	I-3400-78	1051	257
MANGANESE, TOTAL	2200	UG/L	I-3454-78	1055	41
METALS TOTAL CHE-EXT	1		- -	0	125
N-NITROSODI-N-PROP,T	< 1	UG/L	0-3021-80	34428	1107
N-NITROSODIPHENYLA,T	< 1	UG/L	0-3021-80	34433	1106
NAPHTHALENE, TOTAL	< 1	UG/L	0-3021-80	34696	1103
NITROBENZENE, TOTAL	< 1	UG/L	0-3021-80	34447	1104
NITROSODIMETHLYAMI,T	< 1	UG/L	0-3021-80	34438	1105
OIL AND GREASE, TOT.	< 1	MG/L	0-1555-74	556	127
PHENANTHRENE, TOTAL	< 1	UG/L	0-3021-80	34461	1108
PYRENE, TOTAL	< 1	UG/L	0-3021-80	34469	1109
SP. CONDUCTANCE FLD	792	UMHOS	I-1780-77	95	21
WATER TEMPERATURE	13.0	DEG C	- -	10	64
1,2-DICHLOROBENZEN,T	< 1	UG/L	0-3021-80	34536	1085
1,2,4-TRICHLOROBEN,T	< 1	UG/L	0-3021-80	34551	1111
1,3-DICHLOROBENZEN,T	< 1	UG/L	0-3021-80	34566	1086
1,4-DICHLOROBENZEN,T	< 1	UG/L	0-3021-80	34571	1087
2-CHLORETH METHANE,T	< 1	UG/L	0-3021-80	34278	1076
2-CHLORETHYL ETHER,T	< 1	UG/L	0-3021-80	34273	1077
2-CHLORISOPR ETHER,T	< 1	UG/L	0-3021-80	34283	1078
2-CHLORONAPHTHALEN,T	< 1	UG/L	0-3021-80	34581	1080
2-ETHLYHEXYL PHTHA,T	< 1	UG/L	0-3021-80	39100	1094
2,3,7,8-TETRACHLOR,T	< 1	UG/L	0-3021-80	34675	1110
2,4-DINITROTOLUENE,T	< 1	UG/L	0-3021-80	34611	1091
2,6-DINITROTOLUENE,T	< 1	UG/L	0-3021-80	34626	1092
3,3-DICHLOROBENZID,T	< 1	UG/L	0-3021-80	34631	1088
4-BROMOPHENYL PHEN,T	< 1	UG/L	0-3021-80	34636	1079
4-CHLOROPHENYL ETH,T	< 1	UG/L	0-3021-80	34641	1081

TENTATIVE IDENTIFICATION OF OTHER COMPOUNDS

Phosphoric acid-triphenyl ester--13 µg/L
Ethyl benzene--detected but not quantified

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY WRD
CENTRAL LABORATORY, ATLANTA, GEORGIA

LABORATORY ANALYTICAL SHEET FOR LAB-ID 3320009 RECORD-# 125555

STATION_ID: (H455) COLLECTED: BEGIN DATE 831108 TIME 1020 END DATE TIME LAT-LONG-SEQ#: ****** ******* **
NAME: DATA TO BE RETRIEVED FROM HEADER WHEN COMPLETE STATE: 26 USER CODE: 26 MICHIGAN COUNTY: 069 GEO.UNIT:
SAMPLE MEDIUM: 6 STATUS: H SOURCE: 9 HYD.CONDITION: SAMPLE TYPE: HYD.EVENT: PROJECT/ACCT-#: 442603200 COST: 321.55
COMMENTS:
UNIQUE NUMBER REQUESTED SCHEDULES USED 1394 0 0 0 TOTAL PARAMETERS 57
NOTE: THIS SAMPLE WAS LOGGED IN AS "X" TYPE DATA AND WILL NOT TRANSFER TO WATSTORE. "0" IN COL(51) OF AN "A" CARD CHANGES DISP.
PRINTED ON 02/04/84 FIRST RETREIVAL "LABPRIN" 02/04/84

NAME	RMK/VALUE	UNITS	METHOD	W-CODE	LC
ACENAPHTHENE, TOTAL	< 1	UG/L	0-3021-80	34205	1066
ACENAPHTHYLENE, TOT.	< 1	UG/L	0-3021-80	34200	1067
ANALYZING AGENCY	80010		- -	28	91
ANTHRACENE, TOTAL	< 1	UG/L	0-3021-80	34220	1068
BENZIDINE, TOTAL	< 1	UG/L	0-3021-80	39120	1069
BENZO(A)ANTHRACENE,T	2	UG/L	0-3021-80	34526	1070
BENZO(A)PYRENE, TOT.	< 1	UG/L	0-3021-80	34247	1073
BENZO(B)FLUORANTHE,T	< 1	UG/L	0-3021-80	34230	1071
BENZO(GHI)PERYLENE,T	< 1	UG/L	0-3021-80	34521	1074
BENZO(K)FLUORANTHE,T	< 1	UG/L	0-3021-80	34242	1072
BUTYL BENZYL PHTHA,T	< 1	UG/L	0-3021-80	34292	1075
CALCIUM, TOTAL USGS	79	MG/L	I-3152-78	916	244
CENTRAL LAB-ID-#	3320009		- -	99998	1500
CHRYSENE, TOTAL	< 1	UG/L	0-3021-80	34320	1082
DI-N-BUTYL PHTHALA,T	< 1	UG/L	0-3021-80	39110	1084
DI-N-OCTYLPHTHALAT,T	< 1	UG/L	0-3021-80	34596	1093
DIBENZANTHRACENE, T	< 1	UG/L	0-3021-80	34556	1083
DIETHYL PHTHALATE, T	< 1	UG/L	0-3021-80	34336	1089
DIGESTION HCL WATER	2		I-3485-78	0	654
DIMETHYL PHTHALATE,T	< 1	UG/L	0-3021-80	34341	1090
FLUORANTHENE, TOTAL	< 1	UG/L	0-3021-80	34376	1096
FLUORENE, TOTAL	< 1	UG/L	0-3021-80	34381	1095
HEXACHLOROBENZENE,T	< 1	UG/L	0-3021-80	39700	1097
HEXACHLOROBUTADIEN,T	< 1	UG/L	0-3021-80	39702	1098
HEXACHLOROCYCLOPEN,T	< 1	UG/L	0-3021-80	34386	1099
HEXACHLOROETHANE, T,	< 1	UG/L	0-3021-80	34396	1100
INDENO(1,2,3)PYREN,T	< 1	UG/L	0-3021-80	34403	1101
IRON, TOTAL	5000	UG/L	I-3381-78	1045	189

