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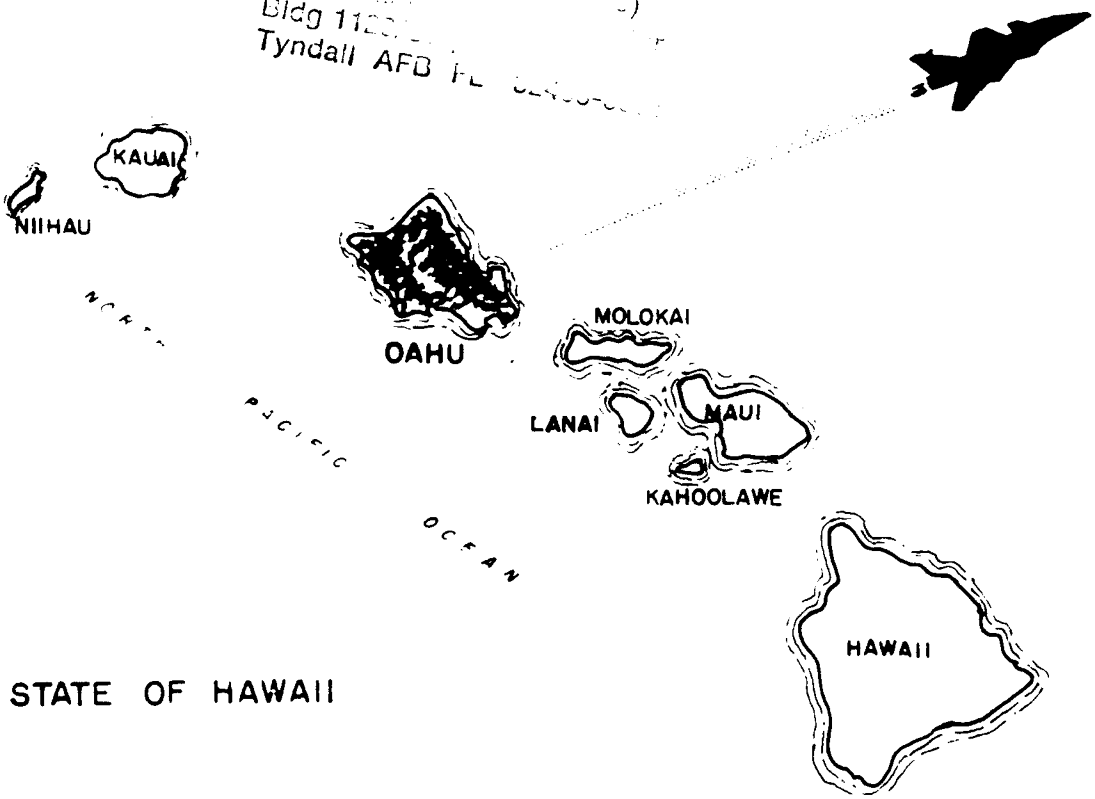
INSTALLATION RESTORATION PROGRAM

PHASE 1

RECORDS SEARCH

WHEELER AIR FORCE BASE

OAHU, HAWAII



INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH
WHEELER AIR FORCE BASE
OAHU, HAWAII

Prepared for

Department of the Air Force
Headquarters 15th Air Base Wing (PACAF)
Wheeler Air Force Base
Hawaii

By

Sam O. Hirota, Inc.
345 Queen Street, Suite 500
Honolulu, Hawaii

July 1983
Contract No. F6460582C0095

NOTICE

This report has been prepared for the U.S. Air Force by Sam O. Hirota, Incorporated 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.

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LIST OF ACRONYMS, ABBREVIATIONS AND SYMBOLS

ABW	Air Base Wing
AFB	Air Force Base
AFCS	Air Force Communication Service
AFESC	Air Force Engineering and Services Center
BEE	Bioenvironmental Engineer
BNA	Base-neutral and acid extractables
C	Carbon
Ca	Calcium
Cl	Chloride
CERCLA	Comprehensive Environmental Response, Compensation,and Liability Act
cfs	Cubic feet per second
CINCPACAF	Commander-in-Chief, Pacific Air Forces
CINCUSARPAC	Commander-in-Chief, United States Army, Pacific
DBCP	Dibromochloropropane
DEEV	Civil Engineering Environmental Planning
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DOD	Department of Defense
DPDO	Defense Property Disposal Office
EDB	Ethylene Dibromide
EPA	Environmental Protection Agency
F	Fluorine
°F	Degrees Fahrenheit
FDCC	Fire Dept. Control Center

15ABW	Fifteenth Air Base Wing
FIT	Field Investigation Team
FTA	Fire Training Area
ft.	Foot (feet)
gpm	Gallons per minute
HARM	Hazardous Assessment Rating Methodology
HCO	Bicarbonate
HEPC	Hickam Environmental Protection Committee
in.	Inch(es)
IRP	Installation Restoration Program
K	Potassium
Mg	Magnesium
mgd	Million gallons per day
mg/l	Milligram per liter
mi	Mile(s)
ml	Milliliter(s)
MSL	Mean Sea Level
N	Nitrogen
Na	Sodium
NO	Nitrate
PACCOMAREA	Pacific Command Area
PACAF	Headquarters Pacific Air Forces
P	Phosphorous
PCB	Polychlorinated biphenyls
PCD	Pacific Communications Division
PD - 680	Dry Cleaning Solvent (petroleum distillate)

PO	Phosphate
POL	Petroleum, Oils and Lubricants
RCRA	Resource Conservation and Recovery Act
R/W	Right of Way
SiO	Silica
SO	Sulfate
sq. ft.	square foot(feet)
sq. mile	square mile
TOC	Total Organic Carbon
TDS	Total Dissolved Solids
UG	Underground
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compounds
WWTP	Wastewater Treatment Plant
°	Degrees
>	greater than

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

A. INTRODUCTION

1. Sam O. Hirota, Inc. was retained by the United States Air Force on 28 September 1982, to conduct the Hazardous Materials Disposal Sites and Installation Restoration Program Records Search for Wheeler Air Force Base under Contract No. F6460582C0095.

2. The current Department of Defense (DOD) Installation Restoration Program Policy is contained in the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5 dated 11 December 1981 and implemented by Air Force message dated 21 January 1982 as a positive action to ensure compliance of military installations with existing environmental regulations. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the Installation Restoration Program. The DOD policy is to identify and fully evaluate suspected problems associated with past hazardous material disposal sites on DOD facilities, to control hazardous contamination, and to control hazards to health and welfare that resulted from these past operations.

3. To implement the DOD policy, a four-phase Installation Restoration Program has been directed. Phase I, the records search phase, is the identification of potential problems. Phase II (not part of this contract) consists of follow-up field work as determined from Phase I. Phase III (not part of this contract) consists of a technology base development study to support the development of project plans for controlling migration or restoration of the installation. Phase IV, (not part of this contract) includes operations which are required to control identified hazardous conditions.

4. The Wheeler Air Force Base Records Search included a detailed review of pertinent installation records, contact with outside agencies for documents relevant to the records search, a pre-performance coordination meeting, and on-site base visits conducted by the contractor. Activities performed during the on-site visits included a detailed search of installation records, ground tours of the installation, and interviews with past and present personnel.

5. Potentially contaminated sites were rated, using the Hazardous Assessment Rating Methodology (HARM). The HARM score indicates the relative potential for environmental contaminanation at each site. For sites showing a high potential, recommendations are made to quantify the potential environmental contaminanation under Phase II of the IRP. For sites showing a moderate potential, a limited Phase II program may be recommended. For sites showing a low potential, no further follow up of Phase II work is recommended.

B. MAJOR FINDINGS

1. Quantities of hazardous wastes were generated by a variety of industrial operations at Wheeler Air Force Base and probably remained relatively stable and comparable to current quantities. However, the base historian's records indicate a substantial increase in base population, POL usage, and transient aircraft traffic during the Korean Conflict than in succeeding years, and it is logical to assume that waste generated increased during this period. There was no significant increase in Air Force activity during the Vietnam Conflict. The majority of wastes are taken off-base by private contract.

2. Determination of past activities and disposal practices was based primarily on the interview phase of the investigation, as written records of materials purchased and used are generally not retained for more than 2 or 3 years. Beginning in the period 1975-1977 the Bioenvironmental Engineering Section began compiling files for shops on-base. These files served as a key reference for determining which shops were using hazardous materials and which were most probably using hazardous materials prior to the initiation of the filing system.

3. Seven sites were identified and evaluated for potential contamination migration. These sites included landfills, fire training areas, the storm drainage and sanitary sewer systems, and sites contaminated by POL leakage.

4. Three distinct aquifers occur within the limits of Wheeler Air Force Base; two of them are deep aquifers in unaltered Koolau basalt and the other is a shallow perched aquifer. The deepest aquifer, with its boundary lying on the southern portion of Wheeler Air Force Base, is in the northerly part of the Pearl Harbor Basal Aquifer. The Pearl Harbor Basal Aquifer carries an immense volume of

excellent quality water and is the most highly exploited groundwater resource in the State. Adjacent to the Pearl Harbor Basal Aquifer is the Wahiawa High Level Aquifer. Most of the urbanized portion of Wheeler Air Force Base lies above the Wahiawa High Level Aquifer. Meaningful contamination of the Wahiawa High Level Aquifer has not taken place, however traces of Dibromocholoropropane (DBCP), an agricultural fumigant not used at Wheeler Air Force Base, have been detected. The existence of perched water was not deliberately investigated until 1980. The perched water at Kunia has been analyzed for dissolved constituents but elsewhere remains largely an unknown phenomenon. At Kunia, which lies among pineapple fields, contaminants such as the fertilizer and biocide residues are present and the water is highly acidic.

C. CONCLUSIONS

1. Information obtained from the records search, environmental setting review, the hydrogeological evaluation and interviews with base military and civilian personnel, past employees, and state and local government agencies, was used to identify and evaluate sites having potential for migration of

contaminants. Table V-1 contains a list of the potential contamination sources identifed at Wheeler Air Force Base and a summary of HARM scores for those sites.

2. Seven sites were identified as having been contaminated by hazardous materials at Wheeler Air Force Base. The HARM site rating indicates the relative potential for environmental impact at each site and is used as a guideline for making recommendations on follow-up Phase II programs. During Phase II, the magnitude and extent of contamination will be quantified by a monitoring investigation.

D. RECOMMENDATIONS

1. Due to the sensitive nature of the location of Wheeler Air Force Base (Wheeler Air Force Base overlies two important aquifer systems), the recommended monitoring program includes data collection (chemical analyses and water sampling) as well as visual inspection of soil samples during well drilling operations.

Table VI-2

SUMMARY OF RECOMMENDED MONITORING

Site	HARM Score	Recommended Monitoring	Rationale
3 (landfill)	66	3 wells to perched aquifer, analyze heavy metals, VOC, TOC, phenol, pH, iron, zinc, nitrate, sulfide; 3 samples per well	site contains industrial and domestic waste, solvents, paint, oil, fuels
4 (fire training area)	57	3 wells to perched aquifer, analyze VOC, BNA, PCB, phenol, TOC; 3 samples per well	site contains solvents, oils, fuel residuals after burning
6, 7, 5 (drainage areas)	51, 51, 49	1 well to perched aquifer per site. analyze lead, VOC, phenol, TOC; 3 samples per well	sites contains solvents, oil, fuels
2 (landfill)	48	same as 1	same as 1
1 (landfill)	45	3 wells to perched aquifer, analyze heavy metals, VOC, TOC, phenol, pH; 3 samples per well	site contains industrial waste, solvents, paint

2. The recommended monitoring program for the seven sites at Wheeler Air Force Base is the minimum program that should be undertaken to verify the extent and degree of hazardous waste contamination. It would be desirable to include additional activities to further define water and soil quality for Wheeler Air Force Base. These include monitoring of existing wells located on or near Wheeler Air Force Base, and the collection and subsequent analyses of soil samples, taken at five foot intervals during the drilling of monitoring wells. While these activities are not a necessity in the initial Phase II investigation, the incremental cost to perform this work would be small. The additional information obtained would be potentially useful should significant contamination be documented during the Phase II study.

I. INTRODUCTION

CHAPTER I

INTRODUCTION

Background

The United States Air Force, due to its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of disposal sites and take action to eliminate the hazards in an environmentally responsible manner. The primary federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Sections 3012 and 6003 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. To assure compliance with these hazardous waste regulations, The Department of Defense, (DOD) developed the Installation Restoration Program (IRP). The current DOD Installation Restoration Program policy is contained in the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5 dated 11 December 1981 and implemented by Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the Installation

Restoration Program. The DOD policy is to identify and fully evaluate suspected problems associated with past hazardous material disposal sites on DOD facilities, to control the migration of hazardous contamination, and to control hazards to health and welfare that may have resulted from these past operations. The IRP will be a basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and clarified by Executive Order 12316.

To conduct the Hazardous Materials Disposal Sites and Installation Restoration Program Records Search for Wheeler Air Force Base, the USAF retained Sam O. Hirota, Incorporated on 28 September 1982 under Contract No. F6460582C0095.

The records search consists of Phase I of the DOD Installation Restoration Program and is intended to review installation records to identify possible hazardous waste-contaminated sites and to assess the potential for environmental contamination. Phase II, which is not part of this contract, consists of on-site field work as determined from Phase I. Phase III, which is also not part of this contract, consists of a technology base development of project plans to control migration or restoration of the installation. Phase IV, which is also not part of this contract, includes operations which are required to control identified hazardous conditions.

Authority

The identification of hazardous waste disposal sites at Air Force installations was directed by Defense Environmental Quality Program Policy Memorandum 81-5 (DEQPPM 81-5) dated 11 December 1981, and was implemented by an USAF message dated 21 January 1982.

Purpose of the Records Search

Purpose of the records search was to identify and evaluate suspected contamination associated with past hazardous material disposal sites on DOD facilities. The potential for environmental contamination was evaluated at Wheeler Air Force Base by reviewing existing information and installation records. Pertinent information includes the history of operations, the geological and hydrogeological conditions which may contribute to the migration of contaminants, and the ecological settings which indicate environmentally sensitive habitats or evidence of environmental stress.

Scope

The records search program included a pre-performance meeting, on-site base visits, review and analysis of the information obtained, and preparation of this report.

The pre-performance meeting was held at Hickam Air Force Base, Hawaii, on 29 October 1982. Attendees at this meeting included representatives of 15ABW, PACAF, AFESC, USAF Clinic, and Sam O. Hirota, Inc. The purpose of the pre-performance meeting was to provide project instructions, clarification and technical guidance by AFESC, and to define the responsibilities of all parties participating in the records search.

On-site base visits were conducted by the contractor in the first two weeks of December 1982. Activities performed during the on-site visits included a detailed search of installation records, ground tours of the installation, and interviews with past and present personnel. The following team professional personnel comprised the contractor's records search team:

1. Dr. Dennis Hirota - Environmental Engineering
2. Dr. John Schenk - Environmental Engineering
3. Dale Scherger - Environmental Engineering

4. Craig Morgan - Environmental Engineering

5. John Mink - Hydrologist, Geologist

6. Nicola Rinaldi - Radiological Health Physicist

7. John Manley - Radiological Health Physicist

Resumes of these team members are included in the Appendix A.

Methodology

The methodology utilized in the Wheeler Air Force Base records search began with a review of past and present operations conducted at the base. Information was obtained from available records and interviews with past and present base employees from various operating areas of the base.

State and local agencies were also contacted for information and pertinent base-related environmental data The agencies contacted are listed in the Appendix I-B.

Following the interviews with past and present base employees, the next activity was to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various operations on the base. This portion of the review included the identification of all known past disposal sites and any other possible sources of contamination. Ground tours of the identified sites were then made by the project team to gather site-specific information.

Based on the above information and utilizing the decision tree shown in Figure I-1, a decision was then made concerning the existence of potential for hazardous material contamination at any of the identified sites. For those sites where a potential for contamination was identified, a determination of the potential for migration of the contamination was made by considering site-specific conditions. If no potential exists, the site was deleted from further consideration.

If the potential for contamination migration was considered significant, the site was evaluated and prioritized using the Hazardous Assessment Rating Methodology (HARM). The HARM score indicates the relative potential for environmental contamination at each site. For those sites showing a high potential, recommendations are made to quantify the potential environmental contamination migration problem under Phase II of the Installation Restoration Program. For those sites showing a moderate potential, a limited Phase II program may be recommended to confirm that a contaminant migration problem does or does not exist. For those sites showing a low potential, no further follow up Phase II work is recommended.

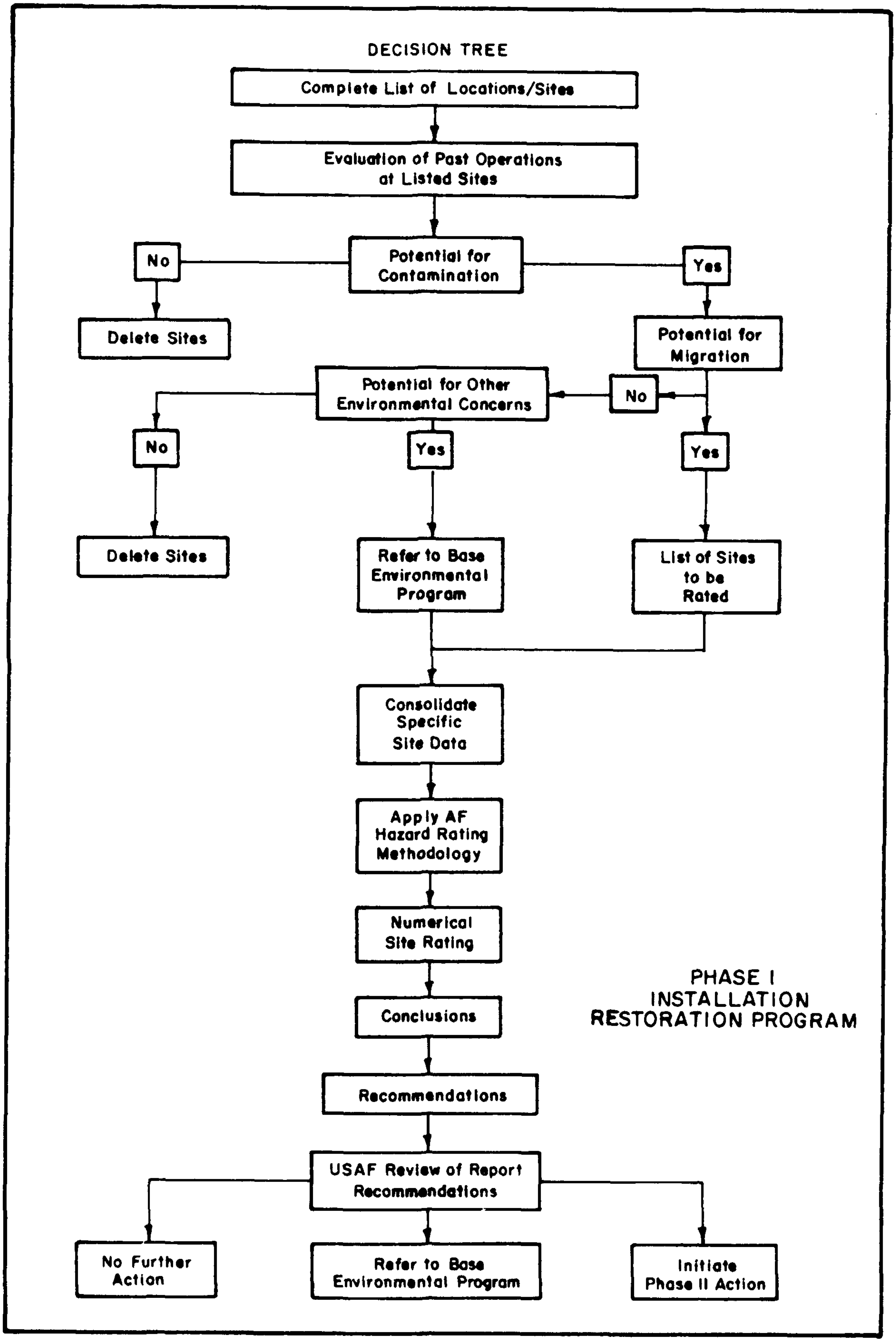

FIGURE I-1 RECORDS SEARCH METHODOLOGY DECISION TREE

II. INSTALLATION DESCRIPTION

CHAPTER II

INSTALLATION DESCRIPTION

Location

Wheeler Air Force Base is located in the central part of the Island of Oahu (Latitude 21 28' 50" North and Longitude 158 02' 30" West) in the State of Hawaii (see Figures II-1 and II-2). The Base, with an airfield elevation of 825 feet, is located on the Schofield Plateau and is adjacent to Kamehameha Highway on the eastern side, Kunia Road on the western side, and Schofield Barracks on the northeastern side (see Figure II-3). The Schofield Plateau lies between two mountain ranges (Koolau to the east and Waianae to the west) and is approximately 14 miles long and 5 miles wide. The plateau rises from about sea level on the south and north sides to an altitude of approximately 1,000 feet in the central area. The highest peak on the island is Mount Kaala at 4,060 feet. The Schofield plateau temperature is cool and theamount of precipitation is moderate. The road distance from the base to the business district of Honolulu is approximately 25 miles. Several modes of transportation are readily available and used in the area. The basic modes are private vehicles and public buses.

