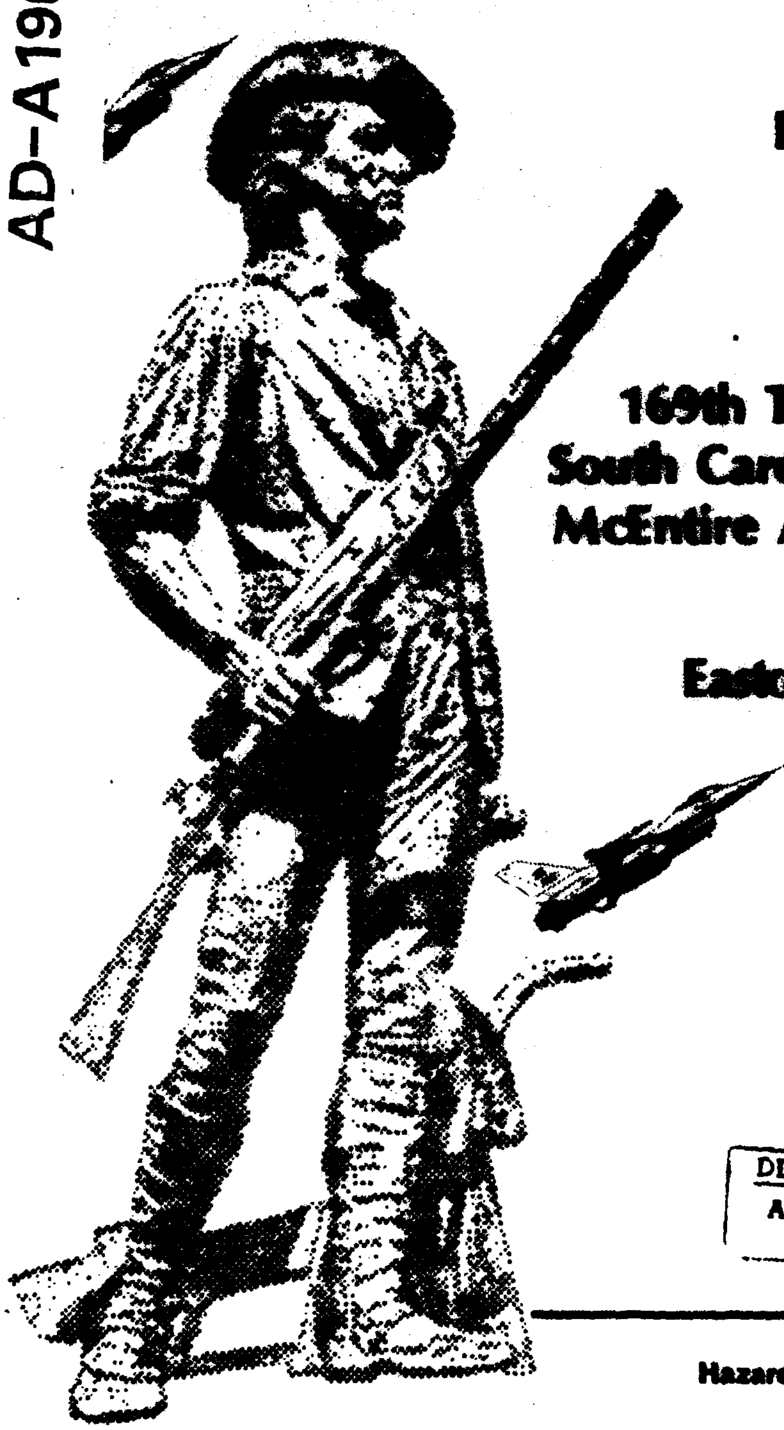
INSTALLATION RESTORATION PROGRAM



Records Search

169th Tactical Fighter Group
South Carolina Air National Guard
McEntire Air National Guard Base

Eastover, South Carolina

Hazardous Materials Technical Center
January 1984

NOTICE

This report has been prepared for the United States Air National Guard by the Hazardous Materials Technical Center 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, the Air National Guard, or the Department of Defense.

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INSTALLATION RESTORATION PROGRAM
RECORDS SEARCH

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Prepared for

169th TACTICAL FIGHTER GROUP
SOUTH CAROLINA AIR NATIONAL GUARD
McENTIRE AIR NATIONAL GUARD BASE
EASTOVER, SOUTH CAROLINA

Prepared by

THE HAZARDOUS MATERIALS TECHNICAL CENTER
P.O. BOX 8168
ROCKVILLE, MD 20856-8168

January 1984

Contract No. DLA900-82-C-4426

88 6 1 101

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

A. Introduction

1. The Hazardous Materials Technical Center (HMTC) was retained on September 8, 1983, to conduct the McEntire Air National Guard (ANG) Base Records Search under Contract No. DLA900-82-C-4426, with funds provided by the Air National Guard (ANG).

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

3. To implement the DOD policy, a four-phase Installation Restoration Program (IRP) has been directed. Phase I, the Records Search, is the identification of potential problems. Phase II (not part of this contract) consists of follow-on field work to determine the extent and magnitude of contaminant migration. Phase III (not part of this contract) consists of development of any required new technology to abate unique contamination problems. Phase IV (not part of this contract) includes those efforts to evaluate alternatives for remedial actions and any efforts required to control identified hazardous conditions.