NAME	RMK/VALUE	UNITS	METHOD	W-CODE	LC
ISOPHORONE, TOTAL	< 1	UG/L	0-3021-80	34408	1102
LEAD, TOTAL	4	UG/L	I-3400-78	1051	257
MANGANESE, TOTAL	490	UG/L	I-3454-78	1055	41
METALS TOTAL CHE-EXT	1		- -	0	125
N-NITROSODI-N-PROP,T	< 1	UG/L	0-3021-80	34428	1107
N-NITROSODIPHENYLA,T	< 1	UG/L	0-3021-80	34433	1106
NAPHTHALENE, TOTAL	< 1	UG/L	0-3021-80	34696	1103
NITROBENZENE, TOTAL	< 1	UG/L	0-3021-80	34447	1104
NITROSODIMETHLYAMI,T	< 1	UG/L	0-3021-80	34438	1105
OIL AND GREASE, TOT.	3	MG/L	0-1555-74	556	127
PHENANTHRENE, TOTAL	< 1	UG/L	0-3021-80	34461	1108
PYRENE, TOTAL	< 1	UG/L	0-3021-80	34469	1109
SP. CONDUCTANCE FLD	481	UMHOS	I-1780-77	95	21
WATER TEMPERATURE	12.0	DEG C	- -	10	64
1,2-DICHLOROBENZEN,T	< 1	UG/L	0-3021-80	34536	1085
1,2,4-TRICHLOROBEN,T	< 1	UG/L	0-3021-80	34551	1111
1,3-DICHLOROBENZEN,T	< 1	UG/L	0-3021-80	34566	1086
1,4-DICHLOROBENZEN,T	< 1	UG/L	0-3021-80	34571	1087
2-CHLOROETH METHANE,T	< 1	UG/L	0-3021-80	34278	1076
2-CHLOROETHYL ETHER,T	< 1	UG/L	0-3021-80	34273	1077
2-CHLOROISOPR ETHER,T	< 1	UG/L	0-3021-80	34283	1078
2-CHLORONAPHTHALEN,T	< 1	UG/L	0-3021-80	34581	1080
2-ETHLYHEXYL PHTHA,T	< 1	UG/L	0-3021-80	39100	1094
2,3,7,8-TETRACHLOR,T	< 1	UG/L	0-3021-80	34675	1110
2,4-DINITROTOLUENE,T	< 1	UG/L	0-3021-80	34611	1091
2,6-DINITROTOLUENE,T	< 1	UG/L	0-3021-80	34626	1092
3,3-DICHLOROBENZID,T	< 1	UG/L	0-3021-80	34631	1088
4-BROMOPHENYL PHEN,T	< 1	UG/L	0-3021-80	34636	1079
4-CHLOROPHENYL ETH,T	< 1	UG/L	0-3021-80	34641	1081

TENTATIVE IDENTIFICATION OF OTHER COMPOUNDS

2,4-dimethyl phenol--9.2 µg/L
Phosphoric acid, triphenyl ester--6.7 µg/L
Ethyl benzene--detected, but not quantified
1,4-dimethyl benzene--210 µg/L

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY WRD
CENTRAL LABORATORY, ATLANTA, GEORGIA

LABORATORY ANALYTICAL SHEET FOR LAB-ID 3320011 RECORD-# 125561

STATION_ID: P86S COLLECTED: BEGIN DATE 831107 TIME 1415 END DATE TIME LAT-LONG-SEQ#: ****** ******* **
NAME: DATA TO BE RETRIEVED FROM HEADER WHEN COMPLETE STATE: 26 USER CODE: 26 MICHIGAN COUNTY: 069 GEO.UNIT:
SAMPLE MEDIUM: 6 STATUS: H SOURCE: 9 HYD.CONDITION: SAMPLE TYPE: HYD.EVENT: PROJECT/ACCT-#: 442603200 COST: 321.55
COMMENTS:
UNIQUE NUMBER REQUESTED SCHEDULES USED 1394 0 0 0 TOTAL PARAMETERS 57
NOTE: THIS SAMPLE WAS LOGGED IN AS "X" TYPE DATA AND WILL NOT TRANSFER TO WATSTORE. "Q" IN COL(51) OF AN "A" CARD CHANGES DISP.
PRINTED ON 02/04/84 FIRST RETREIVAL "LABPRIM" 02/04/84