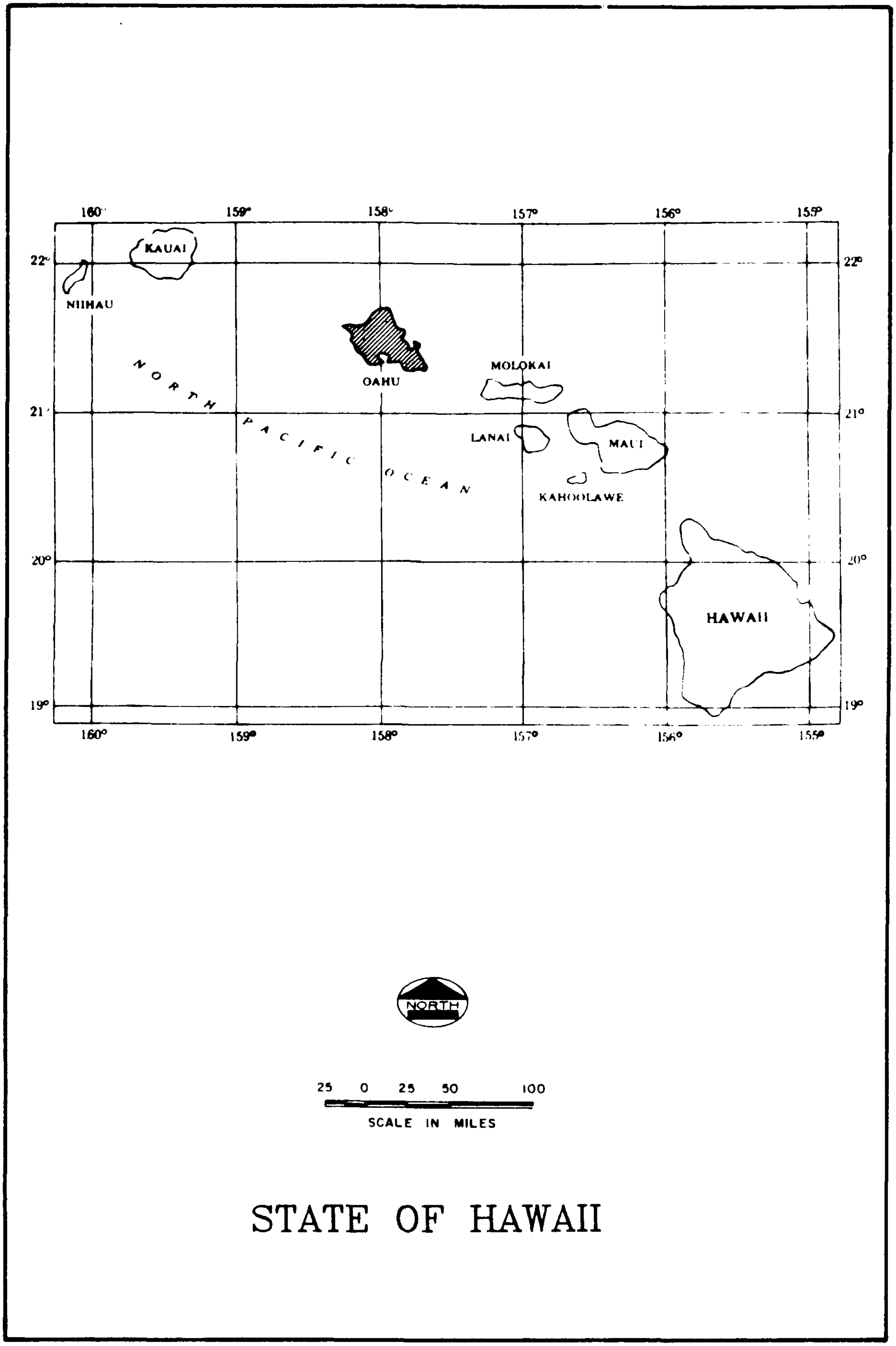

FIGURE II-1 ISLAND OF OAHU, STATE OF HAWAII

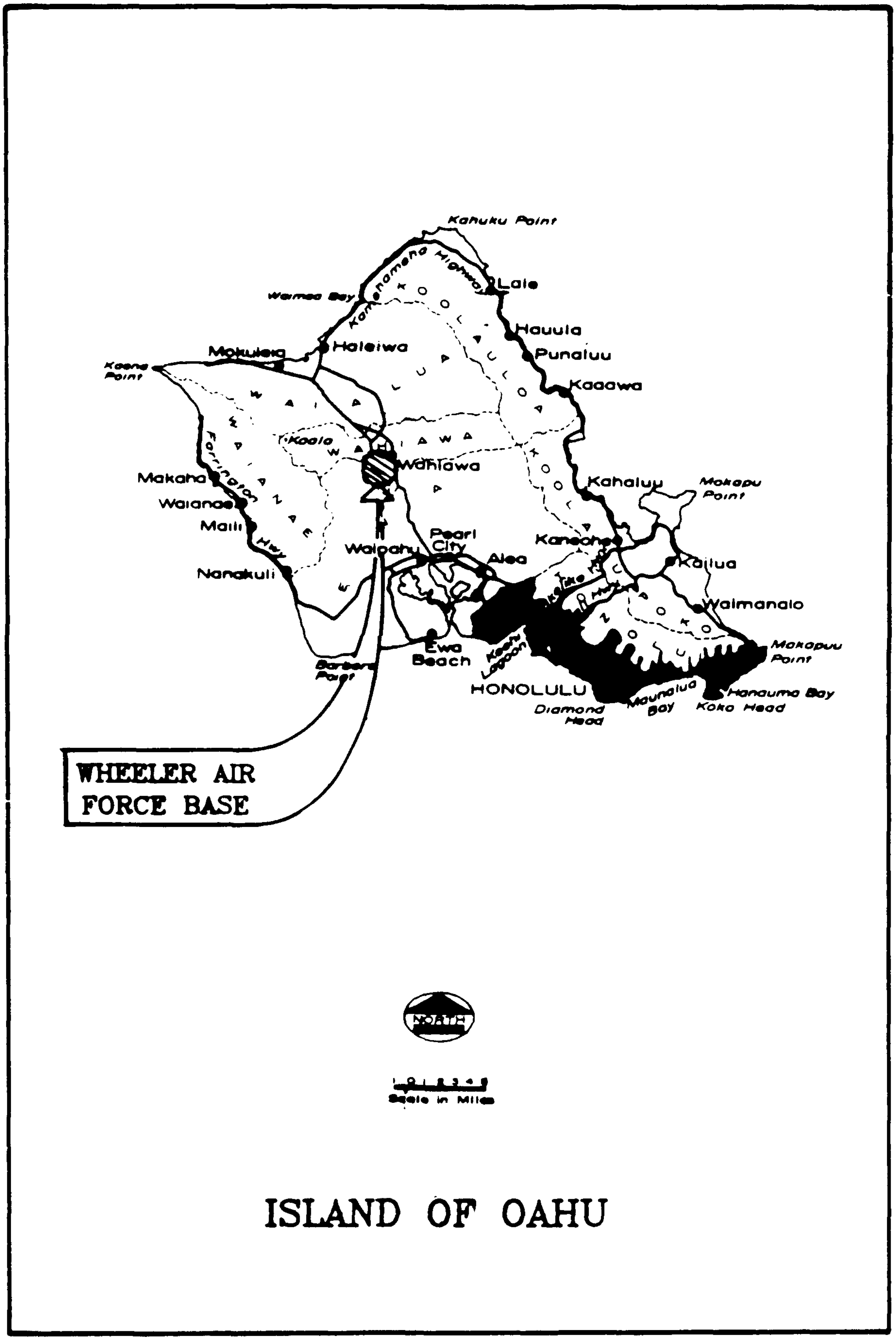

FIGURE II-2 LOCATION MAP, WHEELER AIR FORCE BASE

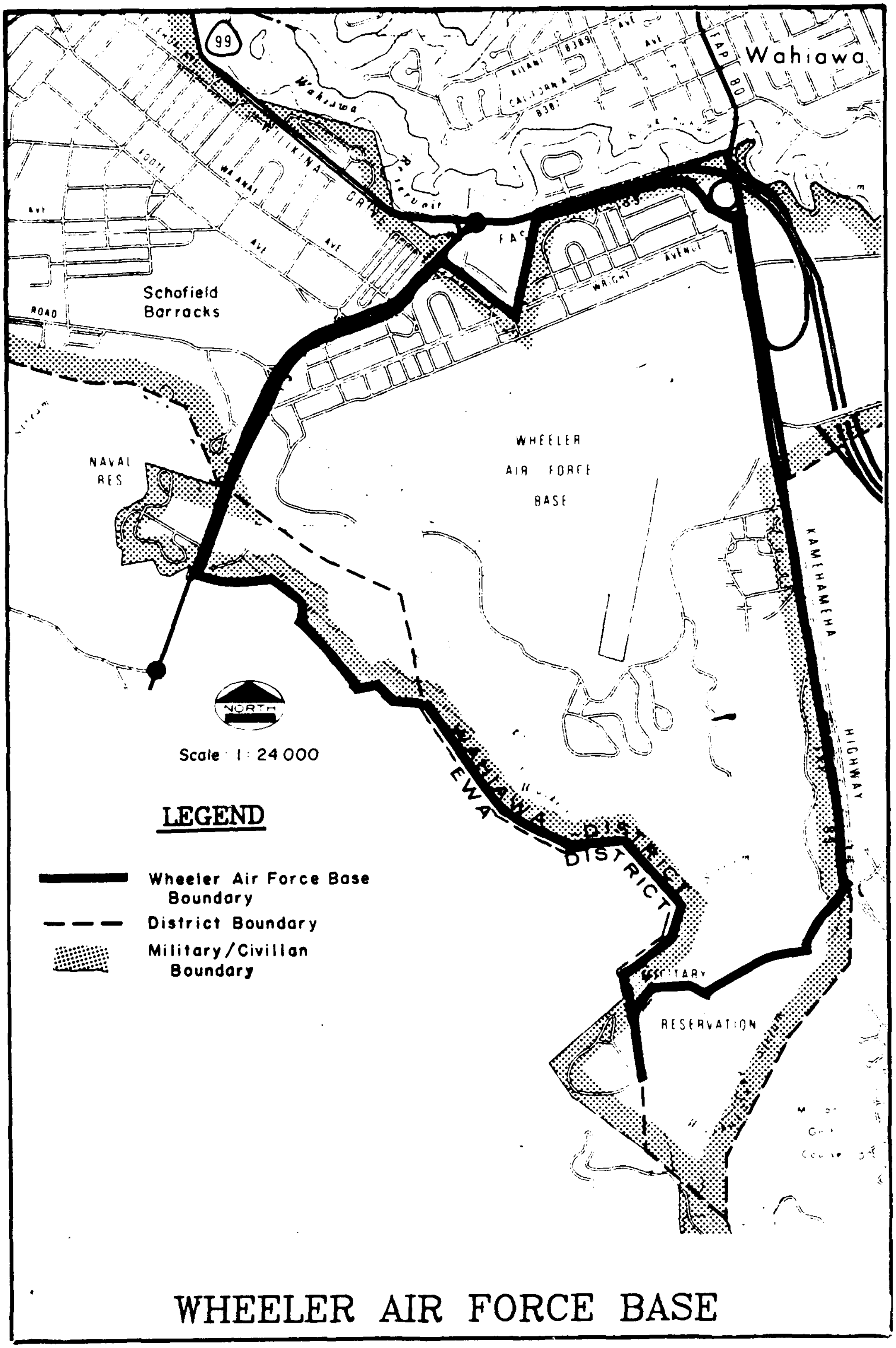

FIGURE II-3 SITE MAP, WHEELER AIR FORCE BASE

Size and Acquisitions

Wheeler Air Force Base, the second primary Air Force installation in Hawaii, consists of approximately 1,431 acres of land on the central saddle of Oahu at an elevation of 825 feet above sea level. The base, named in honor of Major Sheldon H. Wheeler, is surrounded on three sides by pineapple fields, and adjoins the Army's Schofield Barracks and the City of Wahiawa to the north. Since the establishment of the installation in 1922, the U.S. Government has invested in excess of 14 million dollars in buildings, pavements and other improvements.

Acquisition of the major portion of this installation, 1,206 acres, was initiated by a letter from the Acting Secretary of War to the President, dated 20 June 1899 and approved 20 July 1899, entitled Reservation of Lands: Hawaiian Islands, and subsequently modified by Presidential Executive Order No. 2800, dated 4 February 1918. These documents established Schofield Barracks Military Reservation and subsequently reassigned a portion as Wheeler Field by War Department General Order No. 4, dated 5 August 1939. Additionally, 158 acres were acquired by Territorial Executive Order No. 1301, dated 14 December 1948, and 1,514 acres were acquired by Governor's Executive Order No. 1612, dated 9 February 1954. In the boundary relocation affecting Schofield Barracks and Wheeler Air Force Base, the Air Force acquired the 38-acre parcel of land by Memorandum, dated 9 March 1956, from the Secretary of the Army to the Secretary of the Air Force.

Wheeler Air Force Base serves as headquarters for the 15th Air Base Squadron, Wheeler Dispensary Service, 22nd Tactical Air Support Squadron, and components of the Army's 25th Aviation Company and Navy FDCC Detachment.

By memorandum of agreement between CINCPACAF and CINCUSARPAC with respect to utilization of the airfield area at Wheeler Air Force Base, dated 24 September 1973, about 716 acres, including airfield and support facilities were to be for joint use by the U.S. Army elements, Hawaii Air National Guard and the Air Force and support facilities. The following minor rights of way for utility and access are outgranted to the Army:

(1) Permit, HONDE-30, dated 19 May 1958
Sewer Line R/W serving Army's Capehart Housing

(2) Permit, HONEA-183, dated 16 August 1956
Power Line R/W serving East Range

(3) Memo, dated 9 March 1956
Utility and Road R/W for Sewage Disposal Plant

(4) Permit, DA-94-626-ENG-54
Waterline R/W serving East Range

Additionally, the Hawaiian Telephone Company has been granted a five-year easement for UG cable and manholes by Contract No. DA-94-626-ENG-106. (Reference 2).

Area

A summary of on-base land and square footage is as follows:

	ACRES	BUILDING (SQ. FT. - GROSS)
Total on installation	1,388.69	1,522,075
Federally owned, military controlled	1,369.06	1,522,075
Ingrants	19.62	0

III. ENVIRONMENTAL SETTING

CHAPTER III

ENVIRONMENTAL SETTING

Physiographic Setting

Wheeler Air Force Base is located on gently sloping land just south of the drainage divide of central Oahu. Streams to which surface runoff flows eventually discharge into Pearl Harbor. The maximum north-south and east-west dimensions of the base are 1.35 miles and 2.15 miles, respectively, and the total area is 2.24 square miles. The maximum elevation of 865 feet lies at the northern boundary and is virtually coincident with the drainage divide. The minimum elevation of about 550 feet, lying in a stream channel in the most southerly corner of the base, is somewhat over 300 feet lower than the maximum elevation. Most of the base, however, falls between 760 and 865 feet, a total relief of only 105 feet over one mile. Location of the base is shown in Figure II-3.

Two principal streams flow through portions of the base. Waikele Stream, whose course is within a few hundred feet of the southern boundary and nearly parallel to it, is the chief drainage way. Waikakalaua Stream flows for about 2000 feet through the southeastern corner of the base but drains only a small fraction of it. Neither stream is perennial and their valleys are relatively shallow, having bank relief of less than 100 feet. About 5000 feet of

Waikele Stream has been channelized while the remaining approximately 7000 feet follows the original course.

The fairly level natural surface of the major portion of the base has been transformed by construction of runways and ancillary paved areas, service structures and housing. Except for partial channelization of Waikele Stream, the environment of the gulches on the south side of the base is probably similar to what it was 60 years ago when the installation was established. At that time most of the vegetation was already exotic, consisting of trees such as guava, koa haole, eucalyptus and silver oak, and shrubs and grasses including lantana, Hilo grass and panicum. The urbanized portion of the base has been landscaped.

Climate

Located in central Oahu in the lee of the Koolau mountains and windward of the Waianae mountains, Wheeler Air Force Base has a moderate tropical climate in which the temperature infrequently exceeds 85°degrees Fahrenheit (°F) and a temperature of less than 55°F is unusual. The average annual temperature is about 71.5°F, but in the coolest months (January and February) it is 68°F and in the warmest month (August) 75°F. The averages are about 3°F cooler than at sea level.

Trade wind air flow, during which wind velocity averages 12 knots, prevails for 70 percent of the time. This prevalent condition, most persistent in the late spring to early fall months, normally is sunny and dry, though occasionally orographic showers drift in from the Koolaus. The high pressure cell responsible for trade wind flow weakens in the winter months, and frequently the replacing air masses which originate from tropical storms that move toward Hawaii from the south and southwest, or frontal weather that flows in from the west and northwest. These conditions tend to produce substantial rainfall and sometimes high winds. The usual trades may also dissipate temporarily when the high pressure cell weakens so that convective cloud conditions, occasionally resulting in heavy showers, may dominate island weather for days at a time.

Rainfall at Wheeler Air Force Base is in the moderate range for a tropical climate. Although a long record of climatological events at the base has not been kept, a standard rain gage at a site in Wahiawa about one mile from the northeast corner of the base is probably indicative of local conditions. For 62 years of the period 1900-1965, average annual rainfall at Wahiawa Station 872 was 49.9 inches, the maximum annual was 79.6 inches, and the minimum annual 20 inches. Annual rainfall as percentiles was as follows:

75 percentile .... 61.1 inches

50 percentile (median) .... 50.2 inches

25 percentile .... 39.5 inches

The driest months are in summer when trade winds are persistent and rainfall is predominantly orographic and restricted to the mountain ranges. The driest month, June, receives an average of 2.32 inches. The wettest, March, averages 6.65 inches. The wettest month on record was a February during which 33.34 inches fell; zero monthly rainfall is not uncommon.

Evaporation in the Wheeler Air Force Base region is high, averaging just under 74 inches per year. The persistent trade winds undoubtedly enhance evaporation and evapotranspiration. From April through October, average monthly evaporation exceeds average monthly rainfall. Table III-1 summarizes monthly averages of rainfall and evaporation at sites near Wheeler Air Force Base.

The statistically possible extreme rainfall rates for Oahu have been computed by the National Weather Service and the U.S. Army Corps of Engineers (Reference 3).

The 100 year probable rainfall rates for selected periods are as follows:

CLIMATE PARAMETERS
WHEELER AIR FORCE BASE VICINITY

PARAMETER	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
RAINFALL[1]													
Mean (in.)	6.46	5.39	6.65	3.86	2.87	2.32	2.52	3.11	2.87	3.62	4.76	6.54	51.47
EVAPORATION[2]													
Mean (in.)	4.43	4.37	6.03	6.37	7.31	7.76	7.98	7.75	7.10	6.05	4.38	4.03	73.56

(1) Wahiawa Station 872
(2) Wahiawa Station 820.2.
Source data: Pan Evaporation in Hawaii, 1894 - 1970.
State of Hawaii Dept. of Land and Natural Resources.
Report R51, 1973.

TABLE III-1 CLIMATE PARAMETERS WHEELER AIR FORCE BASE

Duration (hours)	Rate (inches)
0.5	3
1.0	4
24	16

Geology

Central Oahu was formed by lava flows that travelled westward from the rift zone of the Koolau volcano. These lavas accumulated on the slopes of an earlier volcano (Waianae) as thin layers of basalt having a total thickness of more than 1000 feet in the Wheeler Air Force Base area. They are relatively flat-lying and consist of the characteristic Hawaiian volcanic association of aa, clinker and pahoehoe in random succession. Aa consists of massive and dense rock, clinker of brecciated material above and below aa, and pahoehoe of smooth vesicular lava. Individual layers are usually less than ten feet thick and extend laterally for no more than several hundred feet. Although highly heterogeneous on a local scale, viewed regionally the basalt layers behave homogeneously with respect to erosional processes and to subsurface transmission of water.

The basalts underlying Wheeler Air Force Base are part of the Koolau Volcanic Series, the most widespread lithology of Oahu. The Koolau series is the basement formation of the east central and eastern portions of the island. Later volcanic activity generated new lava flows and produced ash falls in southeastern Oahu, but none were closer than ten miles to Wheeler Air Force Base. Beneath the Koolau lavas in west central Oahu, including the air base, lie older Waianae volcanic rocks, but they are too deep to be affected by activities at ground level.

A peculiarity of the Wheeler-Schofield-Wahiawa region is the existence of a stable water table 280 feet higher than the one draining to Pearl Harbor. This water table expresses the occurrence of a very large and important groundwater resource in central Oahu. The cause of this phenomenon has not been established, but among reasons postulated are a rift zone striking from either the Waianae or Koolau mountains, and highly weathered, which in Hawaii equates with poorly permeable, ridges extending from the Waianae range.

The top of the Koolau basalt section at Wheeler Air Force Base has weathered to a deep residuum on the order of 150 feet thick, the upper ten feet consisting of soil and subsoil. Except for thin and scanty alluvial deposits in the Waikele and Waikakalaua stream beds, all of the soil-saprolite column formed in place on original basalt. Soil is defined as the surface layer of residuum that was further altered by chemical and biological processes; it is usually less than two feet thick. Below it is subsoil, which has the physical characteristics but not fertility of soil; subsoil is normally less than five to ten feet thick. The remainder of the weathered section is termed saprolite, defined as parent rock disintegrated in place by chemical processes of leaching, hydration and precipitation.

In the central Oahu plateau the nearly flat lava formations are deeply weathered to depths of more than 100 feet. Resistant boulders occur in the weathered column, but generally a vertical section starts with a foot or so of reddish brown soil, then several feet or more of red-brown clayey subsoil followed by 100 feet or more of varicolored (gray, red, yellow, purple, brown) saprolitized rock having a texture that looks like the parent formation. Below the saprolite the rock is unaltered and retains the original characteristics of freshly solidified lava flows. It is these unaltered lava successions that constitute the prime aquifers in Hawaii.

A synthesis of drilling data from eight test borings and a deep well at the town of Kunia, 1.5 miles southwest of Wheeler Air Force Base but similar in its geological environment, provides a typical log as follows (Reference 4):

Depth from Surface Elevation 847 ft.	Material
0 - 10 ft.	Brown soil overlying red brown stiff clay
10 - 145 ft.	Decomposed rock
145 - 825 ft.	Unsaturated, unaltered basalt
> 825 ft.	Saturated, unaltered basalt

The test borings were drilled as part of a program to investigate and mitigate local contamination of groundwater by the agricultural chemicals EDB (ethylene dibromide) and DBCP (dibromochloropropane).

Soils

Except for thin recent alluvium in the gulches of Waikele and Waikakalaua Streams, soils in Wheeler Air Base fall within the Helemano-Wahiawa Soil Association. They are thick and well drained and occur on gentle slopes. The dominant soils belong to the Wahiawa series, which are kaolinitic mollisols (formerly called low humic latosols) consisting of silty clay that drain easily and have a field moisture capacity of about 14 percent (Reference 5). Infiltration tests on Wahiawa soils have shown rates in excess of nine inches per hour (Reference 6).

A typical profile is as follows:

Depth (inches)	Material
0 - 12	Red soil
12 - 48	Red brown subsoil

Because the soils are kaolinitic their base exchange capacity is low, which impairs their effectiveness in retaining contaminants. The distribution of soil types is shown in Figure III-1.

Manana series soils also are found in the base. They are categorized as ultisols (formerly called humic ferruginous latosols) and are composed chiefly of iron and aluminum oxides with a lesser content of kaolinitic clay than in mollisols. Like the mollisols they are somewhat acidic, drain well and resist erosion, and have a field moisture capacity of about 14 percent. Typically a profile consists of eight inches or so of dark red brown soil above several feet of reddish subsoil. The Manana series has even less base exchange capacity than the Wahiawa series.

The slopes of gulches are covered by Helemano soils that formed on alluvium and colluvium engendered by stream transport and slumping of saprolite. These soils resemble the Wahiawa series in having substantial kaolinitic content and in their infiltration and erosion characteristics. Normally ten inches of a red brown soil overlies about 50 inches of silty clay subsoil.

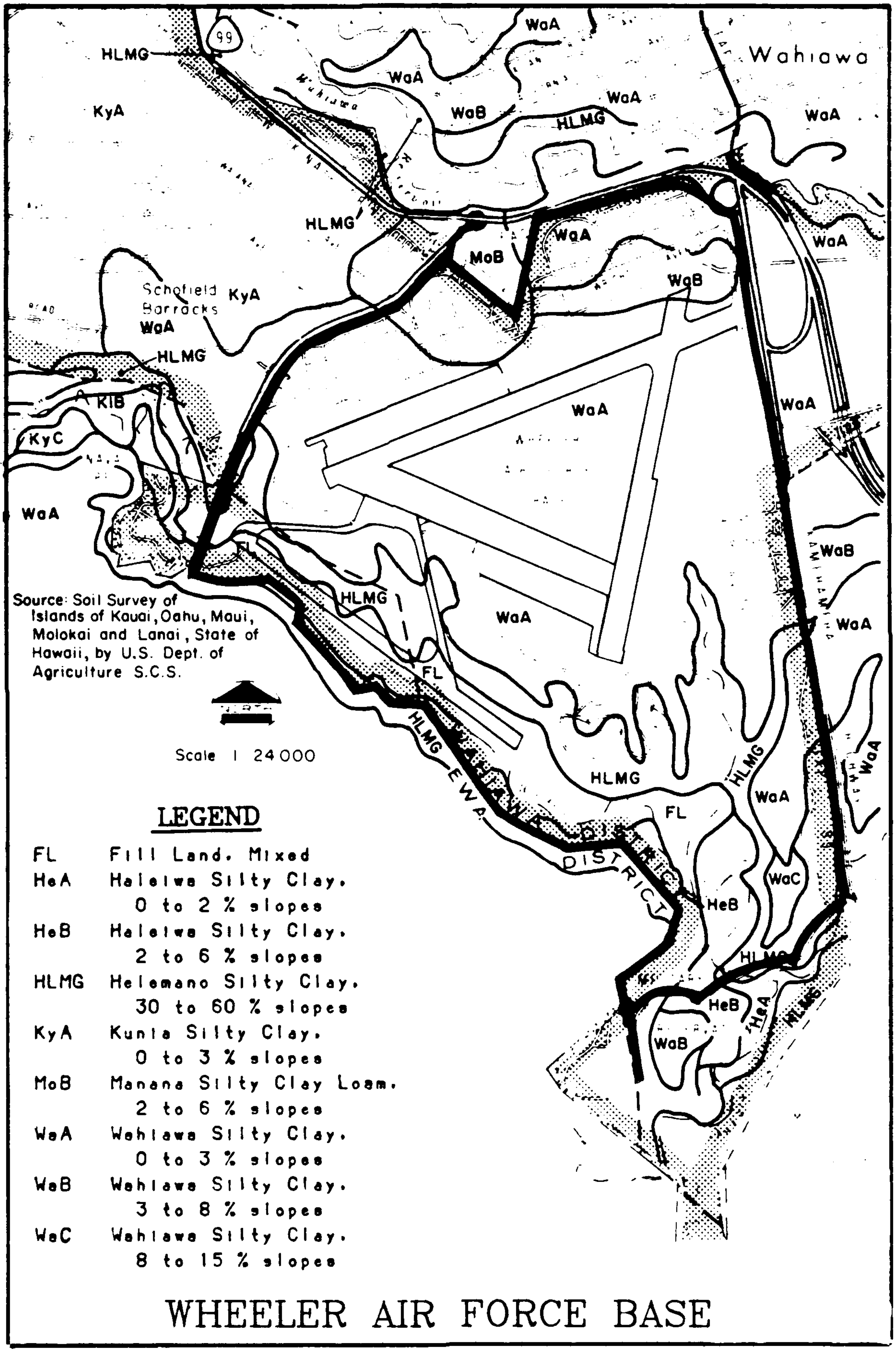

FIGURE III-1 SOIL DISTRIBUTION MAP

All soils in Wheeler Air Force Base were derived from alteration of the Koolau Volcanic Series, most of them as the end product in an in-situ column of weathered residuum overlying parent rock. Texturally they are silty clay loams having available water capacity of 12 to 15 percent. The true soil layer is eight to ten inches thick and the subsoil up to 50 inches thick. They are composed of kaolinitic clay mixed with oxides and hydroxides that are almost exclusively ferric and aluminum. They are deficient in silica and the bases and are slightly to moderately acidic. They drain well but do not erode easily. Their base exchange capacity is low and their ability to act as a buffer against the movement of contaminants is poor.