NAME	RMK/VALUE		UNITS	METHOD	W-CODE	LC
ACENAPHTHENE, TOTAL	<	1	UG/L	0-3021-80	34205	1066
ACENAPHTHYLENE, TOT.	<	1	UG/L	0-3021-80	34200	1067
ANALYZING AGENCY		80010		- -	28	91
ANTHRACENE, TOTAL	<	1	UG/L	0-3021-80	34220	1068
BENZIDINE, TOTAL	<	1	UG/L	0-3021-80	39120	1069
BENZO(A)ANTHRACENE,T		1	UG/L	0-3021-80	34526	1070
BENZO(A)PYRENE, TOT.	<	1	UG/L	0-3021-80	34247	1073
BENZO(B)FLUORANTHE,T	<	1	UG/L	0-3021-80	34230	1071
BENZO(GHI)PERYLENE,T	<	1	UG/L	0-3021-80	34521	1074
BENZO(K)FLUORANTHE,T	<	1	UG/L	0-3021-80	34242	1072
BUTYL BENZYL PHTHA,T	<	1	UG/L	0-3021-80	34292	1075
CALCIUM, TOTAL USGS		60	MG/L	I-3152-78	916	244
CENTRAL LAB-ID-#		3320011		- -	99998	1500
CHRYSENE, TOTAL	<	1	UG/L	0-3021-80	34320	1082
DI-N-BUTYL PHTHALA,T	<	1	UG/L	0-3021-80	39110	1084
DI-N-OCTYLPHTHALAT,T	<	1	UG/L	0-3021-80	34596	1093
DIBENZANTHRACENE, T	<	1	UG/L	0-3021-80	34556	1083
DIETHYL PHTHALATE, T	<	1	UG/L	0-3021-80	34336	1089
DIGESTION HCL WATER		2		I-3485-78	0	654
DIMETHYL PHTHALATE,T	<	1	UG/L	0-3021-80	34341	1090
FLUORANTHENE, TOTAL	<	1	UG/L	0-3021-80	34376	1096
FLUORENE, TOTAL	<	1	UG/L	0-3021-80	34381	1095
HEXACHLOROBENZENE,T	<	1	UG/L	0-3021-80	39700	1097
HEXACHLOROBUTADIEN,T	<	1	UG/L	0-3021-80	39702	1098
HEXACHLOROCYCLOPEN,T	<	1	UG/L	0-3021-80	34386	1099
HEXACHLOROETHANE, T,	<	1	UG/L	0-3021-80	34396	1100
INDENO(1,2,3)PYREN,T	<	1	UG/L	0-3021-80	34403	1101
IRON, TOTAL		350	UG/L	I-3381-78	1045	189

NAME	RMK/VALUE		UNITS	METHOD	W-CODE	LC
ISOPHORONE, TOTAL	<	1	UG/L	0-3021-80	34408	1102
LEAD, TOTAL		3	UG/L	I-3400-78	1051	257
MANGANESE, TOTAL	<	10	UG/L	I-3454-78	1055	41
METALS TOTAL CHE-EXT		1		- -	0	125
N-NITROSODI-N-PROP,T	<	1	UG/L	0-3021-80	34428	1107
N-NITROSODIPHENYLA,T	<	1	UG/L	0-3021-80	34433	1106
NAPHTHALENE, TOTAL	<	1	UG/L	0-3021-80	34696	1103
NITROBENZENE, TOTAL	<	1	UG/L	0-3021-80	34447	1104
NITROSODIMETHLYAMI,T	<	1	UG/L	0-3021-80	34438	1105
OIL AND GREASE, TOT.	<	1	MG/L	0-1555-74	556	127
PHENANTHRENE, TOTAL	<	1	UG/L	0-3021-80	34461	1108
PYRENE, TOTAL	<	1	UG/L	0-3021-80	34469	1109
SP. CONDUCTANCE FLD		378	UMHOS	I-1780-77	95	21
WATER TEMPERATURE		14.5	DEG C	- -	10	64
1,2-DICHLOROBENZEN,T	<	1	UG/L	0-3021-80	34536	1085
1,2,4-TRICHLOROBEN,T	<	1	UG/L	0-3021-80	34551	1111
1,3-DICHLOROBENZEN,T	<	1	UG/L	0-3021-80	34566	1086
1,4-DICHLOROBENZEN,T	<	1	UG/L	0-3021-80	34571	1087
2-CHLORETH METHANE,T	<	1	UG/L	0-3021-80	34278	1076
2-CHLORETHYL ETHER,T	<	1	UG/L	0-3021-80	34273	1077
2-CHLORISOPR ETHER,T	<	1	UG/L	0-3021-80	34283	1078
2-CHLORONAPHTHALEN,T	<	1	UG/L	0-3021-80	34581	1080
2-ETHLYHEXYL PHTHA,T		4	UG/L	0-3021-80	39100	1094
2,3,7,8-TETRACHLOR,T	<	1	UG/L	0-3021-80	34675	1110
2,4-DINITROTOLUENE,T	<	1	UG/L	0-3021-80	34611	1091
2,6-DINITROTOLUENE,T	<	1	UG/L	0-3021-80	34626	1092
3,3-DICHLOROBENZID,T	<	1	UG/L	0-3021-80	34631	1088
4-BROMOPHENYL PHEN,T	<	1	UG/L	0-3021-80	34636	1079
4-CHLOROPHENYL ETH,T	<	1	UG/L	0-3021-80	34641	1081

TENTATIVE IDENTIFICATION OF OTHER COMPOUNDS

Phosphoric acid, triphenyl ester--4.9 μg/L

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY WRD
CENTRAL LABORATORY, ATLANTA, GEORGIA

LABORATORY ANALYTICAL SHEET FOR LAB-ID 3320010 RECORD-# 125558

STATION_ID: (RATD) COLLECTED: BEGIN DATE 831108 TIME 1140 END DATE TIME LAT-LONG-SEQ#: ****** ******* **
NAME: DATA TO BE RETRIEVED FROM HEADER WHEN COMPLETE STATE: 26 USER CODE: 26 MICHIGAN COUNTY: 069 GEO.UNIT:
SAMPLE MEDIUM: 6 STATUS: H SOURCE: 9 HYD.CONDITION: SAMPLE TYPE: HYD.EVENT: PROJECT/ACCT-#: 442603200 COST: 321.55
COMMENTS:
UNIQUE NUMBER REQUESTED SCHEDULES USED 1394 0 0 0 TOTAL PARAMETERS 57
NOTE: THIS SAMPLE WAS LOGGED IN AS "X" TYPE DATA AND WILL NOT TRANSFER TO WATSTORE. "O" IN COL(51) OF AN "A" CARD CHANGES DISP.
PRINTED ON 02/04/84 FIRST RETREIVAL "LABPRIM" 02/04/84

NAME	RMK/VALUE		UNITS	METHOD	W-CODE	LC
ACENAPHTHENE, TOTAL	<	1	UG/L	0-3021-80	34205	1066
ACENAPHTHYLENE, TOT.	<	1	UG/L	0-3021-80	34200	1067
ANALYZING AGENCY		80010		- -	28	91
ANTHRACENE, TOTAL	<	1	UG/L	0-3021-80	34220	1068
BENZIDINE, TOTAL	<	1	UG/L	0-3021-80	39120	1069
BENZO(A)ANTHRACENE,T		2	UG/L	0-3021-80	34526	1070
BENZO(A)PYRENE, TOT.	<	1	UG/L	0-3021-80	34247	1073
BENZO(B)FLUORANTHE,T	<	1	UG/L	0-3021-80	34230	1071
BENZO(GHI)PERYLENE,T	<	1	UG/L	0-3021-80	34521	1074
BENZO(K)FLUORANTHE,T	<	1	UG/L	0-3021-80	34242	1072
BUTYL BENZYL PHTHA,T	<	1	UG/L	0-3021-80	34292	1075
CALCIUM, TOTAL USGS		98	MG/L	I-3152-78	916	244
CENTRAL LAB-ID-#		3320010		- -	99998	1500
CHRYSENE, TOTAL	<	1	UG/L	0-3021-80	34320	1082
DI-N-BUTYL PHTHALA,T	<	1	UG/L	0-3021-80	39110	1084
DI-N-OCTYLPHTHALAT,T	<	1	UG/L	0-3021-80	34596	1093
DIBENZANTHRACENE, T	<	1	UG/L	0-3021-80	34556	1083
DIETHYL PHTHALATE, T	<	1	UG/L	0-3021-80	34336	1089
DIGESTION HCL WATER		2		I-3485-78	0	654
DIMETHYL PHTHALATE,T	<	1	UG/L	0-3021-80	34341	1090
FLUORANTHENE, TOTAL	<	1	UG/L	0-3021-80	34376	1096
FLUORENE, TOTAL	<	1	UG/L	0-3021-80	34381	1095
HEXACHLOROBENZENE,T	<	1	UG/L	0-3021-80	39700	1097
HEXACHLOROBUTADIEN,T	<	1	UG/L	0-3021-80	39702	1098
HEXACHLOROCYCLOPEN,T	<	1	UG/L	0-3021-80	34386	1099
HEXACHLOROETHANE, T.	<	1	UG/L	0-3021-80	34396	1100
INDENO(1,2,3)PYREN,T	<	1	UG/L	0-3021-80	34403	1101
IRON, TOTAL		4600	UG/L	I-3381-78	1045	189

NAME	RMK/VALUE		UNITS	METHOD	W-CODE	LC
ISOPHORONE, TOTAL	<	1	UG/L	0-3021-80	34408	1102
LEAD, TOTAL		5	UG/L	I-3400-78	1051	257
MANGANESE, TOTAL		170	UG/L	I-3454-78	1055	41
METALS TOTAL CHE-EXT		1		- -	0	125
N-NITROSODI-N-PROP,T	<	1	UG/L	0-3021-80	34428	1107
N-NITROSODIPHENYLA,T	<	1	UG/L	0-3021-80	34433	1106
NAPHTHALENE, TOTAL	<	1	UG/L	0-3021-80	34696	1103
NITROBENZENE, TOTAL	<	1	UG/L	0-3021-80	34447	1104
NITROSODIMETHLYAMI,T	<	1	UG/L	0-3021-80	34438	1105
OIL AND GREASE, TOT.		3	MG/L	0-1555-74	556	127
PHENANTHRENE, TOTAL	<	1	UG/L	0-3021-80	34461	1108
PYRENE, TOTAL	<	1	UG/L	0-3021-80	34469	1109
SP. CONDUCTANCE FLD		559	UMHOS	I-1780-77	95	21
WATER TEMPERATURE		11.0	DEG C	- -	10	64
1,2-DICHLOROBENZEN,T	<	1	UG/L	0-3021-80	34536	1085
1,2,4-TRICHLOROBEN,T	<	1	UG/L	0-3021-80	34551	1111
1,3-DICHLOROBENZEN,T	<	1	UG/L	0-3021-80	34566	1086
1,4-DICHLOROBENZEN,T	<	1	UG/L	0-3021-80	34571	1087
2-CHLORETH METHANE,T	<	1	UG/L	0-3021-80	34278	1076
2-CHLORETHYL ETHER,T	<	1	UG/L	0-3021-80	34273	1077
2-CHLORISOPR ETHER,T	<	1	UG/L	0-3021-80	34283	1078
2-CHLORONAPHTHALEN,T	<	1	UG/L	0-3021-80	34581	1080
2-ETHLYHEXYL PHTHA,T	<	1	UG/L	0-3021-80	39100	1094
2,3,7,8-TETRACHLOR,T	<	1	UG/L	0-3021-80	34675	1110
2,4-DINITROTOLUENE,T	<	1	UG/L	0-3021-80	34611	1091
2,6-DINITROTOLUENE,T	<	1	UG/L	0-3021-80	34626	1092
3,3-DICHLOROBENZID,T	<	1	UG/L	0-3021-80	34631	1088
4-BROMOPHENYL PHEN,T	<	1	UG/L	0-3021-80	34636	1079
4-CHLOROPHENYL ETH,T	<	1	UG/L	0-3021-80	34641	1081