Surface Water Hydrology

Of the 1432 acres of Wheeler Air Base, 1400 acres drain to Waikele Stream and only 32 acres to Waikakalaua. These streams join just outside the base boundary to continue as Waikele Stream to Pearl Harbor. The segment of Waikele originates on the eastern slopes of the Waianae Range south of Kolekole Pass and carries drainage from 6.35 square miles where it enters the base. Average rainfall in the drainage basin is about 50 inches per year. The gulch in which the channel meanders is shallow and contains natural flow only during and for short periods after substantial rain showers.

Waikakalaua is one of the major forks of Waikele originating in the Koolau Range. Drainage from 7.14 square miles is collected in it where it crosses the Wheeler Air Force Base boundary along Kamehameha Highway. Although its headwaters reach to the crest of the Koolaus, where maximum average rainfall is approximately 250 inches and over its drainage basin where the average annual rainfall is more than 100 inches, Waikakalaua, like Waikele, is non-perennial and often carries no running water.

Neither Waikele nor Waikakalaua are continuously gaged above their confluence but each has a crest gage for determining flood flows. However, the average daily flow (that is, total annual flow divided by 365) may be estimated by a relationship derived in a study of stream flow impoundment in the Pearl Harbor basin (Reference 7). Using the derived relationship,

$$R = .00064P^{1.6920}$$

in which P is average annual rainfall (inches) in the drainage basin, average runoff, R, in cfs/sq. mi. can be computed. The average flow of Waikele at the entrance to Wheeler Air Force Base is 3.1 cfs and of Waikakalaua at Kamehameha Highway it is 11.1 cfs. Flood flows are vastly greater, of course. The crest gage on Waikele (USGS Station 2126) has shown a maximum instantaneous discharge of 1,810 cfs, while the one on Waikakalaua (USGS 2127) has shown a maximum of 4,820 cfs.

Recurrence intervals of floods for the two crest gages have been tabulated by the USGS (Reference 8). For a ten year record (1958-68), the log Pearson Type III statistical method provides recurrence intervals for each crest gage as follows (see Table III-2):

TABLE III-2 RECURRENCE INTERVALS

Recurrence Interval (years)	Waikele USGS 2126 (cfs)	Waikakalaua USGS 2127 (cfs)
1.01	136.3	152.0
2.0	744.1	784.4
5.0	1,288	1,686
10	1,693	2,615
25	2,243	4,303
50	2,676	6,038
100	3,125	8,286
200	3,591	11,175

The chemical quality of uncontaminated stream waters in the middle and upper portions of the Pearl Harbor drainage basin is excellent. A typical analysis made by the USGS of Kipapa Stream, which is similar in origin to Waikakalaua and does not differ appreciably from Waikele, is shown in Table III-3 (sample collected 5/21/76). Both Kipapa and Waikakalaua Streams are tributaries of the main stem of Waikele Stream.

TABLE III-3 - KIPAPA STREAM CHEMICAL QUALITY ANALYSIS

Dissolved Constituent	Concentration mg/l
Calcium (Ca)	0.7
Magnesium (Mg)	1.8
Sodium (Na)	7.0
Potassium (K)	0.8
Sulfate (SO)	4.1
Chloride (Cl)	11
Silica (SiO)	5.5
Total Dissolved Solids (TDS)	37

Suspended sediment load of the two streams can be estimated from tables of computed annual sediment yields on Oahu published by the USGS and the State Dept. of Land and Natural Resources (Reference 9). Although the data does not include either Waikele or Waikakalaua in the Wheeler Air Force Base area, comparison with similar basins suggest the average annual suspended sediment load in Waikele is 700 tons per square mile (total annual from above Wheeler Air Force Base of 4,445 tons) and for Waikakalaua also 700 tons per square mile (total annual of Kamehameha Highway of 4,998 tons). These sediment loads are relatively small.

The nearest large surface water body to Wheeler Air Force Base is the Wahiawa Reservoir, the mid-section of which lies within 1,000 feet of the northern boundary of the base. Drainage of the reservoir, however, is northward while all Wheeler Air Force Base surface drainage moves south to Pearl Harbor. The reservoir dams the flow of several Koolau mountain streams and has a surface area of approximately 300 acres and a maximum volume of about three billion gallons. It receives treated sewage effluent from Wahiawa but otherwise has chemical characteristics similar to those of the streams. According to a University of Hawaii Study (Reference 10), the reservoir is in a eutrophic condition, i.e., subject to algal blooms as a result of available dissolved phosphorus and nitrogen.

The streams that collect drainage from Wheeler Air Force Base are potential contributors of contaminants to Pearl Harbor and the deep aquifer, but neither the streams themselves nor the larger stream into which they flow are used as a domestic water supply. Some surface water is pumped from Waikele Stream in Waipahu for irrigation of sugar cane but most discharges into West Loch of Pearl Harbor. Waikele is non-perennial between the Waikakalaua confluence and the Kipapa confluence. The Wahiawa Reservoir lies outside the drainage of Wheeler Air Force Base and would be accessible to contamination from it only through subsurface water movement, which is unlikely because the known groundwater gradient is directed southward.

Groundwater Hydrology

The subsurface below Wheeler Air Force Base consists of Koolau basalt to a depth of 1,000 feet and more, below which the older Waianae lavas form the deeper basement. The contact between the two volcanoes has not been positively identified. From the perspective of groundwater occurrence, movement and development only the thick column of Koolau basalt and its weathered surface needs to be considered.

Three distinct aquifers occur within the limits of Wheeler Air Force Base, two of them deep aquifers in unaltered Koolau basalt and the other a shallow perched aquifer in the saprolite of the weathered zone. Figure III-2 illustrates the relationship among the aquifers beneath Wheeler Air Force Base. The deepest aquifer is the northerly part of the Pearl Harbor Basal Aquifer, the most highly exploited groundwater resource in the State. This aquifer is "basal", that is, it consists of a lens of fresh water floating directly on sea water. The water table elevation above mean sea level is approximately 26 feet at Wheeler Air Force Base, about 775 feet below ground surface. The aquifer is unconfined, and therefore any subsurface contamination escaping capture or breakdown would eventually settle on the free water table.

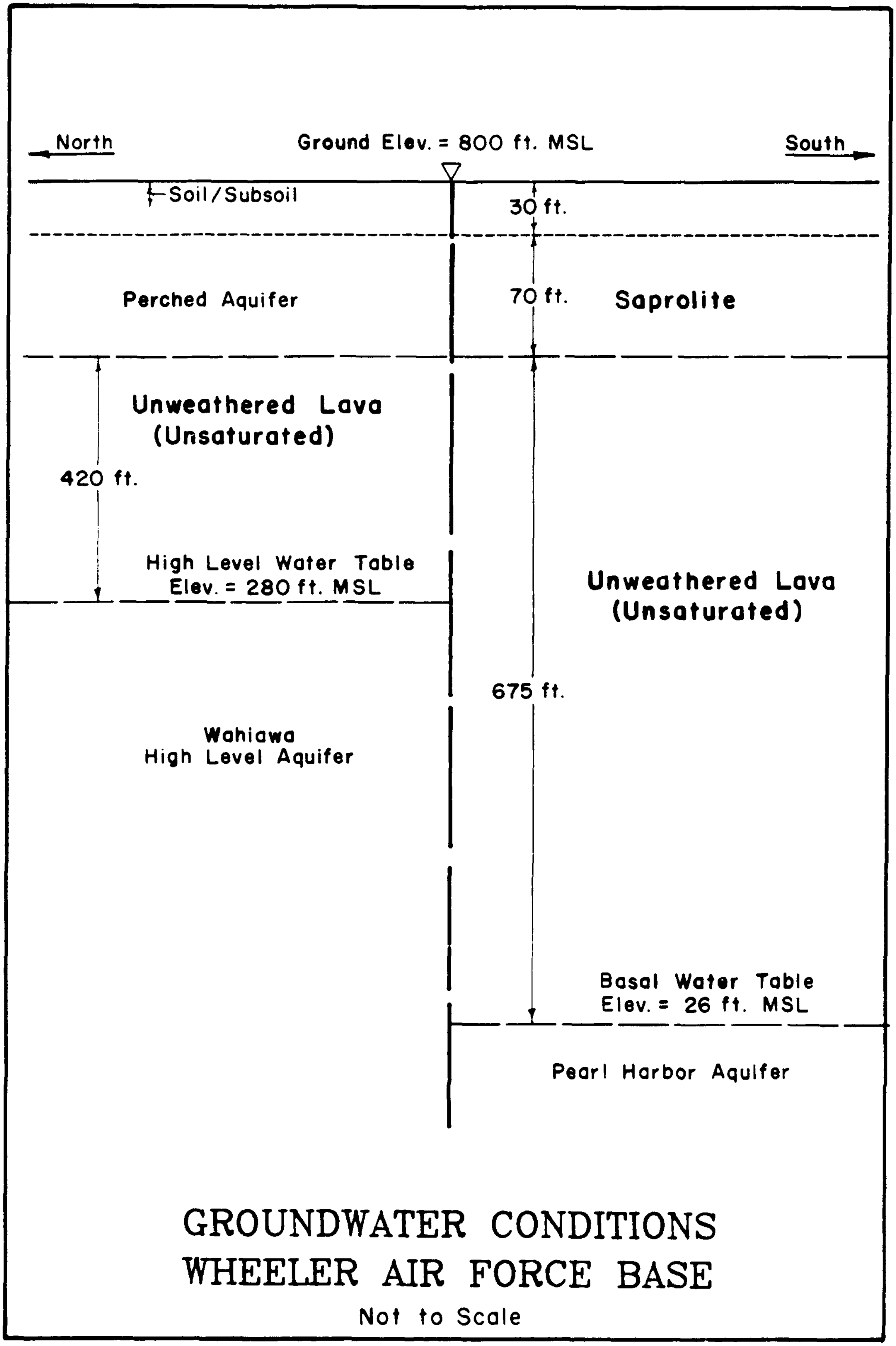

FIGURE III-2 GROUNDWATER CONDITIONS

Adjacent to the Pearl Harbor Basal Aquifer but separated from it by an apparently sharp boundary, the nature of which is still unclear, is an aquifer in the Koolau basalt called the Wahiawa high level aquifer (or Schofield high level aquifer) whose principal water table fluctuates between elevations of 270 and 280 feet above mean sea level. This high water table descends in stepwise fashion to elevations less than 200 feet where an abrupt margin exists between the two aquifers. Figure III-3 shows the approximate location of this boundary. Most of the urbanized portion of Wheeler Air Force Base lies above the high level aquifer while the undeveloped portion of the base is above the basal aquifer. Although the aquifers are hydraulically distinct, the lower one receives much of its recharge by leakage from the higher one. It is probable that all subsurface leakage below Wheeler Air Force Base moves southward to the Pearl Harbor aquifer.

The third aquifer in the region is composed of saprolite, a poorly permeable material that retards the flow of moisture. This perched aquifer is constituted of the weathered section of the Koolau basalt from depths below the surface of about 30 feet to its contact with unaltered rock at 100 to 150 feet. Little attention had been given to the aquifer until 1980 when it was accidentally discovered during an investigation of groundwater contamination at Kunia Camp (Reference 4) several miles down gradient of

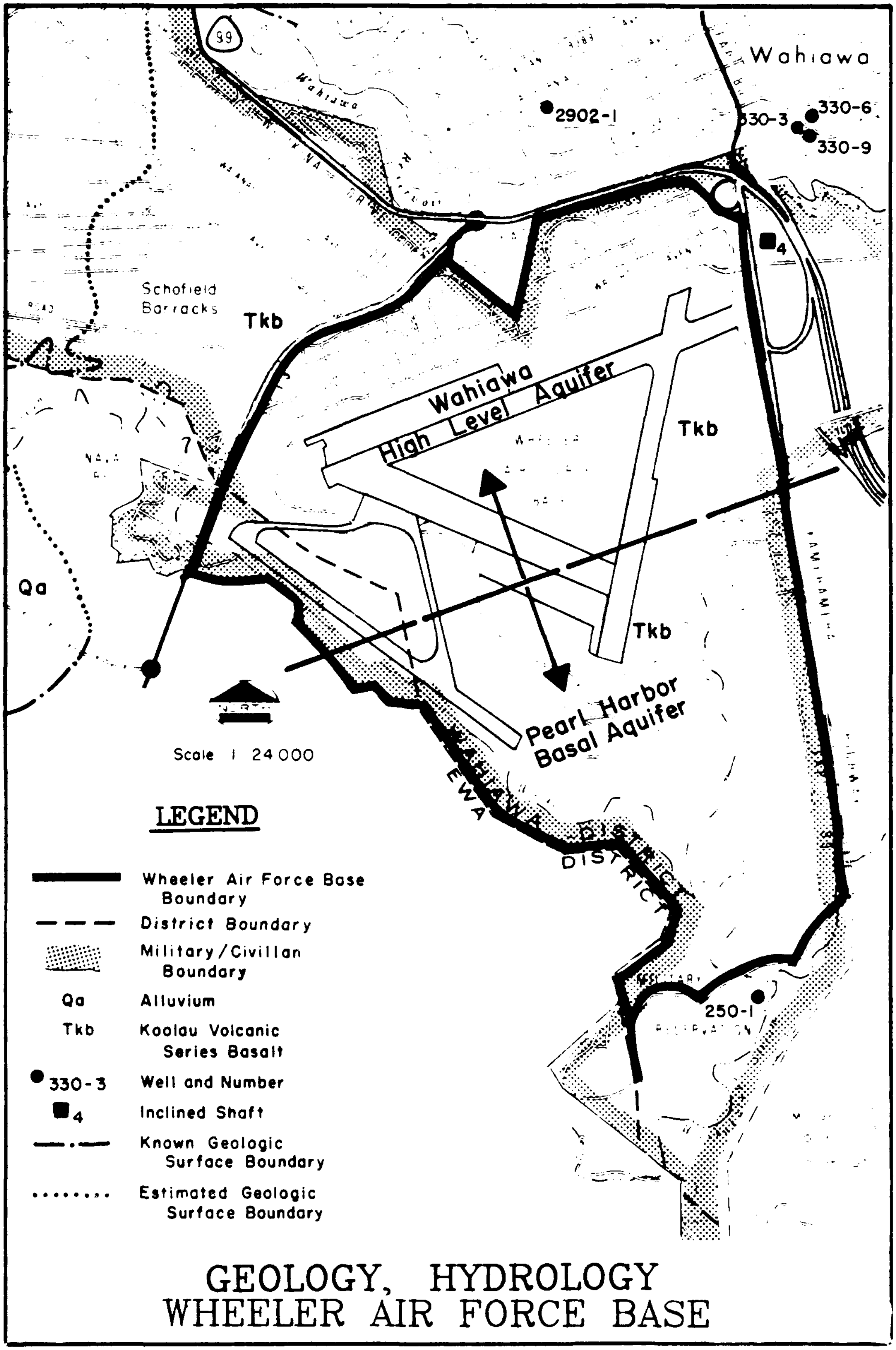

FIGURE III-3 GEOLOGY, HYDROLOGY

Wheeler Air Force Base. The aquifer is regional but not necessarily continuous; it is probably saturated in favorable topographic locations marked by gentle sloping surfaces where the weathered residuum is not easily removed by erosion.

The perched aquifer is not exploitable as a water supply, but it is very important in subsurface movement of water above both the Wahiawa high level aquifer and the Pearl Harbor Basal Aquifer.

Pearl Harbor Basal Aquifer.

The Pearl Harbor Basal Aquifer underlies the southern portion of Wheeler Air Force Base. Pumpage from this aquifer supplies most of the irrigation water for agriculture in southern Oahu an the major share of domestic water for the region extending from Makaha on the Waianae coast to the eastern tip of Honolulu. It is being exploited to the limit of its sustainable yield.

The aquifer is highly permeable and carries an immense volume of excellent quality water. It is recharged by rainfall, leakage from the Wahiawa high level aquifer, and by irrigation water, some of which is transmitted from windward Oahu through tunnels and ditches to central Oahu's sugar fields. Between one third and one half of the rainfall eventually percolates to the aquifer and about one half the irrigation water seeps below the root zone. Leakage from the high level aquifer is unknown but substantial.

Hydraulic conductivity of unaltered Koolau basalt is approximately 1,500 ft./day and the groundwater gradient near Wheeler Air Force Base is about 1 ft./mile. Assuming an effective aquifer porosity of ten percent, the groundwater velocity is slightly less than 3 ft./day. A particle of seepage originating in the middle of Wheeler Air Force Base would take an average of three to four years to move southward beyond the base limits once it reached the deep aquifer. The nearest down gradient water producing well for domestic use (Board of Water Supply) lies 12,000 feet away near Waipahu. At an average particle velocity of 3 ft./day, water from below Wheeler Air Force Base would reach the vicinity of Waipahu in about a decade.

Pathways of contamination to the Pearl Harbor Basal Aquifer are by vertical travel from the surface, temporarily interrupted in most cases by accumulation in the perched saprolite aquifer, and by downward seepage from stream beds. Although distances from the perched aquifer and stream beds are large, about 700 feet, vertical movement is relatively rapid, measurable in months rather than years once a particle escapes retention in the perched zone. No wells have been drilled within the boundaries of the air base, affording no threat of contamination by way of abandoned wells.

Uncontaminated groundwater in the Pearl Harbor aquifer is low in salinity and is biologically sterile. Typical composition of basal groundwater that has neither been mixed with intruding sea water nor affected by external contamination is shown in Table III-4 (Reference 11):

TABLE III-4 - TYPICAL COMPOSITION OF UNCONTAMINATED PEARL HARBOR BASAL GROUNDWATER

Dissolved Constituent	Concentration mg/l
Ca	8.0
Mg	6.0
Na	20
K	2.0
SO_4	5.5
Cl	22
HCO_3	65
PO_4	0.20
F	0.07
NO_3	1.1
TDS	165

The nearest basal aquifer well to Wheeler Air Force Base is at Kunia, one and a half miles away (State No. 2703-1, Old No. 330-5). This well is used only for irrigation. The Board of Water Supply pumps water for Mililani from wells about one and a half miles east of Wheeler Air Force, but the wells are not down the groundwater gradient from the base. A well (State No. 2701-01; Old No. 250-1) was drilled near the southeast corner of the base in 1945 but was abandoned at that time or shortly thereafter. No record exists of its use or disposition.

Wahiawa High Level Aquifer.

In 1936 the U.S. Army, while constructing a 30 degree inclined shaft designed to penetrate to the deep basal aquifer, encountered a stable water table 284 feet above sea level. Discovery of this hitherto unknown aquifer added an enormous increment to the water resources of Oahu. The initial drilling took place within a few hundred feet of the northeast boundary of Wheeler Air Force Base across Kamehameha Highway. The shaft probably lies up the groundwater gradient from Wheeler Air Force Base. Subsequent drilling has demonstrated the existence of a tight barrier that sustains a head differential of approximately 250 feet between the Pearl Harbor Basal Aquifer and the high level aquifer. This differential occurs over a horizontal distance of 1,000 feet or so.

The boundary between the two aquifers strikes through the mid-portion of Wheeler Air Force Base in a generally east-west direction. Drainage and leakage from the higher aquifer is southward to the lower one and possibly westward into the Waianae Basal Aquifer, which lies west of Kunia

Road but is hydraulically continuous with the Koolau Basal Aquifer. Formation characteristics of the high level aquifer are identical to those of the basal aquifer; both consist of Koolau basalt having hydraulic conductivity in the neighborhood of 1,500 ft./day and porosity of 10 to 20 percent. The high level aquifer is recharged by rainfall, especially in the wet Koolau mountains, and to a lesser extent by seepage from Wahiawa Reservoir. Groundwater quality is the same as in the fresh water portion of the basal aquifer.

Water is withdrawn from the high level aquifer to supply the community of Wahiawa and all of Schofield Barracks and Wheeler Air Force Base. On the Waialua side of the drainage divide three wells are used for irrigation. Several wells were drilled in the small Naval Reservation between Kunia Camp and Wheeler Air Force Base in the late 1950's. The Navy discontinued using them some time ago, but one has been converted into a domestic source for Kunia Camp pending completion of a new Del Monte well in the same area.

The water level fluctuates between elevation 270 and 280 feet but has not permanently declined during almost five decades of exploitation (Reference 11). There is no doubt that much more exploitation of this aquifer will occur in the future.

The water table of the high level aquifer at Wheeler Air Force Base lies 550 to 600 feet below the ground. As in the basal aquifer, contaminants escaping the soil-saprolite layer would follow essentially vertical paths to the water table. Residence time of water is likely to be of the same length as in the basal aquifer, about ten years for recharge originating at the extreme up gradient boundary.

Although meaningful contamination of the high level water body has not taken place, on the Waialua side of the divide traces of DBCP (Dibromochloropropane), an agricultural fumigant used in pineapple culture, have been detected. This occurrence suggests that refractory chemicals escaping beyond the biologically active soil zone will eventually percolate to deeper aquifers. Their vertical passage may be interrupted by temporary residence in the perched saprolite aquifer, but ultimately the downward journey is resumed.

Perched Saprolite Aquifer.

The existence of perched water in saprolite above unaltered basalt was not deliberately investigated until the DBCP contamination incident of 1980. Subsequent perusal of logs of wells previously drilled indicated that perched water is widespread over the flatter parts of the intermontane plateau of central Oahu. Recent electrical resistivity soundings bear out this indication.

The saprolite is a very poor aquifer and is saturated only because of its inferior hydraulic characteristics. Water percolating into it accumulates until a sufficient head builds up to force seepage downward. Lateral movement is very limited. The conductivity is less than 1 ft./day (Reference 4).

Where the saprolite occurs, all percolating fluids become temporarily stored in it. In this way the aquifer acts as a holding reservoir in which contaminants accumulate. The depth of saturation varies with recharge rate; in dry summer months ten feet or more of storage may be lost, while in winter replenishment brings storage back to its full thickness of about 100 feet.

The perched water at Kunia has been analyzed for dissolved constituents but elsewhere it remains a largely unknown phenomenon. At Kunia, which lies among pineapple fields that are heavily fertilized and treated with agricultural chemicals, the perched water has a composition markedly different from the deeper aquifers. Contaminants as the residue of fertilizers and biocides are present and the water is highly acid. USGS analyses show the following dissolved constitutents for samples from a test boring at Kunia (see Table III-5):

TABLE III-5 DISSOLVED CONSTITUENTS FOR KUNIA TEST BORING

Dissolved Constituent	Concentration (mg/l)
Ca	1.7
Mg	4.7
K	1.8
Na	16
P	.20
Cl	19
SO_4	20
N (total)	7.6
SiO_2	5.9
Organic C	4.4
pH	4.2

The excessively high nitrogen originates with fertilizers while the low calcium, magnesium and silica reflect the highly leached character of the soil, subsoil and saprolite. The low pH is typical of the soil series overlying the aquifer.

Should any potential contamination problem arise at Wheeler Air Force Base, exploration of the saprolite aquifer will have to be made by means of borings. The retardation affect on contaminants in the saturated zone is being explored at Kunia where contaminants are being removed through low capacity pumping from large diameter borings.

Environmentally Sensitive Areas

The most sensitive environments with respect to potential contamination are the two vitally important Koolau Basalt Aquifers. The Wahiawa high level aquifer serves Schofield, Wheeler Air Force Base and neighboring communities, including Wahiawa, while from the Pearl Harbor aquifer, water is pumped and distributed throughout southern and western Oahu. Contamination of these aquifers would generate problems having no easy solutions.

If contaminants seeped into Waikakalaua and Waikele Streams the stream environment would be degraded even though neither is perennial. Additionally, contamination added to stream flow can eventually percolate to the deeper aquifers or pass all the way to Pearl Harbor.

An endemic endangered bird observed on this installation is the Hawaiian Owl (Pueo) (Asio flammeus sandwichensis) as reported by State wildlife biologists. The birds feed and rest within the installation, but due to lack of forest land, rest elsewhere in nearby forest land and scrub forest areas. The bird population in this area is unknown.

IV. FINDINGS

CHAPTER IV

FINDINGS

General

Activities that generate hazardous wastes and the methods historically used to dispose of these wastes were investigated via a records search and interviews with base military personnel, civilian employees, and retirees. The information obtained during the investigation was used in the assessment of potential environmental contamination by, and migration of, hazardous materials from landfills, spill areas, and hazardous materials storage areas. Figure I-1 presents the decision tree methodology used in the assessment of waste disposal practices.

Determination of past activities and disposal practices was based primarily on the interview phase of the investigation. Written records of materials purchased and used in the various shops are generally not retained for more than two or three years. Therefore, documentation on types and quantities of materials used over the past forty years is generally unavailable except for personal notations or special reports on material used or disposal methods. Beginning in the period 1975-1977 the Bioenvironmental Engineering Section began to compile and maintain files on each shop on-base.

The shop files contain information provided by shop personnel on the quantities of materials used and the typical methods of waste disposal in use at that time. Each shop folder was individually reviewed and summary notations prepared indicating materials used, quantities of materials handled, and current waste disposal practice. These files served as a key reference for determining which shops were currently using hazardous materials and, therefore, were most probably using hazardous materials prior to the initiation of the filing system.

The material quantities listed in the shop folders are, in most cases, the amount of material obtained by the shop on a monthly or yearly basis. These quantities are not the amount of waste material disposed of by the shop. Some materials, such as paints, gasoline, and diesel fuel, are obtained in large quantities but are consumed during use and resulting in essentially no waste to be disposed of. Therefore, in preparing the data for use in this report it was necessary to consider the purpose of each material and estimate what portion was actually disposed of by the shop. Information contained in the shop folders on disposal practices varied from no information to detailed information on material evaporation, disposal to the sewer system, disposal to drums or bowsers, and removal by private contractor. This information always pertained to current conditions (post 1975). There was never any notation on disposal to an on-base landfill.

The information in the shop files was useful in performing this study of past practices in that it provided a basis for compiling a complete shop list, a list of materials used, quantities handled, and possible past disposal methods. The master list of shops available in these files was the only complete list of shops found by the survey team. This list was used to cross-compare information from other sources to ensure that most or all of the shops were accounted for in the survey. The materials list provided the groundwork for follow-up questions regarding use and disposal of the various materials, and also indicated which shops would be of most concern.

Given the lack of previous records in the quantities of materials used in earlier decades, the quantity information in the files provided the only concrete evidence of actual volumes of materials typically handled by the various shops. In order to roughly estimate previous quantities used on-base, additional information was obtained on base activities, mission, and population from the base historian's records. It was assumed that the use of materials would correspond in some manner with the change in base activities over the years.

Most Air Force Civil Engineering shops closed in 1977 when the Army assumed responsibility for these functions. Shop folders are available only for those shops that closed between 1975 and 1977. There are no records available for shops that closed prior to 1975. A request was made to the Army for inspection of Army shop folders, however the Army did not supply any usable information.

Historical information plus current shop file data served as the basis for estimates of typical materials usage at Wheeler Air Force Base. The quantities of materials present in Table IV-1 represent the results of these estimates for the shop activities on base.

Undoubtedly, many of the materials used in the later half of the 1970's were different from materials used in earlier years. However, cleaning solvents, paints, oils, and etc., while differing in composition over the years, were used and disposed of as part of air base operations. Therefore, while specific material names and quantities shown in Table IV-1 may not have been used throughout the period, equivalent or similar classes of materials most likely were in use on a regular basis.

The shop records, as previously stated, provide varying degrees of information on current disposal methods. The records were of little help in determining the past practices utilized on-base except that it can be assumed that materials discharged to the sewer system currently, were likely discharged to the sewer in the past. In addition, it is most probable that the level of waste segregation and handling currently being employed is better than that achieved in the past. Thus, the current practices employed by the shops were used as a basis for questioning various shop personnel on how various materials, currently being stored and then removed by private contractor for disposal or reclaimed, were handled in the past.

A great deal of information was obtained during the interview phase and a high degree of concurrence was noted between interviews, especially as regards to disposal practices and disposal areas. However, there exists some uncertainty as to the identification of specific hazardous materials and time periods when they were in use. Very often shop personnel were unaware of the name of the material in use during day-to-day activities. Degreasers and solvents were simply "engine wash" or "solvent" and records do not exist that allow the investigative team to identify or quantify the types of materials used.

For example, it is known that the Air Force used carbon tetrachloride at one time; it is impossible, however, to determine the time period of use of quantities.

INDUSTRIAL ACTIVITY REVIEW

Hazardous wastes were generated by a wide variety of industrial activities at Wheeler Air Force Base (see Appendix E for a master list of shops present in 1975). In general, the greatest amount of hazardous waste was generated by maintenance of aircraft and ground vehicles with lesser amounts generated by the various grounds maintenance shops (entomology, electrical, boilers, housing) and fuels management and maintenance. Table IV-1 presents a summary of hazardous material usage and disposal practices at Wheeler Air Force Base.

As of 1977, Wheeler Air Force Base activities generated approximately 13,000 gallons of liquid wastes per year including paint wastes, solvents, and POL. The majority of thes wastes were taken off-base by private contractor, either to the Schofield dump or for recovery/recycle. Quantities of wastes generated on-base have probably remained relatively stable, and comparable to current quantities, during the post World War II era. However, the base historian's records indicate a substantially larger base population, POL usage, and transit aircraft traffic during the Korean Conflict than in succeeding years. It is logical to assume that waste generation increased a commensurate amount during this period. There was no significant increase in Air Force activity during the

Vietnam Conflict.

The following sections will discuss those Air Force activities known to have generated hazardous wastes at Wheeler Air Force Base.

Aircraft Maintenance

Wheeler Air Force Base began operations in the early 1920's and continued to be an active air field throughout World War II. In 1949 the base was deactivated, but was reactivated during the Korean Conflict. In the years following the Korean Conflict, Wheeler Air Force Base was a relatively inactive base. In 1977 the Army assumed real property maintenance responsibility for Wheeler Air Force Base.

During the time periods when Wheeler Air Force Base was active, aircraft maintenance was generally limited to flight line maintenance and minor airframe and engine work. Major overhaul work was performed at Hickam Air Force Base. Wheeler Air Force Base had a paint shop but there is no indication that any metal plating was done at this base.

Aircraft maintenance operations generated wastes in the form of contaminated fuels, hydraulic fluids, solvents, degreasers, and waste crankcase oil in the case of piston driven engines. Solvents used at Wheeler Air Force Base have included carbon tetrachloride, trichloroethylene, methyl ethyl ketone, PD-680, acetone, as well as other halogenated and non-halogenated organic compounds. The paint shop used a variety of organic and inorganic paint removers and generated wastes containing varnishes, lacquers, and lead based paints.

Disposal of wastes generated from maintenance activities was carried out in several different manners. Waste crankcase oils were generally spread on dirt roads for dust controls and/or taken off base under private contract. Flammable liquids, including oils, solvents, contaminated fuels and paints, were burned by the Fire Department during training exercises. Solids such as rags and empty containers went to the landfills. Many waste liquids were disposed to the drain or were consumed during use.

Ground Vehicle Maintenance

Ground vehicle maintenance produces the same basic types of hazardous waste as aircraft maintenance but in lesser quantities. Compounds used include paints, paint strippers, oils, ethylene glycol, solvents, and battery acid. Wastes were handled in the same general manner as aircraft maintenance wastes.

Grounds Maintenance

The grounds maintenance shops generated a number of different waste compounds, including solvents, paint wastes, small amounts of oils and lubricants, anti-scale compounds from boilers, and empty pesticide containers. Wastes were handled in the same manner as aircraft maintenance wastes.

Electrical services include a number of transformers containing PCB-contaminated oil. None of the interviewees indicated any knowledge of spills or leaks of PCB-contaminated oils from transformers.

Fuels

There are no known areas of fuel contamination on Wheeler Air Force Base. The interviewees indicated no knowledge of major fuel spills having occurred at the base. Fuel storage tanks were periodically cleaned, with the resulting sludges being placed in the landfill during the time period of interest.

Fire Department Training

Fire Department training activities were conducted at Wheeler Air Force Base from the late 1940's until 1980, when these activities were transferred to Hickam Air Force Base. Only one Fire Training Area was discovered during the course of this investigation. The site will be described in detail in a later section of this report. Included are data on site characteristics, types and quantities of materials utilized, operational frequency and practices.

Disposal on Roadways

Some waste oils were sprayed on dirt roads to control dust. The investigative team was unable to determine the amount of material disposed of in this fashion or when this practice ceased. The amount of waste material disposed of in this way is expected to be rather small due to the relatively small size of the base and the fact that there are few roads in the area.

This practice is not expected to have created any significant environmental contamination and will not be discussed further in this report.

Disposal by Private Contract

During those periods when the landfills were operational, all waste products were disposed of on-base except for recoverable and/or recyclable materials. In 1974, when the base landfill was closed, a majority of waste products were removed from the base by private contract - the exception being those materials burned during fire training exercises.

DISPOSAL SITE IDENTIFICATION AND EVALUATION

Three landfill sites and their operational time periods were identified during the course of this investigation. Site 1 located just south of the sewage treatment plant, off the Gulch Runway, was operational prior to World War II. Site 2 was located just off the northeast corner of the Gulch Runway. The active period of Site 2 is unknown but it is assumed that the area was operational during the 1940's. Site 3, also known as the Kunia Gate Dump, was located west of the Kunia Gate. Site 3 was operational from approximately 1950 until 1974. Site 3 was the major dump site at Wheeler Air Force Base in the post World War II years. For the purposes of this report the Fire Training Area (FTA) is considered a waste disposal area. The Fire Training Area was located near the center of the base off Airdrome Road. The FTA was in use from the 1950's until 1980, when such training activities were moved to Hickam Air Force Base. The location of the above mentioned sites can be found on Figure IV-1. In addition to known waste disposal areas, the storm and sanitary sewer systems will also be discussed.

A preliminary screening was performed on all identified disposal sites based on the information obtained from the interviews and available records. Using the decision tree process, a determination was made as to whether a potential

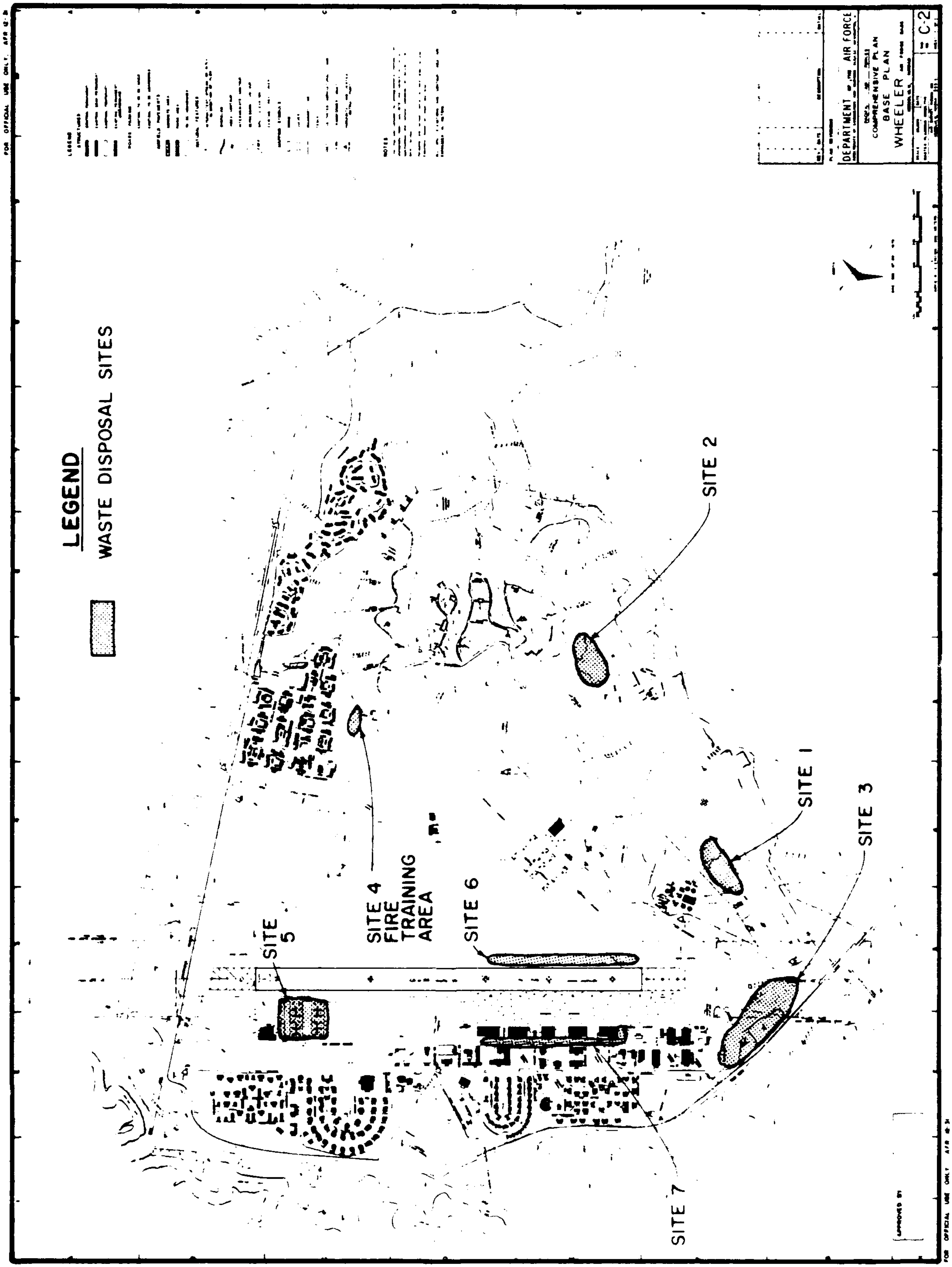

FIGURE IV-1 WASTE DISPOSAL SITES

exists for contamination in any of the identified sites. For those sites where contamination was considered significant, a determination was made as to whether there exists a potential for migration. A summary of this evaluation is given in Table IV-2. These sites were then rated using the U.S. Air Force Hazard Assessment Rating Methodology (HARM).

The HARM system considers four aspects of the hazard posed by a specific site: the waste and its characteristics, pathways for contaminant migration, receptors of the contamination and management practices. Each of these categories contains a number of factors that contribute to the final hazard rating. A more detailed description of the HARM system is presented in Appendix I. HARM rating forms are contained in Appendix J. A summary of the hazard ratings is presented in Table IV-3.

Landfills

As noted earlier, three landfill areas have been identified and located. There was no indication from existing records or from the interviews, that any other landfills existed. Residential and industrial wastes were disposed of in on-base landfills until the closure of Site 3 in 1974. After 1974 waste materials were removed from Wheeler Air Force Base and disposed of by outside contract.

The following sections will discuss the location, the operational time period, geology, and operating characteristics of each of the identified landfills.

Site 1

Site 1, located just south of the sewage treatment plant off the Gulch Runway, was in operation prior to World War II (Figure IV-1). Only one interviewee recalled the area being used as a dump site. Another interviewee did not recall the area and denied that it was ever a dumping area. The interviewee that did recall the area and remembered it as a youth. He grew up across the road and remembered it from the times he would sit and watch the airplanes taking off from the Gulch Runway. He indicated the dump was in use during the 1920's and 1930's.

The site probably sits on a decomposed rock layer 130 feet thick. Below the rock layer is unaltered basalt having the characteristics of freshly solidified lava. Three distinct aquifers occur within the limits of Wheeler Air Force Base, two of them are deep aquifers and the other is a shallow perched aquifer (for a complete discussion of geology and hydrogeology see Chapter III). The perched aquifer is located about 20 feet below ground level extending another 100 to 150 feet. Any movement of contaminants from Site 1 will be to this aquifer. From the perched aquifer, contaminants would migrate downward into the Wahiawa High Level Aquifer. The Wahiawa aquifer supplies potable water to the community of Wahiawa, Schofield Barracks and Wheeler Air Force Base.

Site 1 probably does not contain large amounts of hazardous wastes. Maintenance of the aircraft and ground vehicles of that time did not require the usage of large amounts of hazardous materials. The aircraft were small relative to later aircraft and produced lesser amounts of waste oils and hydraulic fluids. Also, the persistent halogenated organic solvents were not in widespread use during this time period. Waste oils were likely to be of a volume that could easily be handled by spreading on the roads or disposed of by outside contract.

No specific information regarding quantities of waste disposed of at this site was available. The amount of hazardous waste at this site is expected to be Small. The confidence level is Suspected and the hazard rating Medium.

Site 2

Site 2, also known as the Gulch Runway dump, is located just off the northeast corner of the Gulch Runway (Figure IV-1). The active period of this dump site is unknown. However, it can be inferred that this area was the primary dump site during the 1940's; Site 1 was active during the 1920's and 30's while Site 3 (discussed below) was active from the 1950's on.

This site probably sits on a decomposed rock layer about 130 feet thick. Below the rock layer is unaltered basalt having the characteristics of freshly solidified lava. Any movement of contaminants from Site 2 will be to the perched aquifer described above. From the perched aquifer contaminants would migrate to the Pearl Harbor Basal Aquifer. The Pearl Harbor Basal Aquifer supplies the major share of the domestic water for the region extending from Makaha on the Waianae coast to the eastern tip of Honolulu.

No specific information regarding quantities of hazardous waste disposed of at this site was available. An estimation based on current (1977) quantities would not be justified due to the greater level of activity experienced at Wheeler Air Force Base during the active life of this landfill (1940-1949). Therefore, in keeping with the guidance contained in the description of the HARM model - the estimated "worst case" will be applied to Site 2. The estimated worst case for Site 2 is medium quantities of hazardous waste with a hazard rating of High. Confidence level Suspected. The moderate quantity was arrived at by taking the life span of the landfill (9 years) and the cutoff points for the quantity categories (e.g. Large - greater than 85 drums) and assessing the "reasonableness" of the yearly deposition required to achieve the various categories (S, M, L). For example, it is reasonable to assume that 9 full drums of hazardous material were deposited in Site 2 per year during the life span of this landfill, in light of base activities during the time period of interest. In the case of Site 2 it was felt that a reasonable worst case was the medium category: 2 - 9 full drums of hazardous materials per year. The composition of the materials was assumed to be paint sludges, halogenated solvent sludges, bottom sludges from fuel tank cleaning, residual pesticides, and waste POL not fit for recycle/reuse.

A single grab soil sample was taken from this dump site by a USEPA Field Investigation Team. A discussion of the investigation is present in Appendix F.

Site 3.

Site 3, also known as the Kunia Gate Dump, is located west of the Kunia Gate (Figure IV-1). This site was active from the 1950's until about 1974. After 1974 all waste material from Wheeler Air Force Base was taken off base via outside contract.

This site is located in a decomposed rock layer approximately 130 feet thick. Below the rock layer is unaltered basalt having the characteristics of freshly solidified lava.

Any migration of contaminants from Site 3 will be to the perched aquifer described earlier. From the perched aquifer, contaminants would migrate downward into the Wahiawa High Level Aquifer. The Wahiawa aquifer supplies potable water to the communities of Wahiawa, Schofield Barracks and Wheeler Air Force Base.

Since Site 3 was a major on-base landfill it would be expected to contain potentially hazardous wastes typical of those generated by an active Air Force Base - paints, solvents, residual pesticides, and waste POL. Assuming a constant waste generation of 13,000 gallons per year (1977 quantities - last year on record), 95% reuse/recycle of POL and waste solvents for fire training exercises and 100% disposal to drain of non-flammable liquid wastes (detergents, bleaches, acids, and some solvents) an estimated 575 gallons (equivalent to 10 drums) was deposited per year for a total of 11,500 gallons or 200 drums of hazardous materials over the life of the area. Therefore, the waste quantity is rated as Large. The confidence level is Suspected because of conflicting information obtained during the interviews regarding disposal practices. The hazard rating for this site is High due to the suspected presence of POL and halogenated solvents.

Site 4 - Fire Training Area.

The Fire Training Area, in operation until 1980, was located near the center of the base off Airdrome Road (Figure IV-1). In 1980, the training activities were moved to Hickam Air Force Base.

Fire training activities used flammable wastes exclusively until activities ceased in 1980. The Fire Department trained weekly in the 1950's and 1960's, and roughly three times a month in the 1970's. Fire Department personnel indicated that the average fire started with 500-1,000 gallons of flammable material, with 50 to 70 percent being consumed in the burn.

Site 4 is underlain with 5-10 feet of topsoil, under which is a decomposed rock layer approximately 130 feet thick. Under the rocky layer is unaltered basalt having the characteristics of freshly solidified lava.

Movement of contaminants from Site 4 would be to the perched aquifer. From the perched aquifer contaminants would migrate downward into both the Wahiawa High Level Aquifer and the Pearl Harbor Basal Aquifer.

The Army Environmental Services Officer informed the investigative team that the FTA was excavated in 1980 and the dirt taken to the Schofield Barracks landfill. He did not know how much dirt was removed from the area, nor was there any indication of any analyses being performed on the remaining soil. The HEPC (Hickam Environmental Protection Committee) minutes indicate that leaking drums of POL and solvents were found near the FTA by the Air Force and that the Army was taking action to remove the drums and dispose of contaminated soils. There was no indication that the Army intended to excavate the fire pit. No follow-up information on this situation was found in later records of the HEPC.

It is certain that some excavation took place at the Wheeler FTA. The extent of the excavation is unknown. Since the extent of hazardous materials contamination is unknown, Site 4 will be assigned a "worst case" rating according to the guidance supplied in the description of the HARM model. Thus, waste quantities are assumed to be Large; Confidence level Suspected; and hazard rating High.

Storm Drainage System

The storm drainage system at Wheeler Air Force Base is composed of a system of catch basins, pipe networks, and drainage ditches. Ultimate discharge is to Waikele Stream. Currently there are no buildings with floor drains connected to the storm drainage system; available records do not indicate whether certain shops were tied into the system during earlier periods. Exterior wash racks currently discharge to the storm drainage system.

There would be several sources of contaminants reaching the drainage system; POL spills during aircraft fueling operations, POL leakage from parked aircraft and ground vehicles; unauthorized dumping of industrial wastes by shop personnel; and detergents and cleaning solvents resulting from wash rack operation. Once part of the drainage system, contaminants have two pathways to the environment: exfiltration from the pipe network, and infiltration along the drainage ditches. After leaving the drainage network, contaminants will migrate downward until the perched aquifer is reached. Contaminants in the perched aquifer will then slowly leach into the Wahiawa and Pearl Harbor aquifers.

There are two sites associated with the storm drainage system with the potential to contain hazardous materials. These sites are discussed below.

Site 5 - Aircraft Parking Area

Site 5 is located west of Building 829 (Figure IV-1). Aircraft (helicopters) are parked here, with the area also serving as a wash rack. Contaminants in this area would consist of POL resulting from leakage and fuel tank expansion, and cleaning compounds. Contaminants would reach the storm drainage system as part of storm water runoff from the paved area or during washing operations. Some cleaning compounds could reach grassy areas surrounding the site due to sloppage and poor housekeeping practices. Most contaminants will runoff to the catch basins, however, some will reach the drainage ditch on the west side of the area.

This site has the potential for environmental contamination, therefore the site requires rating using the HARM model. Hazardous waste quantities are expected to be Small and their presence Suspected. The hazard rating is Medium (cleaning solvents).

Site 6 - Aircraft Parking Area

Site 6 is the grassy area south of the instrument runway and running east to west from Building 110 to Building 114 (Figure IV-1). This area is located near an aircraft parking/fueling area. Contaminants at Site 6 would consist of POL resulting from leakage, and AVGAS originating from spills during fueling operations. Contaminants would reach the site as a part of storm water runoff from the paved area or be washed into the area during clean-up operations following spills.

Site 6 has the potential for environmental contamination, therefore, the site requires rating using the HARM model.

In the absence of any factual information on the occurance of significant spillage in this area, an estimated "worst case" will be applied. Quantities of hazardous waste are estimated as Medium, their presence Suspected. The hazard rated is High due to the expected presence of Avgas.