TENTATIVE IDENTIFICATION OF OTHER COMPOUNDS

Phosphoric acid, triphenyl ester--5.8 µg/L

APPENDIX G

Glossary

(Including Acronyms and Abbreviations Used in the Text)

GLOSSARY

List of Acronyms, Abbreviations, and Symbols Used in the Text

AAF	Army Air Field
ADC	Aerospace Defense Command
AFB	Air Force Base
AFESC	Air Force Engineering and Services Center
AFFF	Aqueous Film Forming Foam
AFS	Air Force Station
AG	Above Ground
AGE	Aerospace Ground Equipment
AMS	Avionics Maintenance Squadron
ATC&W	Air Traffic Control and Warning
AVGAS	Aviation Gasoline
BG	Below Ground
BMW	Bombardment Wing
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CES	Civil Engineering Squadron
DCE	Dichloroethylene
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DLA	Defense Logistics Agency
DOD	Department of Defense
DPDO	Defense Property Disposal Office
ECM	Electronic Countermeasure
EPA	Environmental Protection Agency
°F	Degrees Fahrenheit
FAA	Federal Aviation Administration
FIS	Fighter-Interceptor Squadron
FMS	Field Maintenance Squadron
gal/yr	Gallons Per Year
HARM	Hazard Assessment Rating Methodology
In.	Inches
IRP	Installation Restoration Program

JP	Jet Petroleum
MCP	Military Construction Program
MDNR	Michigan Department of Natural Resources
MEK	Methyl Ethyl Ketone
MMS	Munitions Maintenance Squadron
MOGAS	Motor Gasoline
MSL	Mean Sea Level
NDI	Non-destructive Inspection
No.	Number
NPDES	National Pollutant Discharge Elimination System
OLAD	Operating Location for Air Defense
OMS	Operational Maintenance Squadron
PCBs	Polychlorinated Biphenyls
PMEL	Precision Measurement Equipment Laboratory
POL	Petroleum, Oil, and Lubricants
ppb	Parts Per Billion
ppm	Parts Per Million
R&D	Research and Development
RBS	Radar Bombing Site
RCRA	Resource Conservation and Recovery Act
ROCC	Region Operation Control Center
SAC	Strategic Air Command
SAGE	Semi-Automatic Ground Environment
TAC	Tactical Air Command
TCE	Trichloroethylene
TOC	Total Organic Carbon
TSCA	Toxic Substances Control Act
USAF	United States Air Force
USGS	United States Geological Survey
WAFB	Wurtsmith Air Force Base

AQUIFER - A geologic formation, or group of formations, that contains sufficient saturated permeable material to conduct groundwater to yield economically significant quantities of groundwater to wells and springs.

AQUIFER YIELD - Maximum rate of withdrawal of water from an aquifer.

CONTAMINANT - As defined by section 104(a)(2) of CERCLA, shall include, but not be limited to, any element, substance, compound, or mixture, including disease causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformation in such organisms or their offspring.

DICHLOROETHYLENE (DCE) - A general solvent for organic materials; dye extraction; perfumes; lacquers; thermoplastics; and organic synthetics.

DISCHARGE - The process involved in the draining or seepage of fluid out of a lake, pipe, groundwater aquifer or similar fluid containing structure.

DOWNGRADIENT - A direction that is hydraulically down slope; the direction in which ground water flows.

DROUGHTY - Dry, arid, lacking moisture.

FLOOD PLAIN - The relatively smooth valley floors adjacent to and formed by alluviating rivers which are subject to overflow.

GROUND WATER - All subsurface water, especially that part that is in the zone of saturation.

HAZARDOUS WASTE - a solid waste which because of its quantity, concentration, or physical, chemical or infectious characteristics may--

(A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible, illness; or

(B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed.

LEACHATE - a solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water.

LEACHING - the process by which soluble materials in the soil, such as nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

LINER - a continuous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill, or landfill cell which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents or leachate.

METHYL ETHYL KETONE - An organic chemical used as a solvent in cements and adhesives.

MIGRATION (Contaminant) - The movement of contaminants through pathways (groundwater, surface water, soil, and air).

NET PRECIPITATION - Mean annual precipitation minus mean annual evapotranspiration.

OIL/WATER SEPARATOR - A man-made facility designed to separate by gravity liquids of differing densities; typically to skim oil or grease from a water surface.

PCB (Polychlorinated Biphenyl) - A chemically and thermally stable toxic organic compound that, when introduced into the environment, persists for long periods of time, is not readily biodegradable, and is biologically accumulative.

PD680 - A petroleum distillate used as a safety cleaning solvent. Two types of PD680 solvent have been used; Type I, having a flashpoint of 100°F, and Type II, having a flashpoint of 140°F.

PERMEABILITY - The capacity of a porous rock, sediment, or soil for transmitting a fluid without impairment of the structure of the medium; it is a measure of the relative ease of fluid flow under unequal pressure.

RECHARGE - The process involved in the addition or replenishment of water to a groundwater aquifer by natural or artificial processes.

SPECIFIC YIELD - The ratio of the volume of water that the rock, after being saturated will yield by gravity, to the volume of the rock. It is used for water table aquifers.