Sanitary Sewer System

The wastewater treatment plant (WWTP) was constructed in the 1950's. It was extensively modified and upgraded in 1974. The Wheeler/Schofield WWTP uses a standard activated sludge process with anaerobic sludge digestion. Effluent quality is presented in Appendix G. From 1973 to 1982 digested, dewatered sludge was buried at the Schofield Barracks dump. Prior to this time the disposal method for sewage sludge is unknown, however, it is likely that some sludge was deposited in Site 3 (Kunia Gate Dump).

Wastes are transported to the treatment plant through a system of gravity feed pipes and pressure lines. As noted previously, a common method of liquid waste disposal in shop areas was disposal to the sewerage system; treatment plant personnel noted that this is still a fairly common method of disposal as indicated by frequent "upsets" in the biological reactor.

Site 7

For the purposes of this report, Site 7 will be that portion of the system that extends from manhole (MH) 6 on Santos Dumont Street to manhole (MH) 4 on the same line (Figure IV-1). Hazardous materials in the sanitary sewage system would reach the environment through exfiltration from the pipe network. Once out of the sanitary system, contaminants would migrate vertically into the perched aquifer and from there into the Wahiawa aquifer, or to a lesser extent into the Pearl Harbor Basal Aquifer.

The sanitary sewer system has the potential to contain hazardous materials, therefore Site 7 requires a HARM rating. In the absence of any factual information, a worst case estimate will be applied to this area. The quantities of hazardous material in this site are expected to be Medium, their presence is Suspected. The hazard rating is expected to be Medium.

Site 8 - Abandoned Oxidation Ponds

Toward the southern end of the base, east of Navy housing, there are abandoned oxidation ponds (Figure IV-1). Operational in the late 1960's, this area was used to treat domestic sewage prior to the completion of the force main to the WWTP.

Site 8 received no hazardous materials, therefore a HARM rating is not required.

Other Activity Review

In addition to the foregoing activity review, a record search and investigation with respect to disposal practices of radioactive materials was performed. Basis for this records search and personnel interviews includes: (a) possible use of radioactive materials for aircraft instruments; (b) maintenance and cleaning of aircraft used in support of atmospheric weapons testing program; (c) handling and clean-up of weapons accidents involving nuclear weapons; and (d) transportation accidents involving transportation of radioactive materials.

Results of the records search and interviews indicated that existence of radioactive materials in disposal sites, most notably the Fort Kamehameha disposal site, cannot be ruled out, and that work on aircraft luminescent dials presumably made with radioactive materials was performed during a ten-year period at Hickam Air Force Base. No records were reviewed that confirmed that this material was disposed of separately from other hazardous materials. Details of this records search and interviews are included in Appendix H.

Table IV-1

Summary of Hazardous Material Usage and Disposal

Practices at Maintenance Shops.

Shop Name	Location (Bldg. No.)	Waste Material	Waste Quantity*	1940—1950—1960—1970—1980—
Dental Clinic	106	Alcohol, Methanol	2-4 gal	Base Landfill → Off Base
		Hg	50 gal	Base Landfill (Beginning date for recovery) → Recovered
		X-ray Developer	1-2 gal	Base Landfill → Off Base
15th ABSQ Vehicle Maintenance	T-203	Oil	50 gal	
		Hydraulic Fluid		
		Grease	1-5 pounds	
		Paint	2 gal	
		Trichloroethylene	No Longer Used	
		PD 680	1-9 gal	Fire Pit → Off Base
		Antifreeze	5 gal	Base Landfill
		Thinner	2 gal	
		Acid	Variable	
		Benzoyl Peroxide	4-6 oz (No longer used)	
		Aromatic Hydrocarbons	Small	
		Asbestos	Small	
22nd Tass Life Support	206	Polish, Alcohol	Small Small	Base Landfill → Off Base
169th Motor Pool	203	Brake Fluid	Small	
		Paint	1/3 gal	Fire Pit → Fire Pit → Off Base
		PD 680	3-4 gal	Base Landfill → Off Base
		Paint Thinner	1/3 gal	
		Acid	Small	Sewer →
		Asbestos		Base Landfill → Off Base

*Includes evaporation and spillage
Quantities per month unless noted

Summary of Hazardous Material Usage and Disposal

Practices at Maintenance Shops.

Shop Name	Location (Bldg.No.)	Waste Material	Waste Quantity*	1940——1950——1960——1970——1980——
169th				
Radio	204	Methylene Chloride	No Longer Used	Base Landfill → Off Base; Fire Pit
		Alcohol	2 oz.	
		PD680	4 gal	
1. ABSQ	233			
15th ABSQ				
Wood Hobby	233	Paint, Thinner	Small	Base Landfill → Off Base
		Stain, Varnish		
15th CES				
Smart Team	1102	Paint	Consumed	Base Landfill → Off Base
		Oil	Consumed	
		Methylene Chloride	2-4 gal	
6594th Recovery				
Maintenance	2035	PD 680	25 gal	Fire Pit → Fire Pit → Off Base
		Oil	20 gal	
		Hydraulic	2.5 gal	
		Spray Cleaner		Base Landfill → Off Base
		Paint Thinner	3 gal	
22nd TASS AGE	203	PD680	1 gal	Fire Pit → Fire Pit → Off Base; Base Landfill → Off Base
		Hydraulic Fluid	1/2 gal	Base Landfill → Off Base
		Paint, Lacquer		
6594th Test Group				
OMS Branch	2035	PD680	75 gal	Fire Pit → Fire Pit → Off Base
		MEK	6 gal	
		Hydraulic Fluid	300 gal	Base Landfill → Off Base; Fire Pit
		Oil	400 gal	
		Alkaline Cleaners	N/A	Sewer →

*Includes evaporation and spillage quantities per month unless noted

Summary of Hazardous Material Usage and Disposal Practices at Maintenance Shops.

Shop Name	Location (Bldg. No.)	Waste Material	Waste Quantity*	1940—1950—1960—1970—1980
Dental Clinic		X-ray Solution Misc. Solutions	70 gal	Sewer → Sewer Base Landfill → Off Base
ABSQ/CE Carpenter/Mason	205	Cement Adhesive Saw Dust	1-2 gal 1-5 gal N/A	Base Landfill → Off Base
		PD 680	2 gal	Sewer → Off Base Base Landfill
Entomology & Sanitation	205	Herbicide Misc. Water Treatment Chemicals Malathion Pyrithin	1 gal 2-5 gal 1 gal	Base Landfill (Residual Material Empty Drums) → Rinse to Sewer; Off Base (Drums)
Electrical	205	Acid Batteries	Small N/A	Base Landfill → Off Base
Paving Grounds	205	Herbicides	20 pounds (sprayed)	Base Landfill (Residual material empty drums) → Off Base
		Asphalt	N/A	Base Landfill → Off Base
Plumbing/Sheet Metal	205	Metals Misc. Oil, Paint	N/A Small	Base Landfill → Off Base
15th ABSQ Refrigeration/Heating	205	PD 680 Freon	10 gal Consumed	Sewer → Off Base Base Landfill
		Cleaning Solution	6 gal	Sewer →
		Oil	3 gal	Base Landfill → Off Base Fire Pit

*Includes evaporation and spillage
Quantities per month unless noted

Summary of Hazardous Material Usage and Disposal

Practices at Maintenance Shops.

Shop Name	Location (Bldg. No.)	Waste Material	Waste Quantity*	1940—1950—1960—1970—1960—
15th ABSQ				
Power Production	205	Acid	10 gal	Sewer / Ground → Off Base
		Oil	10 gal	
		Alkaline Soap	5 gal	
		PD 680	5 gal	Sewer / Fire Pit → Off Base
Protective Coating	205	PD 680	15 gal	Fire Pit / Ground → Off Base
		Paint	10-20 gal	Base Landfill → Off Base
		Thinner	50 gal	
		Aluminum Paint	1 gal	
Tenant - Army Various Shops		Solvents	N/A	Fire Pit / Base Landfill → Fire Pit → Off Base
		Oils	N/A	Base Landfill / Fire Pit → Off Base
		Paints Fuels	N/A	Fire Pit → Off Base

*Includes evaporation and spillage
Quantities per month unless noted

TABLE IV-2

DISPOSAL SITE RATING SUMMARY

Site	Waste Type	Contamination	Migration	Rated
1	Industrial, Domestic, Demolition	yes	yes	yes
2	Industrial, Domestic, Demolition	yes	yes	yes
3	Industrial, Domestic, Demolition	yes	yes	yes
4	Industrial, POL	yes	yes	yes
5	Industrial, POL	yes	yes	yes
6	Industrial, POL	yes	yes	yes
7	POL	yes	yes	yes
8	Domestic	no	NA	no

Note: NA = not applicable using decision tree methodology

TABLE IV-3

SUMMARY OF SITE RATING RESULTS

Site	Waste Type	Receptors	Waste Characteristics	Pathways	Waste Management Factor	Final Score
1	Industrial, Domestic	61	18	57	1.0	45
2	Industrial, Domestic	52	34	57	1.0	48
3	Industrial, Domestic	71	70	57	1.0	66
4	Industrial, POL	64	63	43	1.0	57
5	Industrial, POL	70	27	50	1.0	49
6	Industrial, POL	64	40	50	1.0	51
7	POL	68	36	50	1.0	51

V. CONCLUSIONS

CHAPTER V

CONCLUSIONS

The goal of the IRP Phase I study is the identification of sites where there is the potential for environmental contamination by hazardous materials resulting from past disposal practices and to assess the probability of contaminant migration from these sites. The conclusions given below are based on the assessment of the information obtained from the records search, the environmental setting review, the hydrogeological evaluation and interviews with base military and civilian personnel, past employees and state and local government agencies. Table V-1 contains a list of the potentially contaminated sources identified at Wheeler Air Force Base and a summary of HARM scores for those sites. The sites as discussed individually below.

1. Site 3 (Kunia Gate Dump) is located west of Kunia Gate. This site was active from about 1950 until 1974. Site 3 is suspected of containing large amounts of hazardous materials. There is a moderate potential for migration of hazardous materials from the landfill (Pathways subscore: 57). The Receptors subscore is relatively high (71). The overall site score is somewhat moderated by the Suspected rating in waste characteristics and the moderate potential for migration. The

final site rating score is 66.

2. Site 4 (Fire Training Area) is located near the center of the base off Airdrome Road. The site is suspected of being contaminated with larger amounts of hazardous materials. There is relatively low potential for migration (Pathways subscore: 43) of hazardous materials from this area. The receptors subscore is moderate (64) which tends to raise the overall site rating. The final HARM score for Site 4 is 57.

3. Site 6 (Aircraft Parking Area) is the grassy area south of the instrument runway and running east to west from Building 110 to Building 114. The area is suspected of containing medium quantities of hazardous materials. There is a moderate potential for migration of contaminants from this area (pathways subscore: 50). The receptors subscore is moderate (64) which tends to raise the overal HARM rating for this site. The final site rating score is (51).

4. Site 7 (Sanitary Sewer System) is that portion of the system that extends from manhole (MH) 6 on Santos Dumont Street to manhole (MH) 4 on the same line. The area is suspected of being contaminated with medium quantities of hazardous materials.

There is a moderate potential for migration of hazardous materials from this area (Pathways subscore: 50). The receptors subscore is relatively High (68) which tends to raise the overall HARM rating for this site. The final site rating for Site 7 is (51).

5. Site 5 (Aircraft Parking/Wash Rack) is located west of Building 829. The site is suspected of containing small amounts of hazardous materials. There is a moderate potential for migration of hazardous materials from this site (pathways subscore: 50). The receptors subscore is relatively High (70) which tends to raise the overall site rate. The final site rating score is (49).

6. Site 2 (Gulch Runway Dump) is located off the northeast corner of the Gulch Runway. This landfill was operational during the 1940's. Site 2 is suspected of containing medium amounts of hazardous materials. There is a moderate potential for migration of contaminants (Pathways subscore: 57). The Receptors subscore is also moderate (52). The final site rating score for this areas is 48, indicating a relatively low potential for environmental contamination beyond the boundaries

of the landfill.

7. Site 1 (Landfill) is located just south of the sewage treatment plant adjacent to the Gulch Runway. This area was in use during the 1920's and 1930's. Site 1 is suspected of being contaminated with small amounts of moderately hazardous materials. There is a moderate potential for migration of contaminants (Pathways subscore: 57). The Receptors subscore is moderate (61) but the lack of large amounts of hazardous materials mitigates the impact of this site. The final site rating score is 45.

8. Site 8 (Oxidation Ponds) is located near the southern end of the base. No hazardous materials will be found here therefore the site does not require a HARM rating.

TABLE V-1

POTENTIAL CONTAMINATION SOURCES
WHEELER AIR FORCE BASE

Site	Description	Receptor Subscore	Waste Charact. Subscore	Pathways Subscore	Mgmnt Subscore	Overall Score
3	Landfill	71	70	57	66	66
4	Fire Training Area	64	63	43	57	57
6	Aircraft Parking	64	40	50	51	51
7	Sanitary Sewer System	68	36	50	51	51
5	Aircraft Parking/ Wash Rack	70	27	50	49	49
2	Landfill	52	34	57	48	48
1	Landfill	61	18	57	45	45

VI. RECOMMENDATIONS

CHAPTER VI

RECOMMENDATIONS

A total of seven sites have been identified at Wheeler Air Force Base which are, or possibly are, contaminated by hazardous materials. Each site was rated using the Hazardous Assessment Rating Methodology (HARM). The HARM rating provided a basis for comparing the relative potential for environmental impact at each site and served as an aid in preparing recommendations for follow-up field investigations to confirm the contamination and/or migration.

During Phase II of the restoration program, sampling and analyses will serve to define the magnitude and extent of contamination which has occurred on the base. The recommendations given below outline a general approach for the follow-up monitoring program.

Several key factors, as identified in the Phase I site investigation, have been considered in preparing the recommended field testing program. The first is the sensitive nature of the location of Wheeler Air Force Base. The base is located over two main aquifer systems: the Pearl Harbor Basal Aquifer and the Wahiawa High Level Aquifer. The Pearl Harbor Aquifer is a main water supply for domestic water on the island as well as for irrigation purposes. The Wahiawa High Level Aquifer is also a domestic water source and is used for irrigation. Therefore, any potential or actual contamination of these aquifers would have far reaching impact on the general population. The second factor is that the base is physically located over both aquifers with the boundary between them passing directly beneath the base. In addition, the presence of a perched aquifer overlying both main water supplies necessitates the consideration of water quality in three different aquifers. This presents a somewhat unique situation. Additional factors influencing the recommended program include the fact that the perched aquifer serves as a retention source to protect the lower aquifers and has been found to be contaminated in nearby areas, apparently from agricultural sources, and that existing wells in the deep aquifers in nearby areas have not shown contamination problems. Finally, Sites 1, 2, and 3 are located across the southwestern boundary of the base which apparently is also the downgradient boundary based on the general direction of groundwater in the area. This fact allowed for the opportunity to locate monitoring wells which could provide both immediate information on water quality near the identified sites and also comprise a portion of a longer term monitoring network to provide an overall picture of the groundwater quality as it enters and leaves the base property.

Given this setting, the monitoring program includes data collection from all three aquifers. The primary emphasis of the program is the definition of water quality in the perched aquifer underlying each identified site. Monitoring wells are specified for each site to provide actual data on the quality of the perched aquifer water. Chemical parameters are specified based on the expected types of contamination present as determined during the Phase I study. The number of monitoring wells is based on the size of the identified site and the HARM rating score. Upgradient wells in the perched aquifer have been included for several sites to provide background information, particularly given the knowledge that nearby off-base sites have been found to be contaminated. This base wide network of monitoring wells also includes existing wells, thus providing the ability to obtain both upgradient and downgradient data for both domestic water supply aquifers.

Recommendations for each of the seven sites are given below. Figure VI-1 shows the general locations of the recommended monitoring well sites. Table VI-1 provides a general list of typical chemical analyses to be performed at the various sites. Table VI-2 provides a summary of the type and number of monitoring wells to be installed with a recommended sampling frequency.

Site 3

This site was the active base landfill from the 1950's through 1974, receiving all domestic and industrial waste generated on the base. Materials deposited in this location include solvents, oils, fuels, paints, typical metal parts and debris and household refuse. This site is the largest of the landfill areas and has the highest HARM rating of the sites on base. It is recommended that three monitoring wells be placed into the perched aquifer at this site. One well should be near Kunia Gate upgradient to provide background water quality, and two wells at the southern boundary (downgradient wells). Particular attention should be focused on signs of leachate generation during the installation of these wells. Downgradient wells will provide water quality measurements of the water leaving the site. Each well should be sampled at least three times to provide a proven, reliable data set. Samples should be analyzed for all parameters shown in Table VI-1. In addition, zinc, iron, nitrate and sulfide should be analyzed at this location. These parameters serve as common indicators of leachate generation in landfills which have received large quantities of waste materials. Visual inspection of the soils during drilling should be accomplished to provide indication if any gross soil contamination.

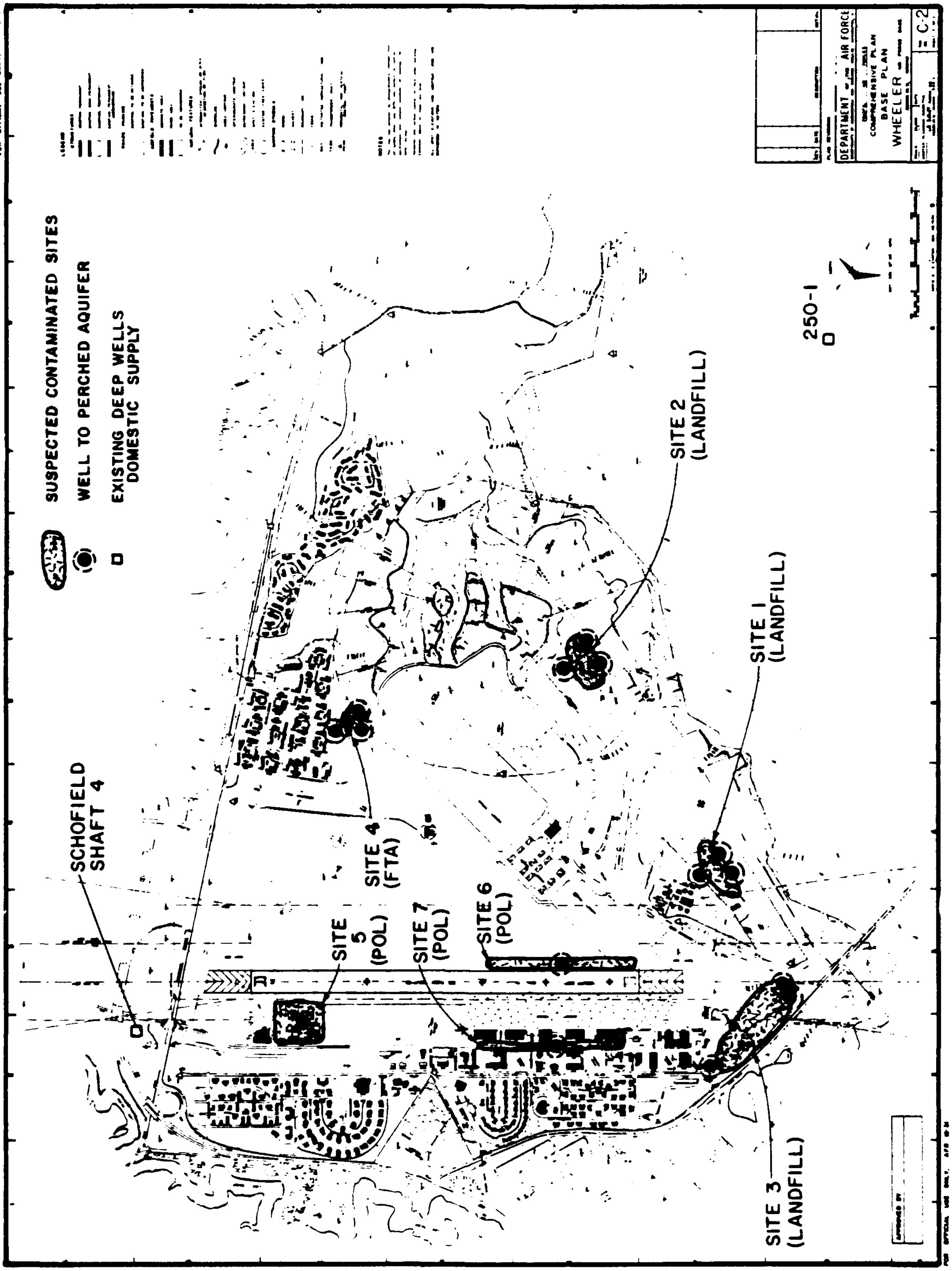

FIGURE VI-1 MONITORING WELL SITES

If neither upgradient nor downgradient wells show evidence of contamination or leachate generation, this is not evidence that the site does not generate environmental contamination; it may be the leachates are percolating straight downwards from the site. In the case that no contamination is found in either upgradient or downgradient wells, it may be appropriate to sample the soils directly beneath the site, perhaps via slant drilling.

Site 4

This site was the Fire Training Area on the base. The site received quantities of solvents, oils and fuels for use in fire training exercises. These materials were poured onto the ground and burned during training exercises. This site contains non-flammable materials and residuals which remained after each burn. It is recommended that three monitoring wells be placed into the perched aquifer, with one upgradient well for background data, and two downgradient wells along the perimeter. Each well should be monitored three times over a two to three week period. Water samples should be analyzed for phenols, total organic carbon, for semi-volatile materials including polychorinated biphenyl (PCB), and for volatile organics. The semi-volatile materials (Base-neutral and acid extractables, EPA Method 625) have been added because the primary materials remaining after a fire burn will most likely be in this class of compounds. Some chlorinated volatile materials may also be present, so the volatile organic testing should also be included. In addition, it is highly desirable to have the volatile organics data for comparison in the overall assessment of the base groundwater quality. It is particularly important that the soils at this site be visually inspected during drilling, as the presence of heavy oils absorbed into the soil is highly possible at this location.

It may again be appropriate, for reasons outlined above for Site 3, to sample the soils directly beneath the site, perhaps via slant drilling.

Sites 6, 7, and 5

Each of these sites are adjacent to aircraft parking and maintenance areas. While no major spills of fuels have been documented in these areas, it is likely that wash-off of solvents and oils, and minor fuel spills have occurred over the years. Therefore it is recommended that one monitoring well into the perched aquifer be installed at each site. At least three water samples should be collected from each well over a period of two to three weeks. Samples should be analyzed for volatile organic materials, phenols, lead, and total organic carbon. As at the fire training site, careful visual examination of the soils for signs of contamination should be accomplished during the drilling operation.

Sites 2 and 1:

These sites were general landfill locations during the 1920's and the 1930's (Site 1), and the 1940's (Site 2) receiving waste materials which included general solvents, paints, oils, residual pesticides, and metal parts. Site 1 is also located adjacent to the sewage treatment plant near the old sludge drying beds. Three wells drilled to the perched water aquifer are recommended for each site. One upgradient and two downgradient locations per site are specified. A minimum of three water samples from each well should be collected over a two to three week time period to provide a sound data base. Samples should be analyzed for volatile organic compounds, phenols, lead, and total organic carbon. In addition, soil samples should be examined during the drilling operation for any visual signs of gross contamination.

The monitoring program outlined above is the minimum program that should be undertaken to verify the extent and degree of hazardous waste contamination and/or migration at Wheeler Air Force Base. It would be desirable to include additional activities as given below to further define water and soil quality for Wheeler Air Force Base. While these activities are not a necessity in the initial Phase II investigation, the incremental cost to perform this work would be small. The additional information obtained would be potentially of great use should significant contamination and/or migration be documented during the Phase II study. The additional work includes:

Other Monitoring Sites

Existing wells in the deep aquifers are located near Wheeler Air Force Base. These wells include the following:

1. Schofield Shaft 4 and Well (upgradient Wahiawa Aquifer)

2. Kunia Naval Reservation Wells (west of base, Wahiawa Aquifer)

3. Waipahu Well (12,000 feet south, downgradient, Pearl Harbor Aquifer)

These wells provide an opportunity to analyze water quality above and below the base without the added cost of additional well installation. While monitoring these sites is not a requirement for direct evaluation of the individual sites, given the sensitive nature of the area's water resources, it is recommended that these sites be analyzed at least one or two times during the Phase II program. Of the three locations, the base water supply will provide the most direct data, as it is located upgradient in the Wahiawa Aquifer. It is recommended that these wells be analyzed for the parameters shown in Table VI-1.