SURFACE WATER - All water exposed at the ground surface; including streams, rivers, ponds, and lakes.

TILL - Unsorted and unstratified drift, generally unconsolidated, deposited directly by and underneath a glacier without subsequent reworking by water from the glacier, and consisting of a heterogeneous mixture of clay, sand, gravel, and boulders varying widely in size and shape.

1,1,1-TRICHLOROETHANE (Methyl Chloroform) - A solvent used for cleaning precision instruments, metal degreasing and textile processing.

TRICHLOROETHYLENE (TCE) - A solvent used for metal degreasing; extraction solvent for oils, fats, waxes; solvent dyeing; dry cleaning; refrigerant and heat exchange liquid; fumigant; cleaning and drying electronic parts; diluent in paints and adhesives; textile processing; chemical intermediate; aerospace operations (flushing liquid oxygen).

UPGRADIENT - A direction that is hydraulically up slope.

WATER TABLE - The upper limit of the portion of the ground wholly saturated with water.

APPENDIX H

References

REFERENCES

1. __________, Mineral Resources, June 1975.

2. __________, Land Use Analysis, June 1976.

3. Anonymous, The Wurtsmith Air Force Base Guide, National Military Publications, El Cajon, California, 1984.

4. Chester Engineers, East Central Michigan Planning and Development Area-wide Waste Treatment Management Plan, Appendices 8, 9, and 10, Water Quality Relationships, Ann Arbor, Michigan, Volume 1B, 1978.

5. Cummings, T.R., Letter to USAF Headquarters, Nebraska Concerning Wurtsmith AFB benzene plume, U.S. Geological Survey, Lansing, Michigan, February 13, 1984.

6. DEM Operating Instruction 85-7, July 31, 1984.

7. The East Central Michigan Planning and Development Regional Commission, Environmental and Natural Elements of Iosco County, June 1973.

8. Giebelhaus, Capt S.J., "Litigation Report - Possible Litigation as a Result of Trichloroethylene Contaminations, Wurtsmith AFB, Michigan", Wurtsmith AFB, Michigan, December 4, 1978.

9. Handy, A.H., Water Resources Activities in Michigan, 1982, U.S. Geological Survey, Lansing, Michigan, 1982.

10. Kelley, F.J., Notice of Citizen Suit, Lansing, Michigan, May 15, 1979.

11. Kelley v. the United States of America, et al, TCE Lawsuit, August 29, 1979.

12. Kelley v. the United States of America, et al, Defendants' Answer, October 1979.

13. Kelley v. the United States of America, et al, Consent Decree, November 24, 1980.

14. Kolzow, Ronald, Letter to MDNR Clarifying Status of Wastewater Treatment Lagoons and Seepage Beds at Wurtsmith AFB, U.S. EPA Region V, Chicago, IL, July 18, 1984.

15. McDonald, J.O., Joint Notice and Order, TCE Ground-water Contamination at Wurtsmith AFB, October 28, 1978.

16. McShane, Maj M.B., and Rankin, Capt C.A., "Status Report to 4 December 1978 Litigation Report Regarding Trichloroethylene (TCE) Contamination at Wurtsmith AFB, MI", Wurtsmith AFB, Michigan, May 22, 1979.

17. Polasek, Thomas, Michigan Department of Natural Resources, personal communication, October 1984.

18. Prince, J.K., "Trichloroethylene - Health Effects Advisory and Recommended Drinking Water Level", U.S. Environmental Protection Agency - Region V, Chicago, IL, 1978.

19. Sax, Irving N., Dangerous Properties of Industrial Materials, 6th Edition, Van Nostrand Reinhold Company, 1984.

20. Scambilis, Lt Col N.A., Letter to U.S. EPA Region V Concerning Joint Findings and Notice of Violation and Order for Compliance, USAF Headquarters, Nebraska, November 13, 1978.

21. Scambilis, Lt Col N.A., Compliance Document for 30 November 1980 Consent Decree, November 25, 1980.

22. Stark, J.R., Cummings, T.R., Twenter, F.R., Ground-water Contamination at Wurtsmith Air Force Base, Michigan, U.S. Geological Survey, Lansing, Michigan, 1983.

23. Taylor, G.T., Request for Entry Upon Wurtsmith AFB, State of Michigan, October 2, 1979.

24. U.S. Environmental Protection Agency, "Methods of Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1979.

25. U.S. Environmental Protection Agency, "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods", SW-846, 2nd Edition, 1982.

26. Versar, Inc., "Federal Facility Status Report, Wurtsmith Air Force Base MI", March 20, 1984.

27. Wurtsmith AFB, Tab A-1 Environmental Narrative, 1978.

28. Wurtsmith AFB, Final Ground-water Remedial Plan for Wurtsmith Air Force Base, April 27, 1981.

29. Wurtsmith AFB, Land Management Plan, March 5, 1975.

30. Wurtsmith AFB, "Annual Review of Pest Control", June 5, 1984.

31. Wurtsmith AFB, "Superfund Site Notification", May 22, 1981.

32. Wurtsmith AFB, "Generator Annual Hazardous Waste Report", January 6, 1983.

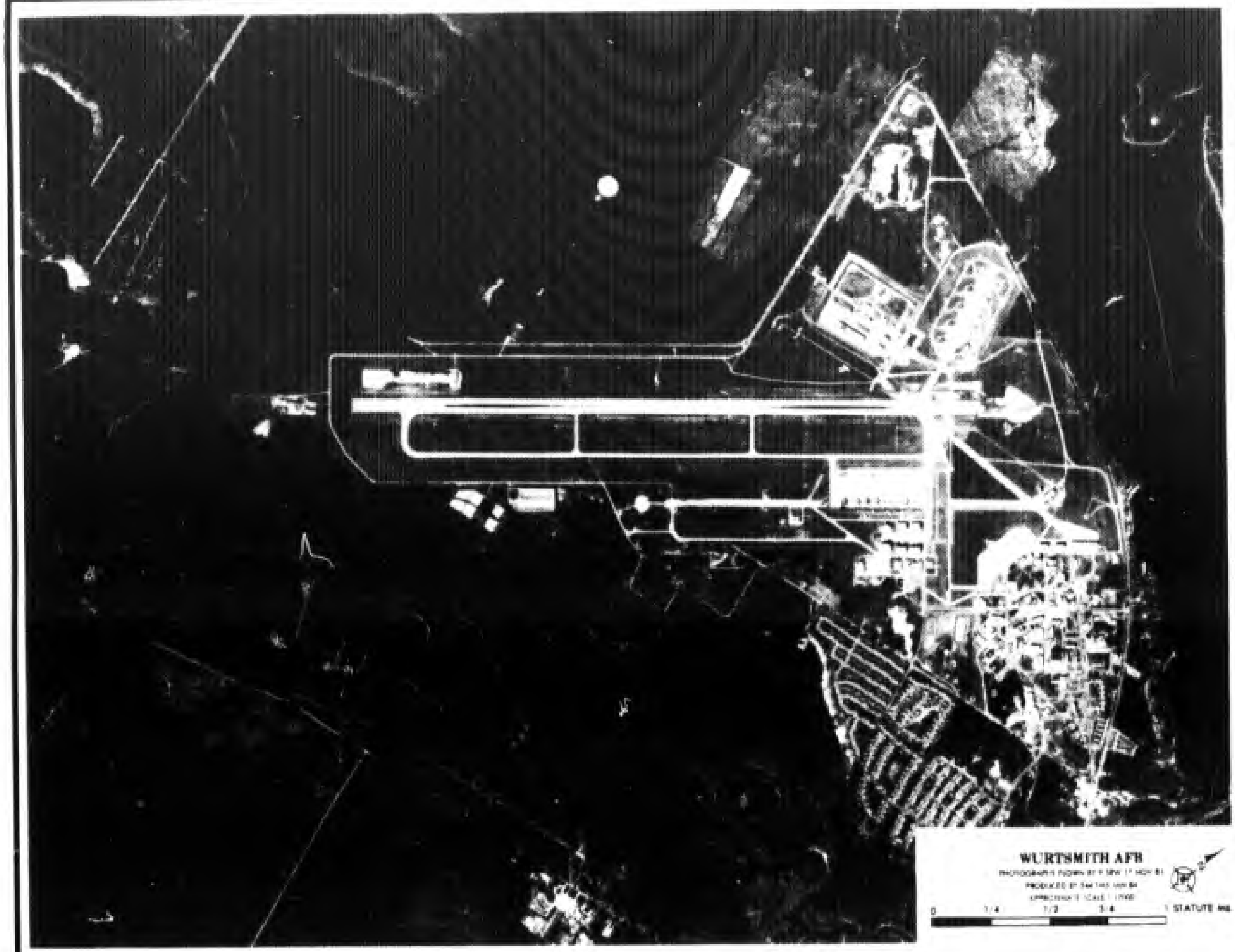
33. Wurtsmith AFB, "Wurtsmith Air Force Base Spill Prevention and Response Plan", (draft), 1984.

34. Wurtsmith AFB, Notes Pertaining to Interviews with Landfill Operators by Legal Department, circa 1979.

APPENDIX I

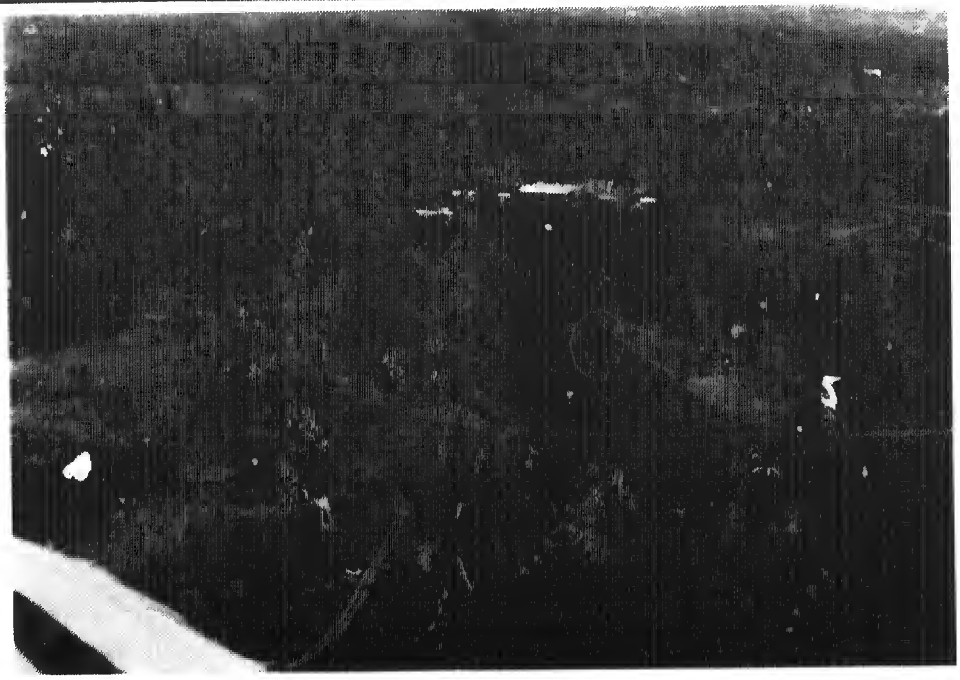
Aerial and Ground Photos
Wurtsmith Air Force Base

Aerial Photos
Port Austin Air Force Station
Empire Air Force Station
Bayshore Air Force Station



AERIAL VIEW OF WURTSMITH AIR FORCE BASE
(17 November 1981)

Van Ettan Lake is visible to the right, the Au Sable River is visible at the lower left.