Soil Sampling

Data from the monitoring wells will show if hazardous materials have migrated to the perched aquifer. However, this data will not show how extensively the soils overlying these areas are contaminated. It would be desirable to obtain soil samples during the drilling operation for subsequent analyses. These samples would show the extent and depth to which contamination has occurred. It is recommended that soil samples be taken at five foot intervals for each well drilled into the perched aquifer and archived. This will generally result in five to seven samples per hole, depending on the depth to water at each location. It is also recommended that fairly simple tests - total recoverable petroleum hydrocarbon analysis, EPA Method 418.1, and volatile organics screen by gas chromatography - be performed on these samples. These general screening procedures are relatively fast and inexpensive methods of determining contamination by organic materials. Samples from each location should also be stored pending the first data results. In this way, additional and more detailed analyses could be performed if needed without incurring additional sample collection costs.

Deep Aquifer Monitoring

If existing wells to the deep aquifer are monitored and found to be contaminated, or, if the perched aquifer is found to be heavily contaminated, the following deep aquifer monitoring program is recommended:

1. Two wells located on the south side of the Gulch runway, opposite Sites 1 and 2. A minimum of three water samples from each well should be collected over a two to three week period. Samples should be analyzed for volatile organic compounds, phenols, lead and total organic carbon.

2. One downgradient well should be located near the south base property line opposite Site 3. The well should be monitored three times over a two to three week period. If this well shows signs of contamination, an upgradient deep aquifer well should be installed near Kunia Gate and sampled with the same frequency as the downgradient well. Analyses for both wells should include all parameters listed in Table VI-1.

3. One downgradient deep aquifer well should be installed near Site 4. The well should be monitored a minimum of three times over a two to three week period. If the downgradient well shows signs of contamination, an upgradient well should be installed and sampled with the same frequency.

Analyses for both wells should include volatile organic compounds, phenols, and total organic carbon.

Table VI-1

RATIONALE FOR RECOMMENDED ANALYSIS

Parameter	Rationale
volatile organic compounds	organic solvents and possible decomposition products. Includes many of the industrial chemicals known to have been utilized by the Air Force.
phenols	phenolic cleaners and paint strippers
lead	fuel spills, POL disposal
cadmium, copper, chromium	heavy metals from parts and machinery wastes
total organic carbon	solvents, POL, paint wastes
pH, conductivity	acid, caustic contamination, dissolved salts from leachate.
pesticides	herbicides, insecticides in discarded containers. General usage for control.

Table VI-2

SUMMARY OF RECOMMENDED MONITORING

Site	HARM Score	Recommended Monitoring	Rationale
3 (landfill)	66	3 wells to perched aquifer, analyze heavy metals, VOC, TOC, phenol, pH, iron, zinc, nitrate, sulfide; 3 samples per well	site contains industrial and domestic waste, solvents, paint, oil, fuels
4 (fire training area)	57	3 wells to perched aquifer, analyze VOC, BNA, PCB, phenol, TOC; 3 samples per well	site contains solvents, oils, fuel residuals after burning
6, 7, 5 (drainage areas)	51, 51, 49	1 well to perched aquifer per site. analyze lead, VOC, phenol, TOC; 3 samples per well	sites contains solvents, oil, fuels
2 (landfill)	48	same as 1	same as 1
1 (landfill)	45	3 wells to perched aquifer, analyze heavy metals, VOC, TOC, phenol, pH; 3 samples per well	site contains industrial waste, solvents, paint

APPENDIX A

Resumes for Contractor's Record Search Team

Dennis I. Hirota

EDUCATION

Ph.D.	Civil Engineering - Water Resources University of Michigan, 1970
M.S.	Sanitary Engineering University of Michigan, 1964
B.S.	Civil Engineering University of Michigan, 1963

PROFESSIONAL EXPERIENCE

1971 to present — Sam O. Hirota, Inc., Honolulu

Vice-President

1971 to present — Aquatic Sciences Corporation

President

1977 to present — University of Hawaii, Department of Achitecture

Lecturer in Computer application in Architecture

1968 to 1971 — USAF Environmental Engineering Research
Kirtland AFB, New Mexico

Research Engineer (Captain, USAF)
U.S. Air Force Civil Engineering Advance
Research and Development Center

1969 to 1970 — University of New Mexico

Adjunct Professor in graduate level of instruction in water treatment design

PROFESSIONAL REGISTRATION

Civil Engineer, Hawaii

PROFESSIONAL/COMMUNITY ACTIVITIES

Member, Board of Directors, Hale Kipa

President, Punahou Alumni Association

Member, Thematic Committee on Enivronmental Education
Department of Education

Member, Citizen's Committee for Environmental Education

Member, Board of Trustees, Le Jardin, d'Enfants

American Society of Civil Engineers

American Institute of Chemical Engineers

American Society of Photogrammetry

Water Pollution Control Federation

American Chemical Society,Chi Epsilon

John E. Schenk

EDUCATION

B.S.E.	Civil Engineering University of Michigan, 1963	
M.S.E.	Sanitary Engineering University of Michigan, 1964	
Ph.D.	Civil Engineering - Water Resources University of Michigan, 1969	

PROFESSIONAL EXPERIENCE

1969 to Present — Environmental Control Technology Corporation
3983 Research Park Drive
Ann Arbor, Michigan 48104

Executive Vice-President:	1975 to present
Vice President:	1973 - 1975
Associate:	1969 - 1973

1972 to Present — University of Michigan
Ann Arbor, Michigan 48109

Adjunct Professor of Civil Engineering:	1979
Instructor in Civil Engineering:	1969 - 1973
Laboratory Assistance: Sanitary Engineering Department	1962 - 1963

1968 — Ayres, Lewis, Norris & May, Inc.
Ann Arbor, Michigan 48104

Advisory Consultant

1960 — Atwell-Hicks Consulting Engineers,
Ann Arbor, Michigan

Surveying

PROFESSIONAL SOCIETIES

National Society of Professional Engineers (Michigan)

American Society of Civil Engineers

American Water Works Association

Water Pollution Control Federation

HONOR SOCIETIES

Chi Epsilon

Tau Beta Pi

Phi Kappa Phi

Society of the Sigma Xi

REGISTRATION

Registered Professional Engineer, State of Michigan

PROFESSIONAL PUBLICATIONS AND PRESENTATIONS

Schenk, John E. and Walter J. Weber, Jr., "Chemical Interactions of Dissolved Silica with Iron (II) and (III)". Journal American Water Works Association, February 1968.

Schenk, John Erwin, Ph.D., "Interactions of Monomeric Silica with Iron, Manganese, and Aluminum in Aqueous Solution". Dissertation, 1969.

Schenk, John E., and Walter J. Weber,Jr., "The Effects of Silica on Iron and Manganese in Natural Waters". Presented at American Chemical Society Meeting; New York City, New York, September 1969.

Schenk, John E., Peter C. Meier, Michael E. Bender, "Analysis of Pollution from Marine Engines - Status Report". 27th Annual Purdue Industrial Waste Conference, 1972.

Simon, Philip B. and John E. Schenk, "Refined Techniques for Monitoring Water Quality". Presented at the 165th national meeting of the American Chemical Society, Dallas, Texas, April 1972

Bender, Michael E., Robert A. Jordan, and John E. Schenk, "Status of Outboard Marine Exhaust Research Project". Summer Symposium, Boating Industry Association, Lake Geneva, Wisconsin, June 1972.

Schenk, John E., et. al., "Effects of Outboard Marine Engine Exhaust on the Aquatic Environment". Presented at the Seventh Conference of the International Association on Water Pollution Research, Paris, 1974. Published in Progress in Water Technology, 1974.

Schenk, John E. and Dale A. Scherger, "The Affect of Residential and Commercial-Industrial Land Usage on Water Quality". Prepared for the Great Lakes Pollution from Land Use Activities. November, 1974.

Schenk, John E., "Chemical Oxidation". Presentation at IAWPR Short Course; University of Birmingham, 1974.

Simon, Philip B., and John E. Schenk, "A Refined Technique for Monitoring Lead and Cadmium in Water". Industrial Hygiene News Report, June 1973.

Environmental Control Technology Corporation, "Water Pollution Investigation: Detroit and St. Clair Rivers". U.S.E.P.A., December 1974.

Sanocki S.L., P.B. Simon, R.L. Weitzel, D.E. Jerger, and J.E. Schenk, "Aquatic Field Surveys at Iowa Army Ammunition Plant" Prepared for the U.S. Army Medical R & D Command. November 1976.

Weitzel, R.L., R.C. Eisenman, and J.E. Schenk, "Aquatic Field Surveys for Radford Army Ammunition Plant". Prepared for U.S.A.M.R. & D. Command. November 1976.

Jerger, D.E., P.B. Simon, R.L. Weitzel, and J.E. Schenk, "Microbiological Investigations, Iowa and Joliet Army Ammunition Plants". Prepared for U.S.A.M.R.&D. Command. November 1976.

Dale A. Scherger

EDUCATION

B.S.E. Chemical Engineering
University of Michigan, 1971

M.S.E. Water Resources
University of Michigan, 1972

PROFESSIONAL EXPERIENCE

1969 to Present — Environmental Control Technology Corporation
3983 Research Park Drive
Ann Arbor, Michigan 48104

Director of Engineering Studies: 1976 to present

Staff Engineer: 1972 - 1976

Engineer and Laboratory Technician: 1969 - 1972

1967 to 1969 — University of Michigan

Laboratory Technician

PROFESSIONAL SOCIETIES

American Institute of Chemical Engineers

Water Pollution Control Federation

REGISTRATION

Registered Professional Engineer, State of Michigan

PUBLICATIONS

Atkins, Peter, F., Jr., Dale A. Scherger, Robert A. Barnes; "Ammonia Removal in a Physical-Chemical Wastewater Treatment Process", Presented at the 27th Annual Purdue Industrial Waste Conference, 1972.

Scherger, Dale A., and R.P., Canale; "Water Quality Model of Coliform Bacteria in the Huron River", APSE meetings, December 1972.

Craig A. Morgan

EDUCATION

B.S.	Biology Western Michigan University, 1977
M.D.	Water Resources, Science University of Michigan, 1979
B.S.E.	Civil Engineering University of Michigan, expected, 1984

PROFESSIONAL EXPERIENCE

10/80 to Present

Environmental Control Technology Corporation
3965 Research Park Drive
Ann Arbor, Michigan 48104

Staff Scientist

5/80 to 10/80

Great Lakes Basin Commission
3475 Plymouth Road
Ann Arbor, Michigan

Planning Assistant

10/78 to 12/79

University of Michigan
College of Engineering
Ann Arbor, Michigan 48109

Research Assistant

8/78 to 1/79

Environmental Dynamics, Inc.
1254 North Main
Ann Arbor, Michigan 48103

Research Chemist

2/76 to 4/76

Western Michigan University
Kalamazoo, Michigan

Research Biologist

PUBLICATIONS

Morgan, Craig A. and Sonzogni, W.C., "Effect of Water Level Regulation on Water Quality in the Great Lakes", Great Lakes Environmental Planning Study, Great Lake Basin Commission, Ann Arbor, Michigan.

Sonzogni, William C.; Morgan, Craig A.; Heidtke, T.M.; Monteith, T.J., "Water Conservation Effects on Wastewater Treatment and Overall Water Quality of the Great Lakes", Great Lakes Environmental Planning Study, Great Lakes Basin Commission, Ann Arbor, Michigan.

John F. Mink

EDUCATION

B.S.	Geology and Mineralogy Pennsylvania State University, 1949
M.S.	Geophysical Sciences University of Chicago, 1951
	Fellowship Environmental Engineering The John Hopkins University, U.S. Public Health, 1965 to 1967

PROFESSIONAL EXPERIENCE

1960 to present	Environmental sciences and geology Consultant in hydrology
1968 to 1972	The Earth Sciences Group Inc., Washington Vice-President
1967 to 1968	Research Analysis Corporation McLean, Virginia Environmental Analyst
1960 to 1964	Honolulu Board of Water Supply Honolulu, Hawaii Hydrologist-Geologist
1956 to 1960	U.S. Geological Survey Honolulu, Hawaii Groundwater Geologist
1953 to 1956	Pacific Chemical and Fertilizer Co. Honolulu, Hawaii Chemicals Supervisor
1952 to 1953	Hawaiian Sugar Planters Assn. Experiment Station, Honolulu

PROFESSIONAL SOCIETIES, RECOGNITIONS, AND AFFILIATIONS

Registered Geologist No. 364, California
State of Hawaii Water Commission, 1977-1979
Research Affiliate, University of Hawaii
Research Affiliate, University of Guam
Member: Geological Society of America; American Geophysical Union; American Association for the Advancement of Science; Geological Society of Washington; Hawaiian Academy of Science; American Association of Professional Geologists.

TYPICAL MAJOR PROJECTS

Hawaii	Investigation of water supplies in Southern Oahu, for U.S. Geological Survey. Determination of state groundwater resources in Oahu for Honolulu Board of Water Supply. Numerous water resources for studies for domestic and agricultural use for each of the Hawaiian islands.
Pacific Islands	1. Guam - Continuing evaluation of water resources. Project Director, Northern Guam Lens Study, 1979-1982. 2. U.S. Trust Territory of Pacific - Evaluation of water supplies in each district. 3. Tahiti and Bora Bora - Location and development of drinking water sources. 4. Okinawa - Investigation of drinking and agricultural water supplies.
Asia	1. Taiwan - Development of water supplies for sugar cane irrigation in Southern Taiwan. 2. Diego Garcia - Investigation of a groundwater supply for the U.S. base. 3. Korea - Investigation of water supplies for the island of Chaeju, Republic of Korea.
Egypt	Assessment of the development of the deep Nubian Aquifer in the Western Desert for agriculture.
Venezuela	Investigation of an irrigation water supply in the Apure River basin.

PUBLICATIONS

International scientific journals: Science; Journal of Geophysical Research; Bulletin of the Seismological Society of America; Pacific Science; Bulletin of the International Association of Scientific Hydrology.

Government and University: U.S. Geological Survey; State of Hawaii; University of Hawaii; City and County of Honolulu; University of Guam.

Consultant Reports: Guam; Trust Territory of the Pacific; Tahiti; Fiji; Hawaii; Okinawa; New Mexico; Maryland; New Jersey; Venezuela; Egypt.

Nicola Rinaldi

EDUCATION

A.A.S.	Major in nuclear engineering Hartford State Technical College, 1972
B.S.	Major in radiological health physics Lowell Technological Institute, 1974

PROFESSIONAL EXPERIENCE

1/78 to 11/80 (part-time)
11/80 to present
Gamma Corporation
P.O. Box 430
Wahiawa, Hawaii 96786

Health Physicist

7/75 to 11/80 (part-time)
Health Physics Associates
P.O. Box 430
Wahiawa, Hawaii 96786

Health Physicist

10/76 to 1/80
University of Hawaii
2002 East-West Road
Honolulu, Hawaii 96822

Health Physicist

1/76 to 10/76
Pearl Harbor Naval Shipyard
Pearl Harbor, Hawaii

Health Physicist

1/75 to 7/75
Cambridge Nuclear Radiopharmaceutical Corp.
575 Middlesex Turnpike
Billerica, MA 01865

Radiation Safety Officer

5/74 to 9/74
Maine Yankee Atomic Power Company
Box 450, RFD 2
Wiscasset, Maine 04578

Health Physicist Technician

COMMUNITY AFFAIRS

1976 First Secretary of Hawaii Chapter of Health Physics Society.

1978 President of Hawaii Chapter of Health Physics Society.

1980 Chairman of State Advisory Committee to Study Radiological Safety.

Philip James Manly

EDUCATION

B.S. Major in physics, minor in electrical engineering
Massachusets Institute of Technology, 1967

M.S. Major in health physics and environmental engineering
Rensselaer Polytechnic Institute, 1971

PROFESSIONAL EXPERIENCE

1978 to present — Gamma Corporation
P.O. Box 430
Wahiawa, Hawaii 96786

President

19/4 to 1978 (part-time) — Health Physics Associates
P.O. Box 430
Wahiawa, Hawaii 96786

Principal of consulting firm

19/1 to 1979 — Pearl Harbor Naval Shipyard
Pearl Harbor, Hawaii

Worked in Radiological Control Office

HONORS

Academic — Associate member of Sigma Xi; listed in American Men and Women of Science, Who's Who in the West, Personalities of America Men of Achievement.

Professional — Certified by American Board of Health Physics, 1976

COMMUNITY AFFAIRS

1976	Founded Hawaii Chapter of Health Physics Society; elected first president.
1979	Conducted 13th Mid-year Topical Symposium for Health Physics Society on Health Physics Training.
1981	Provided technical consultation in preparation of videotape "Slowly Dying Embers, Radioactive Waste in the Pacific", jointly produced by Health Physics Society, East-West Center, and League of Women Voters.
1982	Elected President of Hawaii Chapter, Health Physics Society.

APPENDIX B

Outside Agency Contact List

APPENDIX B

OUTSIDE AGENCY CONTACT LIST

1. Hawaii Department of Transportation, Airports Division, Mr. Owen Miyamoto, Honolulu, Hawaii, (808) 836-6432.

2. Hawaii Department of Health, Drinking Water Section, Mr. Thomas Arizumi, Honolulu, Hawaii (808) 548-2235.

3. Hawaii Department of Health, Environmental Protection and Health Services Division, Mr. David Higa, Honolulu, Hawaii, (808) 548-6908 (Also Mr. Denis Lau and Mr. Dennis Tulang).

4. Hawaii Department of Land and Natural Resources, Mr. Manabu Tagomori, Honolulu, Hawaii (808) 548-7619.

5. City of Honolulu, Board of Water Supply. Mr. Herbert Minakami, Honolulu, Hawaii (808) 548-6183.

APPENDIX C

Installation History and Mission

INSTALLATION HISTORY AND MISSION

History

By Presidential Executive Order No. 1918, the federal government acquired the land for Wheeler Air Force Base from the Territory of Hawaii in 1922. The base was named Wheeler Field on November 11, 1922 in honor of Major Sheldon H. Wheeler who died in an aircraft accident in July 1921. Initial construction and land clearance south of Schofield Barracks began on February 6, 1922.

Of primary historic importance is the first non-stop Mainland to Hawaii flight from Oakland, California, to Wheeler Field that was made on June 28-29, 1927. The first solo flight from Hawaii to the Mainland was made by Amelia Earhart from Wheeler Field to California.

At the time of the Japanese attack on Hawaii, units of the Air Force stationed at Wheeler Field included the 14th Pursuit Wing, 15th Pursuit Group, 18th Air Base Group, 17th Air Base Squadron, and the 24th and 25th Material Squadrons. Casualties at Wheeler Field, December 7, 1941, included 37 killed, 6 missing and 53 wounded. During the years of World War II and until 1949, Wheeler Field was under the command of the 7th Air Force.

In 1949, Wheeler Field was deactivated; however, expansion of the United States Air Force during the Korean War resulted in the reactivation of the field as Wheeler Air Force Base. Today, by agreement with the U.S. Army, administration and maintenance of Wheeler Air Force Base is performed by the 15th Air Base Squadron, and operational use of the airfield is now controlled by the US Army. The Army has also gained control of the Base Civil Engineering responsibilities. (Reference 1).

Mission

Primary Mission (Reference 15 ABW Reg 23-16). The mission of the 15th Air Base Squadron is to command, operate, and maintain Wheeler Air Force Base and satellite Air Force installations as directed; and to provide administrative, logistical, and munitions services and support to Headquarters PACAF and other tenant units according to existing directives or agreements. The 15th Air Base Squadron is assigned to the 15th Air Base Wing.

Tenant Mission (Reference. 15 ABW/PA). The major tenants' missions are:

326th Air Division - The mission of the 326th Air Division is to plan, coordinate, and conduct the Hawaii air defense mission utilizing elements of the Hawaii Air National Guard. The 326th Air Division, also called the Hawaiian Air Defense Division, is headquartered at Wheeler Air Force Base. In addition to protecting the Hawaiian Islands and other significant installations through the Pacific Islands Air Defense Region (PIADR), the 326th is responsible for conducting tactical air operations and exercises to include the employment of 22nd Tactical Air Support Squadron (TASS) assets to support the U.S. Army's 25th Infantry Division, headquartered at neighboring Schofield Barracks.

22nd Tactical Air Support Squadron(TASS) - The mission of the 22nd TASS is to provide the Air Force component commander of a properly designated joint force with combat operationally ready elements of the tactical air control system capable of operating and maintaining a tactical air support sub-system to satisfy ground force operational requirements.

1843rd Engineering Installation Group - The 1843rd is responsible for the full range of program management, engineering and installation of ground communications-electronics facilities in support of the Air Force and other military missions throughout the Pacific area.

US Army - Wheeler Air Force Base has become the center of operations for all Army aviation assets assigned to the 25th Infantry Division. Their major mission involves combat readiness training, extensive aviator proficiency training, Headquarters liaison flights, and VIP support.

Mission History. The biggest change over the last 10 years has been the build up of the Army. Aviation units at Wheeler Air Force Base, which has resulted in a functional change from a small, limited use fixed-wing airfield to a moderate size rotary-wing air base.

APPENDIX D

Records Search Interview List

Wheeler Air Force Base Records Search Interview List

Interviewee	Area of Knowledge	Years on Installation
1	Fire Control/Training	2
2	Sanitary Waste Treatment	9
3	Equipment Operator	21
4	DPDO	--
5	Grounds Maintenance	1
6	Sanitation/Pest Control	21
7	Utilities/Ground Maintenance	38
8	Environmental Engineering	3
9	Heavy Equipment Operator	30
10	Bioenvironmental Engineer	2
11	Bioenvironmental Engineering	2
12	Bioenvironmental Environmental Technician	2
13	Base Env. Coordinator	2

APPENDIX E

Master List of Industrial Activities

Master List of Industrial Activities
Wheeler Air Force Base

(Shops Closed 1977)

Name	Present Location	Handles Hazardous Material	Generates Hazardous Material
15th CES			
Carpenter/Mason	205	X	X
Entomology	205	X	
Sanitation	205	X	
Electrical	205	X	
Paving/Grounds	205	X	
Plumbing/Sheet Metal	205		
Refrigeration	205	X	
Heating	205	X	X
Power Production	205	X	X
Protective Coating	205	X	X
(Shops Remaining Open Through 1982)			
15th ABSQ			
Vehicle Maintenance	203	X	
Wood Hobby Shop	233	X	
22nd TASS			
Life Support	206		
AGE	203	X	X
169th			
Motor Pool	203	X	X
Radio Shop	204	X	
15th CES			
SMART Team	1102	X	
6594th Test Group			
Recovery Maintenance	2035	X	X
OMS	2035	X	X
Dental Clinic	106	X	
Tenants			
Various Army Shops		X	X

APPENDIX F

USEPA Field Investigation of Waste Sites

Under the provision of the Resource Conservation and Recovery Act of 1976, the Environmental Protection Agency, Region IV, Complianced Response Branch, requested that a Field Investigation Team (FIT) visit Wheeler Air Force Base in response to an Air Force CERCLA notification regarding the possibility of hazardous waste disposal in Site 1.

The FIT made that visit on April 5, 1982. While on base the team took 2 samples:

1. Soil grab sample at the Gulch Runway sump (Site 2).

2. Schofield Shaft Well, which supplies potable water to Wheeler Air Force Base.

The FIT report (Field Investigations of Uncontrolled Hazardous Waste Sites, Contract Number 68-01-6056. Ecology and Environment, Inc.) indicates that no contamination was present in the above samples. However, it must be noted that the soil sample was a surface grab and would not be expected to show contamination unless some hazardous material was dumped at the particular spot in the very recent past. It should also be noted that the groundwater analyses. and the soil analyses, included only pesticides - no industrial chemicals. Therefore, it is not possible to draw any conclusions regarding industrial contamination from the FIT samples.

The analytical results from these samples are presented below. Other analyses obtained by the IRP investigative team during their visit to the Schofield pump station are also presented. Routine monitoring of the Schofield Shaft Well has not indicated any detectable amounts of industrial contaminants.