SITE D-6

AERIAL VIEW OF INACTIVE LANDFILL SOUTH-SOUTHWEST OF DPDO
(Wurtsmith Air Force Base, view facing north)

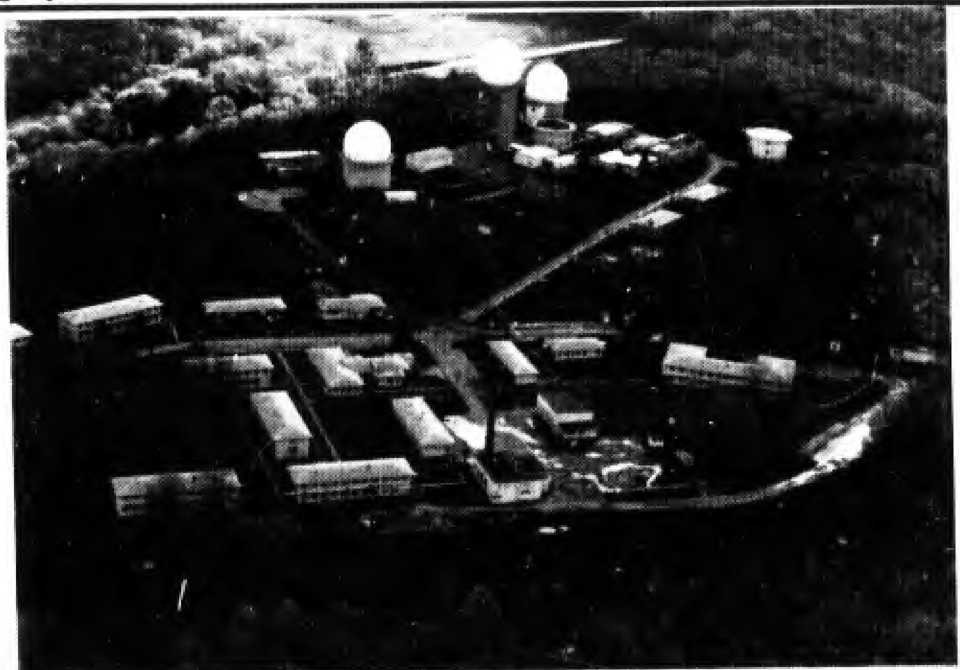
Capped portion is visible in the center of the photograph.

SITE D-5

Tanker Trailer Removed from Northern Landfill in 1979

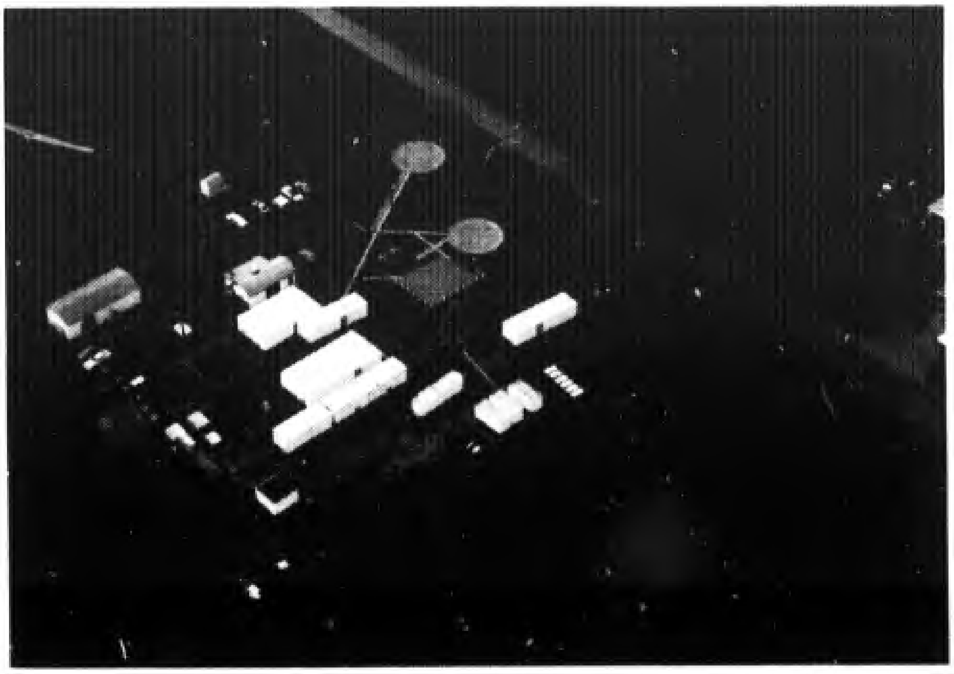
AERIAL VIEW OF PORT AUSTIN AIR FORCE STATION
(17 October 1984, view facing west)

The power plant (Site SP-18) is visible behind the radar dome on the right of the photograph.



AERIAL VIEW OF EMPIRE AIR FORCE STATION
(17 October 1984, view facing east)

The buildings at the bottom of the photograph are closed and belong to the National Park Service. The radar dome to the left is the Air Force height finder radar. The other two radar domes belong to the FAA.



AERIAL VIEW OF BAYSHORE AIR FORCE STATION
(17 October 1984, view facing southwest)

This station was formally closed 1 October 1984.