WHEELER AFB

U.S. ENVIRONMENTAL PROTECTION AGENCY-HWI Sample Management Office
P.O. Box 818, Alexandria, VA 22313 - 703/683-0385

Sample Number: Y1446

ORGANICS ANALYSIS DATA SHEET - Page 1

Laboratory Name: Mead CompuChem
Case Number: 956
Lab Sample ID NO.: 14692
QC Report No.: 41-104,4291,4491
Signature of Person Authorized to Release Data: [signature]

ACID COMPOUNDS		ug/g	BASE/NEUTRAL COMPOUNDS		ug/g
88-06-2	2,4,6-trichlorophenol	0.2U	101-55-3	4-bromophenyl phenyl ether	0.2U
59-50-7	p-chloro-m-cresol	0.4U	39638-32-9	bis-(2-chloroisopropyl)ether	0.2U
95-57-8	2-chlorophenol	0.2U	111-91-1	bis(2-chloroethoxy)methane	0.2U
120-83-2	2,4-dichlorophenol	0.2U	87-68-3	hexachlorobutadiene	0.2U
105-67-9	2,4-dimethylphenol	0.2U	77-47-4	hexachlorocyclopentadiene	0.2U
88-75-5	2-nitrophenol	0.2U	78-59-1	isophorone	0.2U
100-02-7	4-nitrophenol	1.8U	91-20-3	naphthalene	0.2U
51-28-5	2,4-dinitrophenol	0.8U	98-95-3	nitrobenzene	0.2U
534-52-1	4,6 dinitro-o-cresol	0.4U	NA	N-nitrosodimethylamine	NA
87-86-5	pentachlorophenol	0.5U	86-30-6	N-nitrosodiphenylamine	0.2U
108-95-2	phenol	0.2U	621-64-7	N-nitrosodi-n-propylamine	0.2U
			117-81-7	bis(2-ethylhexyl)phthalate	0.2U
	BASE/NEUTRAL COMPOUNDS		85-68-7	butyl benzyl phthalate	0.2U
			84-74-2	di-n-butyl phthalate	0.2U
83-32-9	acenaphthene	0.2U	117-84-0	di-n-octyl phthalate	0.2U
92-87-5	benzidine	0.5U	84-66-2	diethyl phthalate	J0.050
120-82-1	1,2,4-trichlorobenzene	0.2U	131-11-3	dimethyl phthalate	0.2U
118-74-1	hexachlorobenzene	0.2U	56-55-3	benzo(a)anthracene	0.2U
67-72-1	hexachloroethane	0.2U	50-32-8	benzo(a)pyrene	0.2U
111-44-4	bis(2-chloroethyl)ether	0.2U	205-99-2	3,4-benzofluoranthene	0.5U
91-58-7	2-chloronaphthalene	0.2U	207-08-9	benzo(k)fluoranthene	0.2U
95-50-1	1,2-dichlorobenzene	0.2U	218-01-9	chrysene	0.2U
541-73-1	1,3-dichlorobenzene	0.2U	208-96-8	acenaphthylene	0.2U
106-46-7	1,4-dichlorobenzene	0.2U	120-12-7	anthracene	0.2U
91-94-1	3,3'-dichlorobenzidine	0.2U	191-24-2	benzo(ghi)perylene	0.5U
121-14-2	2,4-dinitrotoluene	0.2U	86-73-7	fluorene	0.2U
606-20-2	2,6-dinitrotoluene	0.2U	85-01-8	phenanthrene	0.5U
	1,2-diphenylhydrazine	0.2U	53-70-3	dibenzo(a,h)anthracene	0.5U
122-66-7	(as azobenzene)	0.2U	193-39-5	indeno(1,2,3-cd)pyrene	0.5U
206-44-0	fluoranthene	0.2U	129-00-0	pyrene	0.5U
7005-72-3	4-chlorophenyl phenyl ether	0.2U			

ORGANICS ANALYSIS DATA SHEET-Page 2

Sample Number: V1418

Laboratory Name: Mead CompuChem

Lab Sample ID No.: 14686

Case Number: 956

QC Report No.: 41-101, 42-91, 43-91

	VOLATILES	ug/g
107-02-8	acrolein	0.10U
107-13-1	acrylonitrile	0.10U
71-43-2	benzene	0.01U
56-23-5	carbon tetrachloride	0.01U
108-90-7	chlorobenzene	0.01U
107-06-2	1,2-dichloroethane	0.01U
71-55-6	1,1,1-trichloroethane	0.01U
75-34-3	1,1-dichloroethane	0.01U
79-00-5	1,1,2-trichloroethane	0.01U
79-34-5	1,1,2,2-tetrachloroethane	0.01U
75-00-3	chloroethane	0.01U
110-75-8	2-chloroethylvinyl ether	0.01U
67-66-3	chloroform	0.01U
75-35-4	1,1-dichloroethene	0.01U
156-60-5	1,2-trans-dichloroethene	0.01U
78-87-5	1,2-dichloropropane	0.01U
10061-0X-XX	1,3-dichloropropylene	0.01U
100-41-4	ethylbenzene	0.01U
75-09-2	methylene chloride	0.024
74-87-3	chloromethane	0.01U
74-83-9	bromomethane	0.01U
75-25-2	bromoform	0.01U
75-27-4	dichlorobromomethane	0.01U
75-69-4	trichlorofluoromethane	0.01U
75-71-8	dichlorodifluoromethane	0.01U
124-48-1	chlorodibromomethane	0.01U
127-18-4	tetrachloroethylene	0.01U
108-88-3	toluene	0.01U
79-01-6	trichloroethylene	0.01U
75-01-4	vinyl chloride	0.01U

	PESTICIDES	ug/g
309-00-2	aldrin*	0.01U
60-57-1	dieldrin	0.01U
57-74-9	chlordane	0.01U
50-29-3	4,4'-DDT	0.01U
72-55-9	4,4'-DDE	0.01U
72-54-8	4,4'-DDD	0.01U
115-29-7	endosulfan I	0.01U
115-29-7	endosulfan II	0.01U
1031-07-8	endosulfan sulfate	0.01U
78-20-8	endrin	0.01U
7421-43-4	endrin aldehyde	0.01U
76-44-8	heptachlor	0.01U
1024-57-3	heptachlor epoxide	0.01U
319-84-6	BHC-Alpha	0.01U
319-85-7	BHC-Beta	0.01U
319-85-8	BHC-Delta	0.01U
58-89-9	BHC-Gamma	0.01U
53469-21-9	PCB-1242	0.01U
11097-69-7	PCB-1254	0.01U
11104-28-2	PCB-1221	0.01U
11141-16-5	PCB-1232	0.01U
12672-24-6	PCB-1248	0.01U
11096-82-5	PCB-1260	0.01U
12674-11-2	PCB-1016	0.01U
8001-35-2	toxaphene	0.04U

	DIOXINS	
1746-01-6	2,3,7,8-tetrachlorodibenzo-p-dioxin	0.01U

*Less than 0.2 ug/l (pesticides less than, 0.01 ug/l)

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Hawaii - [illegible]

Sample Number
X1448

SCHOFIELD ~~DEEP~~ SOIL ~~S~~

ORGANICS ANALYSIS DATA SHEET - Page 1

Laboratory Name: Mead CompuChem | Case Number: 956

Lab Sample ID No.: 14686 | QC Report No.: 4-101,4291,4691

Signature of Person Authorized to Release Data: R.D. Willis

ACID COMPOUNDS		ug/g	BASE/NEUTRAL COMPOUNDS		ug/g
88-06-2	2,4,6-trichlorophenol	0.2U	101-55-3	4-bromophenyl phenyl ether	0.2U
59-50-7	p-chloro-m-cresol	0.4U	39638-32-9	bis(2-chloroisopropyl)ether	0.2U
95-57-8	2-chlorophenol	0.2U	111-91-1	bis(2-chloroethoxy)methane	0.2U
120-83-2	2,4-dichlorophenol	0.2U	87-68-3	hexachlorobutadiene	0.2U
105-67-9	2,4-dimethylphenol	0.2U	77-47-4	hexachlorocyclopentadiene	0.2U
88-75-5	2-nitrophenol	0.2U	78-59-1	isophorone	0.2U
100-02-7	4-nitrophenol	1.8U	91-20-3	naphthalene	0.2U
51-28-5	2,4-dinitrophenol	0.8U	98-95-3	nitrobenzene	0.2U
534-52-1	4,6 dinitro-o-cresol	0.4U	NA	N-nitrosodimethylamine	NA
87-86-5	pentachlorophenol	0.5U	86-30-6	N-nitrosodiphenylamine	0.2U
108-95-2	phenol	0.2U	621-64-7	N-nitrosodi-n-propylamine	0.2U
			117-81-7	bis(2-ethylhexyl)phthalate	0.2U
BASE/NEUTRAL COMPOUNDS			85-68-7	butyl benzyl phthalate	0.2U
			84-74-2	di-n-butyl phthalate	0.2U
83-32-9	acenaphthene	0.2U	117-84-0	di-n-octyl phthalate	0.2U
92-87-5	benzidine	0.5U	84-66-2	diethyl phthalate	[illegible] 0.2U
120-82-1	1,2,4-trichlorobenzene	0.2U	131-11-3	dimethyl phthalate	0.2U
118-74-1	hexachlorobenzene	0.2U	56-55-3	benzo(a)anthracene	0.2U
67-72-1	hexachloroethane	0.2U	50-32-8	benzo(a)pyrene	0.2U
111-44-4	bis(2-chloroethyl)ether	0.2U	205-99-2	3,4-benzofluoranthene	0.5U
91-58-7	2-chloronaphthalene	0.2U	207-08-9	benzo(k)fluoranthene	0.2U
95-50-1	1,2-dichlorobenzene	0.2U	218-01-9	chrysene	0.2U
541-73-1	1,3-dichlorobenzene	0.2U	208-96-8	acenaphthylene	0.2U
106-46-7	1,4-dichlorobenzene	0.2U	120-12-7	anthracene	0.2U
91-94-1	3,3'-dichlorobenzidine	0.2U	191-24-2	benzo(ghi)perylene	0.5U
121-14-2	2,4-dinitrotoluene	0.2U	86-73-7	fluorene	0.2U
606-20-2	2,6-dinitrotoluene	0.2U	85-01-8	phenanthrene	0.5U
	1,2-diphenylhydrazine	0.2U	53-70-3	dibenzo(a,h)anthracene	0.5U
122-66-7	(as azobenzene)	0.2U	193-39-5	indeno(1,2,3-cd)pyrene	0.5U
206-44-0	fluoranthene	0.2U	129-00-0	pyrene	0.5U
7005-72-3	4-chlorophenyl phenyl ether	0.2U			

ORGANICS ANALYSIS DATA SHEET-Page 2

Sample Number
CH 956-41447

SCHOFIELD DEEP

Laboratory Name Mead CompuChem

Lab Sample ID NO. 14694

GC Report NO. 19-55, 17-44, 27-44

	VOLATILES	ug/l
2V	acrolein	ND
3V	acrylonitrile	ND
4V	benzene	ND
6V	carbon tetrachloride	ND
7V	chlorobenzene	ND
10V	1,2-dichloroethane	ND
11V	1,1,1-trichloroethane	ND
13V	1,1-dichloroethane	ND
14V	1,1,2-trichloroethane	ND
15V	1,1,2,2-tetrachloroethane	ND
16V	chloroethane	ND
19V	2-chloroethylvinyl ether	ND
23V	chloroform	ND
29V	1,1-dichloroethylene	ND
30V	1,2-trans-dichloroethylene	ND
32V	1,2-dichloropropane	ND
33V	1,3-dichloropropylene	ND
38V	ethylbenzene	ND
44V	methylene chloride	ND
45V	methyl chloride	ND
46V	methyl bromide	ND
47V	bromoform	ND
48V	dichlorobromomethane	ND
49V	trichlorofluoromethane	ND
50V	dichlorodifluoromethane	ND
51V	chlorodibromomethane	ND
85V	tetrachloroethylene	ND
86V	toluene	ND
87V	trichloroethylene	ND
88V	vinyl chloride	ND

ND = NOT DETECTED

	PESTICIDES	ug/l
89P	aldrin	ND
90P	dieldrin	ND
91P	chlordane	ND
92P	4,4'-DDT	ND
93P	4,4'-DDE	ND
94P	4,4'-DDD	ND
95P	alpha-endosulfan	ND
96P	beta-endosulfan	ND
97P	endosulfan sulfate	ND
98P	endrin	ND
99P	endrin aldehyde	ND
100P	heptachlor	ND
101P	heptachlor epoxide	ND
102P	alpha-BHC	ND
103P	beta-BHC	ND
104P	delta-BHC	ND
105P	gamma-BHC	ND
106P	PCB-1242	ND
107P	PCB-1254	ND
108P	PCB-1221	ND
109P	PCB-1232	ND
110P	PCB-1248	ND
111P	PCB-1260	ND
112P	PCB-1016	ND
113P	toxaphene	ND

DIOXINS

129B	2,3,7,8-tetrachlorodibenzo-p-dioxin	ND

*Less than 10 ug/l

(pesticides less than, 1ug/l)

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SCHOFIELD DEEP SHAFT
Sample Number

ORGANICS ANALYSIS DATA SHEET

C# 956-41147

Laboratory Name Mead CompuChem
Lab Sample ID NO. 14684
QC Report NO. 18-55, 11-44, 27-44

	ACID COMPOUNDS	ug/l
21A	2,4,6-trichlorophenol	ND
22A	p-chloro-m-cresol	ND
24A	2-chlorophenol	ND
31A	2,4-dichlorophenol	ND
34A	2,4-dimethylphenol	ND
57A	2-nitrophenol	ND
58A	4-nitrophenol	ND
59A	2,4-dinitrophenol	ND
60A	4,6-dinitro-o-cresol	ND
64A	pentachlorophenol	ND
65A	phenol	ND

	BASE/NEUTRAL COMPOUNDS	ug/l
1B	acenaphthene	ND
5B	benzidine	ND
8B	1,2,4-trichlorobenzene	ND
9B	hexachlorobenzene	ND
12B	hexachloroethane	ND
18B	bis(2-chloroethyl)ether	NA
20B	2-chloronaphthalene	ND
25B	1,2-dichlorobenzene	ND
26B	1,3-dichlorobenzene	ND
27B	1,4-dichlorobenzene	ND
28B	3,3'-dichlorobenzidine	ND
35B	2,4-dinitrotoluene	ND
36B	2,6-dinitrotoluene	ND
37B	1,2-diphenylhydrazine (as azobenzene)	ND
39B	fluoranthene	ND
40B	4-chlorophenyl phenyl ether	ND
41B	4-bromophenyl phenyl ether	ND
42B	bis-(2-chloroisopropyl)ether	ND
43B	bis(2-chloroethoxy)methane	ND
52B	hexachlorobutadiene	ND
53B	hexachlorocyclopentadiene	ND
54B	isophorone	ND
55B	naphthalene	ND
56B	nitrobenzene	ND
61B	N-nitrosodimethylamine	NA
62B	N-nitrosodiphenylamine	ND
63B	N-nitrosodi-n-propylamine	ND
66B	bis(2-ethylhexyl)phthalate	ND
67B	butyl benzyl phthalate	ND
68B	di-n-butyl phthalate	ND
69B	di-n-octyl phthalate	ND
70B	diethyl phthalate	ND
71B	dimethyl phthalate	ND
72B	benzo(a)anthracene	ND
73B	benzo(a)pyrene	ND
74B	3,4-benzofluoranthene	ND
75B	benzo(k)fluoranthene	ND
76B	chrysene	ND
77B	acenaphthylene	ND
78B	anthracene	ND
79B	benzo(ghi)perylene	ND
80B	fluorene	ND
81B	phenanthrene	ND
82B	dibenzo(a,h)anthracene	ND
83B	indeno(1,2,3-cd)pyrene	ND
84B	pyrene	ND

ND = NOT DETECTED

ORGANICS ANALYSIS DATA SHEET—Page 2

Sample Number: Y1446

Laboratory Name: Mead CompuChem

Lab Sample ID NO. 141672

Case Number: 956

QC Report No. 41-101, 42-91, 46-91

	VOLATILES	ug/g
107-02-8	acrolein	0.10U
107-13-1	acrylonitrile	0.10U
71-43-2	benzene	0.01U
56-23-5	carbon tetrachloride	0.01U
108-90-7	chlorobenzene	0.01U
107-06-2	1,2-dichloroethane	0.01U
71-55-6	1,1,1-trichloroethane	0.01U
75-34-3	1,1-dichloroethane	0.01U
79-00-5	1,1,2-trichloroethane	0.01U
79-34-5	1,1,2,2-tetrachloroethane	0.01U
75-00-3	chloroethane	0.01U
110-75-8	2-chloroethylvinyl ether	0.01U
67-66-3	chloroform	0.01U
75-35-4	1,1-dichloroethene	0.01U
156-60-5	1,2-trans-dichloroethene	0.01U
78-87-5	1,2-dichloropropane	0.01U
10061-0X-XX	1,3-dichloropropylene	0.01U
100-41-4	ethylbenzene	0.01U
75-09-2	methylene chloride	0.01U
74-87-3	chloromethane	0.01U
74-83-9	bromomethane	0.01U
75-25-2	bromoform	0.01U
75-27-4	dichlorobromomethane	0.01U
75-69-4	trichlorofluoromethane	0.01U
75-71-8	dichlorodifluoromethane	0.01U
124-48-1	chlorodibromomethane	0.01U
127-18-4	tetrachloroethylene	0.01U
108-88-3	toluene	0.01U
79-01-6	trichloroethylene	0.01U
75-01-4	vinyl chloride	0.01U

	PESTICIDES	ug/g
309-00-2	aldrin	0.01U
60-57-1	dieldrin	0.01U
57-74-9	chlordane	0.01U
50-29-3	4,4'-DDT	0.01U
72-55-9	4,4'-DDE	0.01U
72-54-8	4,4'-DDD	0.01U
115-29-7	endosulfan I	0.01U
115-29-7	endosulfan II	0.01U
1031-07-8	endosulfan sulfate	0.01U
72-20-8	endrin	0.01U
7421-93-4	endrin aldehyde	0.01U
76-44-8	heptachlor	0.01U
1024-57-3	heptachlor epoxide	0.01U
319-84-6	BHC-Alpha	0.01U
319-85-7	BHC-Beta	0.01U
319-86-8	BHC-Delta	0.01U
58-89-9	BHC-Gama	0.01U
53469-21-9	PCB-1242	0.01U
11097-69-1	PCB-1254	0.01U
11104-28-2	PCB-1221	0.01U
11141-16-5	PCB-1232	0.01U
12672-29-6	PCB-1248	0.01U
11096-82-5	PCB-1260	0.01U
12674-11-2	PCB-1016	0.01U
8001-35-2	toxaphene	0.04U

	DIOXINS	
1746-01-6	2,3,7,8-tetrachlorodibenzo-p-dioxin	0.01U

*Less than 0.2 ug/l

(pesticides less than 0.01 ug/l)

TABLE 2-2 (Cont'd)

PARAMETER	SAMPLE CODES									
	Pearl City (MY 8891)	Pearl City (MY 8892)	Bird Sanctuary (MY 8893)	Pearl City (MY 8894)	Del Monte Well (MY 8895)	Wheeler AFB (MY 8896)	Deep Shaft (MY 8897)	Schofield Landfill (MY 8898)		
	mg/l	mg/l	mg/kg	mg/l	mg/l	mg/kg	mg/l	mg/kg	/	/
aluminum	1.6	1.3	2000	0.35	ND	330	ND	560		
chromium	ND	ND	14	0.021	ND	ND	ND	ND		
barium	ND	ND	ND	0.35	ND	ND	ND	ND		
beryllium	ND	ND	ND	ND	ND	ND	ND	ND		
cadmium	ND	ND	0.8	0.011	ND	ND	ND	ND		
cobalt	ND	ND	10	0.11	ND	ND	ND	ND		
copper	ND	ND	7.5	0.13	ND	ND	ND	8.9		
iron	1.5	1.2	6800	1.6	0.28	46	0.24	68		
lead	0.011	0.009	14	0.18	0.051	4.5	0.05	4.5		
nickel	ND	ND	16	0.22	ND	ND	ND	ND		
manganese	0.31	0.21	440	1.7	0.025	ND	0.03	140		
zinc	0.043	0.03	21	0.96	0.040	ND	0.05	11		
boron	ND	ND	32	4.5	ND	ND	ND	ND		
vanadium	ND	ND	ND	ND	ND	ND	ND	ND		
arsenic	ND	ND	ND	ND	ND	ND	ND	ND		
antimony	ND	ND	ND	0.022	ND	ND	ND	ND		
selenium	ND	ND	ND	ND	ND	ND	ND	ND		
thallium	ND	ND	ND	ND	ND	ND	ND	ND		
mercury	ND	ND	ND	ND	ND	ND	ND	ND		
tin	ND	ND	ND	ND	ND	ND	ND	ND		
silver	ND	ND	ND	ND	ND	ND	ND	ND		
ammonia	0.11	ND	ND	58	ND	ND	ND	ND		
cyanide	ND	ND	ND	0.02	ND	ND	ND	ND		
sulfide	ND	ND	56	0.92	ND	ND	ND	ND		

ND = Not Detected

TABLE 2-3 (Cont'd)

PARAMETER	SAMPLE CODES									
	Pearl City (Y 1441)	Pearl City (Y 1442)	Bird Sanctuary (Y 1443)	Pearl City (Y 1444)	Del Monte Well (Y 1445)	Wheeler AFB (Y 1446)	Deep Shaft (Y 1447)	Schofield Landfill (Y 1448)		
	ug/l	ug/l	ug/kg	ug/l	ug/l	ug/kg	ug/l	ug/kg		
chloroform	ND	ND	ND	ND	ND	ND	ND	ND		
methylene chloride	ND	ND	ND	ND	ND	ND	ND	24		
phenol	ND	ND	ND	ND	ND	ND	ND	ND		
pentachlo-rophenol	ND	ND	ND	ND	ND	ND	ND	ND		
naphtha-lene	ND	ND	ND	ND	ND	ND	ND	ND		
bis(2-ethylhexyl) phthalate	ND	ND	ND	ND	ND	ND	ND	ND		
fluoroan-thene	ND	ND	ND	ND	ND	ND	ND	ND		
diethyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND		
di-n-butyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND		
pyrene	ND	ND	ND	ND	ND	ND	ND	ND		
phenan-threne	ND	ND	ND	ND	ND	ND	ND	ND		
benzofluo-roanthene	ND	ND	ND	ND	ND	ND	ND	ND		
benzo(a) pyrene	ND	ND	ND	ND	ND	ND	ND	ND		
chlordane	ND	ND	ND	ND	ND	ND	ND	ND		
pp'DDE	ND	ND	ND	ND	ND	ND	ND	ND		
pp'DDD	ND	ND	ND	ND	ND	ND	ND	ND		
pp'DDT	ND	ND	ND	ND	ND	ND	ND	ND		

PHYSICAL AND CHEMICAL ANALYSIS OF WATER

SAMPLE NO.: SHO-1 SDWA - 20
DATE: August 1981

FROM: (Station or unit)
U.S. NAVY PUBLIC WORKS CENTER, PEARL HARBOR

TO: (Name and location of laboratory)
U.S. NAVY PUBLIC WORKS CENTER, PEARL HARBOR, ENVIRONMENTAL/INDUSTRIAL LABORATORY

SAMPLE FROM (Location of sampling point)
U.S. ARMY SCHOFIELD BARRACKS DEEP WELL, POTABLE WATER

COLLECTED BY	DATE	HOUR	SOURCE (Designate ground, surface, raw, treated)
SH/YY	20 Aug 1981	0930	Ground

REASON FOR EXAMINATION	EXAMINATION REQUESTED BY
Annual Analysis for Quality Evaluation	Compliance with NAVFACINST 5450.19B Oct 1974 encl 2 Sec I Para D

NOTE: All results reported in parts per million unless otherwise noted except for pH, temperature, and specific conductance. One liter of potable water is assumed to weigh one kilogram.

I. FIELD ANALYSIS

1. pH	TEMPERATURE °F	TEMPERATURE °C
6.71		22.5

ITEM	PPM
2. CARBON DIOXIDE (CO_2)	12
3. DISSOLVED OXYGEN (O_2)	8.2
4. HYDROGEN SULFIDE (H_2S)	
5. CHLORINE DEMAND (Cl_2)	

FIELD ANALYSIS BY

DATE OF ANALYSIS

II. SPECIAL LABORATORY ANALYSES

Check (X) individual items to be included in the Special Analyses. Request determination only of those substances suspected of being present in significant amounts.

(X)	ITEM	PPM
	1. As	<0.010
	2. Se	<0.005
	3. Pb	<0.005
	4. B	
	5. Cu	0.03
	6. Zn	0.05
	7. Cr (Hexavalent)	<0.005
	8. PO	0.10
	9. Cd	<0.001
	10. CN	
	11. Phenolic Compounds (PPB)	
	12. Others (Specify)	
	13. Ba	<0.010
	14. Hg	<0.0004
	15. [illegible]	<0.005
	16. Sat. Index	-2.11

III. ROUTINE LABORATORY ANALYSIS

(CHECK ONE) REQUESTED / NOT REQUESTED

ITEM	VALUE
1. COLOR	5
2. TURBIDITY	0.16
3. ALKALINITY ($CaCO_3$) P	0
3. ALKALINITY ($CaCO_3$) MO	44
4. TOTAL HARDNESS ($CaCO_3$)	51
5. NON-CARBONATE HARDNESS ($CaCO_3$) (By Computation)	7
6. CARBONATE HARDNESS ($CaCO_3$) (By Computation)	44
7. TOTAL DISSOLVED SOLIDS	166
8. SPECIFIC CONDUCTANCE (Micromhos)	

ITEM	PPM
9. CALCIUM (Ca)	9.6
10. MAGNESIUM (Mg)	6.5
11. SODIUM (Na) AND POTASSIUM (K)	15 & 1.1
12. HYDROXIDE (OH)*	
13. BICARBONATE (HCO_3)*	54
14. CARBONATE (CO_3)*	
15. SULFATE (SO_4)	[illegible]
16. CHLORIDE (Cl)	10
17. NITRATE (NO_3)	3.4
18. IRON (Fe) TOTAL	0.17
19. MANGANESE (Mn)	ND
20. SILICA (SiO_2)	[illegible]
21. FLUORIDE (F)	0.2[illegible]

*State whether determined or computed from P and MO alkalinity.

REMARKS (Such as unusual appearance, taste, odor, etc.)

Endrin	ND
Lindane	ND
Methoxychlor	ND
Toxaphene	ND
2,4,-D	ND
2,4,5,-TP Silvex	ND

LABORATORY ANALYSIS BY

DATE OF ANALYSIS

DD FORM 1 APR 53 710 REPLACES WD AGO FORM 8-125, 1 APR 45, WHICH IS OBSOLETE. NAVY—PEARL HARBOR

APPENDIX G

Effluent Quality Waste Water Treatment Plant

Wheeler Air Force Base/Schofield Barracks
Waste Water Treatment Plant

September 9-10, 1982

Parameter	Influent	Effluent
TSS (mg/l)	226	19
BOD (mg/l)	300	19
Coliform (cells)	--	49/100 ml
Flow (mgd)	2.4	

August 18-19, 1982

Parameter	Influent	Effluent
TSS (mg/l)	186	32
BOD (mg/l)	208	7
Flow (mgd)	2.5	

Note: Data taken directly from file by investigative team.

APPENDIX H

Radioactive Materials Section

GAMMA

GAMMA CORPORATION
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CONSULTANT SERVICES FOR RECORDS SEARCH, HAZARDOUS MATERIALS DISPOSAL SITES HICKAM AND WHEELER AIR FORCE BASES, OAHU, HAWAII

1. GENERAL

This report describes consultant services performed by Gamma Corporation in support of Project HIC82-9074 for a record search, investigation, and production of preliminary and final reports on the results of the record search and investigation with respect to disposal practices of radioactive materials.

2. PROJECT LOCATION

Project sites were located on Hickam and Wheeler Air Force Bases, Oahu, Hawaii.

3. OBJECTIVE

The objective of this support investigation was to identify the potential for ground water contamination from past waste disposal practices with regards to radioactive materials, and to assess the probability of contaminant migration beyond the installment boundary. This investigation also provides data necessary to determine whether a follow-on field survey is required.

4. WORK PERFORMED

Gamma Corporation performed the following investigation and review work in order to accomplish the above objective:

a. Conducted a records search of standard operating procedures, disposal records, work records, and other records to identify potential past uses of radioactive materials that could have lead to disposal of radioactive materials in a waste disposal site.

b. Designed an interview form for use in interviewing past and present employees with respect to use of radioactive materials at the facilities. A copy of the interview form is enclosed in Attachment 1.

c. Interviewed past and present employees who have worked in areas where use of radioactive materials is possible. Such areas included the instrument shops, maintenance shops, weapons handling areas, and areas associated with the support for weapons testing in the Pacific.

5. SUSPECTED USES OF RADIOACTIVE MATERIALS

The following possible uses of radioactive materials were used as a basis for the records search and personnel interviews:

a. Use of radium-226, tritium, and promethium-147 in radioluminescent dials of aircraft instruments. Overhaul or repair of these instruments could lead to radioactive materials disposal.

b. Maintenance and cleaning of aircraft used in support of the atmospheric weapons testing program in the Pacific. Aircraft used in observation and data collection during these tests could have become contaminated with the radioactive material.

c. Handling and clean-up of weapons accidents involving nuclear weapons.

d. Transportation accidents involving transportation of radioactive materials.

6. PERSONNEL CONDUCTING SURVEY

Records review and personnel interviews were conducted by Mr. Nick Rinaldi. Mr. Rinaldi is a professional health physicist with six years experience in various health physics programs. Review of the records review and personnel interview procedures and preparation of the final report was performed by Mr. Philip Manly. Mr. Manly is a certified health physicist with ten years experience in radiation protection programs.

7. RESULTS OF RECORDS REVIEW AND INTERVIEWS

A time line showing the inclusive dates of coverage for the records review and for each of the interviews is given in Attachment 2.

a. Only current operating procedures, and current records could be accessed for the records review. According to Air Force policy, records over two years old are shipped to a central records storage site and could not be accessed during this records search. In addition, old revisions of operating procedures are not kept when newer revisions are issued. Consequently, records keeping requirements and radioactive materials handling practices of previous decades could not be reviewed. However, according to current operating procedures, very few records of radioactive materials disposal are required to be kept.

b. Results of personnel interviews were far more inclusive. Coverage of time from the early 1940's through present was achieved for interviews regarding instrument maintenance and repair, information regarding the AEC trailers or leaching ponds, and disposal of radicactive materials. Information on nuclear weapons maintenance and storage and Broken Arrow incidents was restricted only to current time (within the last few years), although no activity involving radioactive materials waste disposal was mentioned in either of these categories. A summary of the results of the interviews for each of the categories is given in Attachment 3.

8. CONCLUSIONS AND ASSESSMENT

The following conclusions were drawn from the personnel interviews for each of the subject areas of interest:

a. Instrument maintenance and repair: Aircraft instruments with luminous dials were routinely repainted or replaced when the luminous material wore off. Radioactive materials were presumably used for the luminous dials and these were separated and stored in a few places in the warehouses. The repair shop for instruments was terminated in the mid-1950's. From this information, it is quite possible that radioactive materials, consisting of radium-226 and daughters, were disposed of in some waste disposal sites during the period from mid-1940 to mid-1950's. Such radioactive material is the same as is present in small concentrations in all earth materials, although higher concentrations could leach from waste disposal sites into surrounding waters.

b. AEC trailers/leaching ponds: Questions were asked specifically about leaching ponds and AEC trailers based on information that there were such trailers and that radioactive materials might be involved with these trailers in connection with weapons testing programs in the Pacific. The general concensus of the interview results is that a staging area was planned for some Pacific testing in the mid-1950's, although this plan was never put into action and the staging facility was never constructed. It seems probable that there were no radioactive materials involved with the AEC trailers or the leaching ponds.

c. Disposal of radioactive materials: The general concensus of interviews was that hazardous wastes were transferred to the Fort Kam disposal site for disposal. Fort Kam disposal site was under the maintenance of Public Works Center of the Navy and records relating to disposals at Fort Kam would be presumably kept by the Navy. No information was obtained regarding the disposal of radioactive materials at the Fort Kam site. One report indicated that current operating procedures require that radioactive materials be shipped to a U.S. Air Force waste storage facility on the mainland United States.

d. Nuclear weapons maintenance and storage: Only current information was available on nuclear weapons maintenance and storage. This information indicated no maintenance was being conducted by Hickam Air Force Base on nuclear weapons. No other information can be obtained on prior maintenance practices.

e. Broken Arrow incidents (incidents involving nuclear weapons): Only current information was available on Broken Arrow incidents at Hickam Air Force Base. This information indicated that there have been no Broken Arrow incidents. No information on prior practices or prior Broken Arrows was obtained.

CONCLUSIONS

Based on the reults on the records search and personnel interviews, the existence of radioactive materials in disposal sites, most notably the Fort Kam disposal site, cannot be ruled out. Results of interviews indicated that work on luminiscent aircraft dials, presumably made luminescent with radioactive materials, was performed during a ten-year period at Hickam Air Force Base. No records were reviewed that confirmed that this material was disposed of separately from other hazardous materials.

Submitted by: January 5, 1983

GAMMA CORPORATION

Philip J. Manly

Philip J. Manly
Certified Health Physicist

RECORDS SEARCH - PROJECT NO. HIC82-9074

Hello. I'm Nick Rinaldi, the Health Physicist on the Installation Restoration Program. My part in all this is to look at how radioactive materials on this base were handled in the past, as well as how they are being handled now.

In looking over the records at the base, I found that a lot of records don't go back as far as we need to check, or can't give us all the information we need. We're hoping that by talking to some of the people in key jobs we may be able to fill in some of the holes in what we know.

This list covers areas I'd especially like to talk about, but of course we aren't limited to what's on the list.

CATEGORIES OF INTEREST

1. STANDARD OPERATING PROCEDURES INVOLVING RADIOACTIVE MATERIALS.
2. MEDICAL USE OF RADIOACTIVE MATERIALS.
3. INSTRUMENT MAINTENANCE AND REPAIR.
4. AEC TRAILERS/LEACHING PONDS.
5. DISPOSAL OF RADIOACTIVE MATERIALS (LOCATE SITE ON MAP).
6. NUCLEAR WEAPONS MAINTENANCE/STORAGE.
7. BROKEN ARROW INCIDENTS.

Attachment 1

RECORDS SEARCH - PROJECT NO. HIC82-9074

```
                                        TIME LINE
  CATAGORY OF INTEREST CODE                      1940      1950      1960      1970      1980
1.  Standard Operating Procedures                                                         |-|

3.  Instrument Maintenance & Repair                 |---------|
                                                         |---------------------------|
                                                             |--|
                                                                                  |---------|

4.  AEC Trailers/Leaching Ponds                                 |---|
                                                                |---------------------------|
                                                                      |---------|

5.  Disposal of Radioactive Material                   |-----------------------------|
                                                                        |-------------------|
                                                                         |------------------|
                                                                                    |-------|
                                                                                          |-|

6.  Nuclear Weapons Maintenance/Storage                                                   |-|
7.  Broken Arrow Incidents                                                                |-|
```

Attachment 2

RECORDS SEARCH - PROJECT NO. HIC82-9074

INTERVIEW RESULTS

CATEGORY OF INTEREST CODE	INCLUSIVE DATES	DESCRIPTION
1	1980-82	Accident recovery of aircraft crash involving hazardous materials including radiological materials. Never had to recover radioactive materials at Hickam.
3	1942-53	During this time, instruments were repaired in this shop. Dials were repainted or replaced when they were hard to see or scratched.
3	1947-75	Gauges, luminous (not sure if the names included radium dial) were stored in a few places. Radioactive materials were separated and stored in a few places in the warehouses.
3	1951-54	Gauges that needed repair went to the old instrument shop. The repair shop terminated in 1955-56.
3	1972-82	Instruments are turned into repair processing center. From there interviewees do not know what happens to them.
4	1954-58	Coordinating Engineer acting on project engineering and operations. Involved in recovery exercises after tests in Pacific.
4	1954-present	Items marked radioactive material from "Down under". Down under means from the Pacific testing program. The packages were small 6"-square to a few cubic feet. Interviewee does not know where packages went.

CATEGORY OF INTEREST CODE	INCLUSIVE DATES	DESCRIPTION
4	1960-1970	Environmental samples shipped from Bikini thru HAFB to LL lab. Only material routed back thru HAFB during testing was tech. data (film & documents). Wash racks at Barber's Point Naval Air Station proposed sites for washing weapons testing observation aircraft.
5	1980-82	While use of Fort Kam dump Navy Public Works Center had no procedures for separating types of wastes transferred there. Wastes consisted of both domestic and industrial wastes. Operating procedures call for all radioactive materials to be shipped to mainland facilities for disposal.
5	1945-74	In charge of procedures for disposal of solid and chemical wastes from shops. No connection with instrument shop. All condemned were turned into HAFB.
5	1962-82	1962 weapons assembly building construction at Barber's Point. After building was completed about 6 each B-57's (Camberra) were used to collect samples of fallout cloud and park at Barber' Point and did some washing in fro of hangar at Barber's Point. No aircraft washed at HAFB.
5	1963-82	SOP for disposal of photographic wastes. End of base sewage system. The area was used as general area for leaching of sanitary and photographic wastes.
5	1974-82	Interviewee has no idea of what happened to packages returning from "Down under". None disposed of at HAFB as long as he has been there.

RECORDS SEARCH - PROJECT NO. HIC82-9074

CATEGORY OF INTEREST CODE	INCLUSIVE DATES	DESCRIPTION
5	1980-82	Tri-service dump closed; started using Pearl City sanitary landfill. Waste is from housing area. Shipyard refuse taken care of by PWC.
6	1980-82	No weapons maintenance being conducted on this base.
7	1974-82	Aerospace shops have a limited role in crash recovery. Interviewee says there has never been an actual Broken Arrow that his people have been involved in.
7	1980-82	No Broken Arrow incidents on HAFB (Broken Arrow incident involves the loss or destruction of a nuclear device).

APPENDIX I

Hazard Assessment Rating Methodology

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

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

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

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

The first site rating model was developed in June 1981 at a meeting with representatives from 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 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering Science, and 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.

Site scores are developed using the appropriate ranking factors according to the method presented in the flow chart (Figure 1). The site rating form is provided in Figure 2 and the rating factor guidelines are provided in Table 1.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination the waste and its characteristics, 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 ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence 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 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste managment practices category factor to the sum of the scores for the other three categories.

FIGURE 1

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART

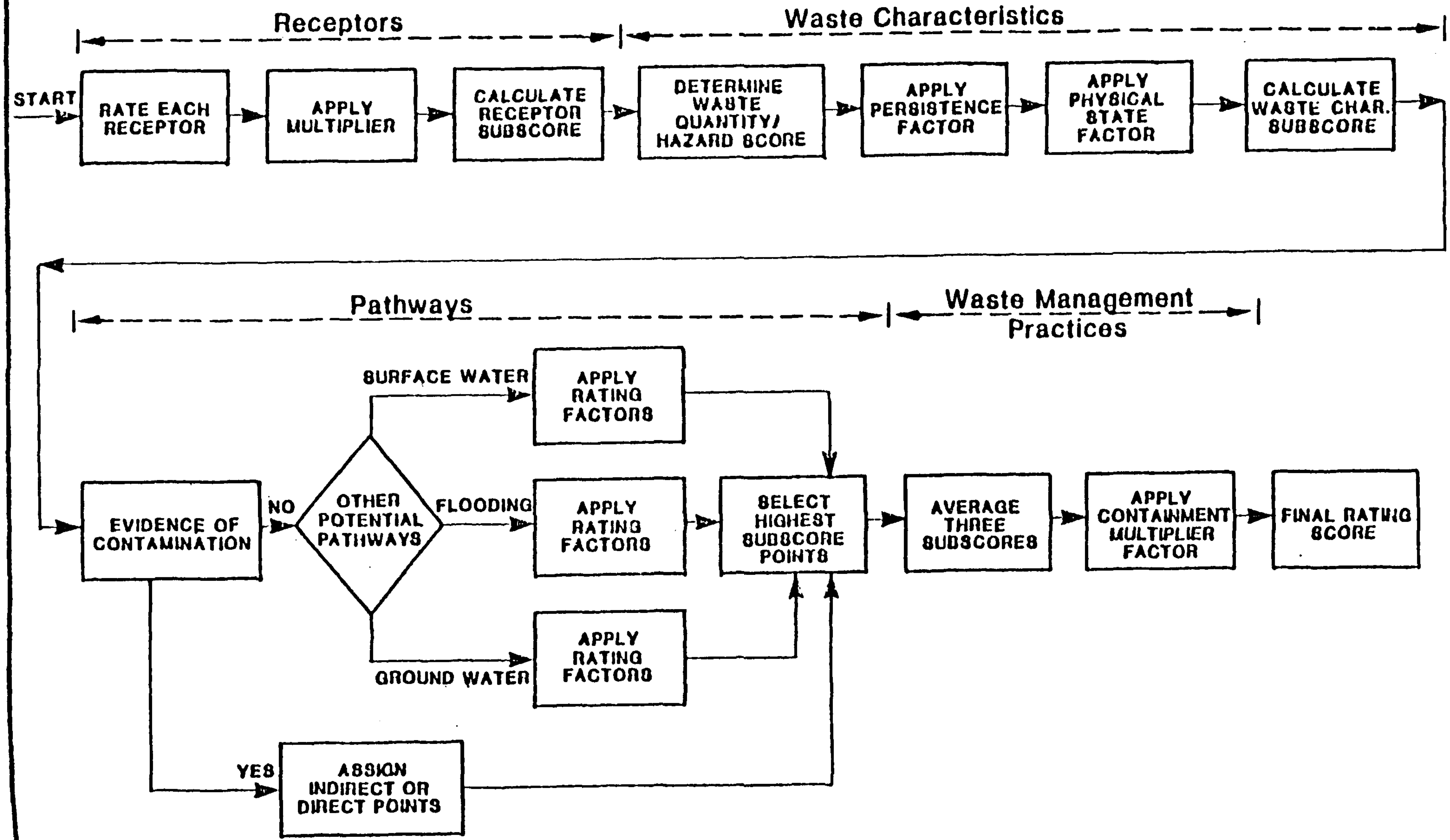

FIGURE 2

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE ______

LOCATION ______

DATE OF OPERATION OR OCCURRENCE ______

OWNER/OPERATOR ______

COMMENTS/DESCRIPTION ______

SITE RATED BY ______

I. RECEPTORS

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

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

II. WASTE CHARACTERISTICS

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

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

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

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

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

III. PATHWAYS

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

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

Subscore ______

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

1. Surface water migration

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 ______

IV. WASTE MANAGEMENT PRACTICES

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

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = [ ]

TABLE 1

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	3
D. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	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 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

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.
- o Based on the above, a determination of the types and quantities of waste disposed of at the site.

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

Hazard Category	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

TABL (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

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

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:
Confidence Level
- o Confirmed confidence levels (C) can be added
- o Suspected confidence levels (S) can be added
- o Confirmed confidence levels cannot be added with suspected confidence levels

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

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

B. Persistence Multiplier for Point Rating

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

C. Physical State Multiplier

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

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

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 Factor	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 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	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-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8

B-2 POTENTIAL FOR FLOODING

Rating Factor	0	1	2	3	Multiplier
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION

Rating Factor	0	1	2	3	Multiplier
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	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
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 below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures.	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

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 Proection 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 J

Waste Site Ratings

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site 1 (Landfill)

LOCATION South of Sewage Treatment Plant off Gulch Runway

DATE OF OPERATION OR OCCURRENCE 1920's and 1930's

OWNER/OPERATOR Wheeler AFB

COMMENTS/DESCRIPTION

SITE RATED BY CAM

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	2	10	20	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	1	9	9	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	110	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 61

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) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

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

30 x 0.8 = 24

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

24 x 0.75 = 18

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 30 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.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
		Subtotals	62	108
Subscore (100 X factor score subtotal/maximum score subtotal)				57
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	0	8	0	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	30	114
Subscore (100 x factor score subtotal/maximum score subtotal)				26

C. Highest pathway subscore.

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

Pathways Subscore 57

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	61
Waste Characteristics	18
Pathways	57
Total 136 divided by 3 =	45
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

45 x 1.0 = 45

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site 2 (Gulch Runway Dump)
LOCATION Northeast Corner of Gulch Runway
DATE OF OPERATION OR OCCURRENCE 1940's
OWNER/OPERATOR Wheeler AFB
COMMENTS/DESCRIPTION CAM
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	0	4	0	12
B. Distance to nearest well	1	10	10	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	1	9	9	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			94	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 52

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 0.75 = 34

III. PATHWAYS

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

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

Subscore ______

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall 3 intensity	3	8	24	24
		Subtotals	62	108

Subscore (100 X factor score subtotal/maximum score subtotal) 57

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

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	0	8	0	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	30	114

Subscore (100 x factor score subtotal/maximum score subtotal) 26

C. Highest pathway subscore.

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

Pathways Subscore 57

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	52
Waste Characteristics	34
Pathways	57

Total 143 divided by 3 = 48 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

48 x 1.0 = 48

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site 3 (Kunia Gate Dump)

LOCATION Wheeler AFB, West of Kunia Gate

DATE OF OPERATION OR OCCURRENCE 1950-1974

OWNER/OPERATOR Wheeler AFB

COMMENTS/DESCRIPTION

SITE RATED BY CAM

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	1	9	9	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	128	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 71

II. WASTE CHARACTERISTICS

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

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

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

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

70 x 1.0 = 70

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

70 x 1.0 = 70

III. PATHWAYS

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

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 30 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	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
		Subtotals	62	108

Subscore (100 X factor score subtotal/maximum score subtotal) 57

2. Flooding

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

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	0	8	0	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	30	114

Subscore (100 x factor score subtotal/maximum score subtotal) 26

C. Highest pathway subscore.

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

Pathways Subscore 57

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	71
Waste Characteristics	70
Pathways	57

Total 198 divided by 3 = 66 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

66 x 1.0 = 66

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site 4 (Fire Training Area)

LOCATION Wheeler AFB near center of base off Airdrome Road

DATE OF OPERATION OR OCCURRENCE 1950-1980

OWNER/OPERATOR Wheeler AFB

COMMENTS/DESCRIPTION

SITE RATED BY CAM

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	2	10	20	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	1	9	9	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

II. WASTE CHARACTERISTICS

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

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

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

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

70 x 0.9 = 63

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

63 x 1.0 = 63

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 30 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	1	8	8	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
Subtotals			46	108

Subscore (100 X factor score subtotal/maximum score subtotal) 43

2. Flooding

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

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	0	8	0	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
Subtotals			30	114

Subscore (100 x factor score subtotal/maximum score subtotal) 26

C. Highest pathway subscore.

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

Pathways Subscore 43

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	64
Waste Characteristics	63
Pathways	43

Total 170 divided by 3 = 57
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

57 x 1.0 = 57

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site 5 (Air Craft Parking Area/Wash Rack)

LOCATION West of Building 829

DATE OF OPERATION OR OCCURRENCE NA

OWNER/OPERATOR Wheeler AFB

COMMENTS/DESCRIPTION

SITE RATED BY CAM

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	1	9	9	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			126	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 70

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) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

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

30 x 0.9 = 27

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

27 x 1.0 = 27

III. PATHWAYS

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

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

Subscore ______

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
		Subtotals	54	108

Subscore (100 X factor score subtotal/maximum score subtotal) 50

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

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	0	8	0	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	30	114

Subscore (100 x factor score subtotal/maximum score subtotal) 26

C. Highest pathway subscore.

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

Pathways Subscore 50

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	70
Waste Characteristics	27
Pathways	50

Total 147 divided by 3 = 49 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

49 x 1.0 = 49

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site 6 (Aircraft Parking Area)
LOCATION South of instrument runway
DATE OF OPERATION OR OCCURRENCE NA
OWNER/OPERATOR Wheeler AFB
COMMENTS/DESCRIPTION
SITE RATED BY CAM

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	2	10	20	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	1	9	9	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

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 0.8 = 40

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

40 x 1.0 = 40

III. PATHWAYS

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

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

Subscore ______

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	1	6	6	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
		Subtotals	54	108

Subscore (100 X factor score subtotal/maximum score subtotal) 50

2. Flooding | 0 | 1 | 0 | 3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	0	8	0	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	30	114

Subscore (100 x factor score subtotal/maximum score subtotal) 26

C. Highest pathway subscore.

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

Pathways Subscore 50

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	64
Waste Characteristics	40
Pathways	50

Total 154 divided by 3 = 51 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

51 x 1.0 = 51

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Site 7 (Sanitary Sewer System)

LOCATION Along Santos Dumont Street Manhole 6 to Manhole 4

DATE OF OPERATION OR OCCURRENCE NA

OWNER/OPERATOR Wheeler AFB

COMMENTS/DESCRIPTION

SITE RATED BY CAM

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	2	10	20	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	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	1	9	9	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	122	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 68

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) M

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 for direct evidence or 30 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	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
		Subtotals	54	108

Subscore (100 X factor score subtotal/maximum score subtotal) 50

2. Flooding

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

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	0	8	0	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	30	114

Subscore (100 x factor score subtotal/maximum score subtotal) 26

C. Highest pathway subscore.

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

Pathways Subscore 50

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	68
Waste Characteristics	36
Pathways	50

Total 154 divided by 3 = 51 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

51 x 1.0 = 51

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