4. The McEntire ANG Base Records Search included a detailed review of pertinent installation records, contacts with 12 government organizations for documents relevant to the Records Search effort, and an onsite base visit conducted by HMTC during September 19-22, 1983. Activities conducted during the onsite base visit included interviews with 23 past and present base employees, ground tours of base facilities, detailed search of base records, and meetings with personnel from several South Carolina State agencies in Columbia, South Carolina.

B. Major Findings

1. The major industrial operations at the McEntire ANG Base include: the Pneudraulics Shop; the Corrosion, Machine, Structural Repair, and Welding Shops; the Engine Shop; Flight Line and Base Flight Shops; Tire Repair and Reclamation Shop; the Paint Shop, and the Motor Pool. These operations generate varying quantities of waste oils, recovered fuels, and spent solvents and cleaners.

2. Various mechanisms for disposal of the waste materials generated by these shops have existed in the past. These include disposal via the Defense Property Disposal Office (DPDO), service contracts with off-base facilities, neutralization of the wastes and discharge to the wastewater drainage system, burning and burial in the on-base landfill, discharge to the sanitary sewage treatment plant, and burning at the various Fire Department Training Areas. Since 1980, the majority of all waste has been disposed of via DPDO, contract with off-base facilities, or at Fire Department Training Area No. 5.

3. Interviews with 23 previous and present base employees and a field survey resulted in the identification of 12 past disposal and/or spill sites at McEntire ANG Base. Of these 12 sites, 6 have been determined to have the potential for contaminant migration and, therefore, have been further evaluated using the Air Force's Hazard Assessment Rating Methodology (HARM). The following table presents a priority listing of these waste disposal and spill sites and their associated hazard assessment scores.

			Subscores				
Priority	Site No.	Site Description	Receptors	Waste Characteristics	Pathway	Waste Mgmt. Practices	Overall Score
1st	2	No. 5 Fire Training Area	49	90	67	1.00	69
2nd	1	No. 1 Fire Training Area	53	80	67	1.00	67
3rd	3	Sanitary Landfill	53	54	72	0.95	57
4th	4	Y-Area Storage Site	49	54	74	0.95	56
5th	5	Oil Dump Site	53	40	74	1.00	56
6th	6	C-141 Spill	49	48	74	0.95	54

4. Based on an evaluation of these sites, four general locations have been identified where groundwater* monitoring is recommended, as illustrated in the figure on page ES-7.

C. Conclusions

1. Information obtained through interviews with 23 past and present base personnel, review of base records, and field observations indicate that small quantities of hazardous wastes have been disposed of on McEntire ANG Base property.

2. No evidence of off-base environmental stress was observed, resulting from either past waste disposal practices or waste spillage at McEntire ANG Base. Minor on-base environmental stress in the form of discolored soil and stunted grasses was observed at sites 2, 4, and 6.

3. No direct or indirect evidence of groundwater contamination was discovered. However, the close proximity of several of the disposal/spill sites to one another and their close proximity to a shallow subsurface gravel aquifer along the western boundary of the base results in a moderate potential that trace concentrations of organic fuels and solvents may migrate off base and subsequently discharge into Cedar Creek via groundwater movement through the shallow gravel aquifer.

4. The identified waste disposal/spill sites are confined to a relatively small area of McEntire ANG Base and are generally aligned in directions nearly parallel to the anticipated direction of shallow groundwater flow. Therefore, the probability is high that, if contamination from these sites has reached the shallow ground water, the total land-surface area below which the ground water is contaminated will be small. Further, because the shallow aquifer discharges to Cedar Creek it is extremely unlikely that any off-base domestic wells which draw water from the shallow aquifer

*In this document, "ground water" is two words when it appears as a noun, and is one word when it appears as a unit modifier.

will have become contaminated, even if the on-base shallow aquifer has received contaminants. Most off-base wells draw water from the deep, rather than the shallow aquifer, thereby diminishing their likelihood of contamination.

5. It is highly unlikely that any of the aforementioned base activities have resulted in contamination of any off-base ground water supplies which are obtained from the deep aquifer.

6. Rather than monitoring each of the six spill/disposal sites previously identified, only four monitoring locations requiring four wells each are initially recommended for monitoring. The basis for this recommendation is the relatively close proximity of sites 1 and 3, and sites 4 and 6.

D. Recommendations

The overall hazard potential resulting from previous disposal practices and spills at McEntire ANG Base is relatively low; however, the existing potential for contaminant migration necessitates monitoring of selected areas. Four locations are recommended where shallow groundwater monitoring wells should be installed. The primary purposes for these wells are to:

- Determine whether the shallow gravel aquifer is present under the area of investigation and, therefore, whether the potential for subsurface migration of contamination at the monitored area exists.
- If the gravel aquifer is present, facilitate analysis of the shallow ground water under and down-gradient of the site.
- Determine the direction and rate of contaminant migration if the shallow gravel aquifer is present, and if it is contaminated.

Four locations are recommended where shallow groundwater monitoring wells should be installed. The first location to be monitored is in the vicinity of disposal/spill sites 1 and 3, which are, respectively, the No. 1 Fire Department Training Area and the sanitary landfill. The center of this monitoring location is approximately 600 feet northwest of the westernmost extent of Mississippi Road. The second location is at site

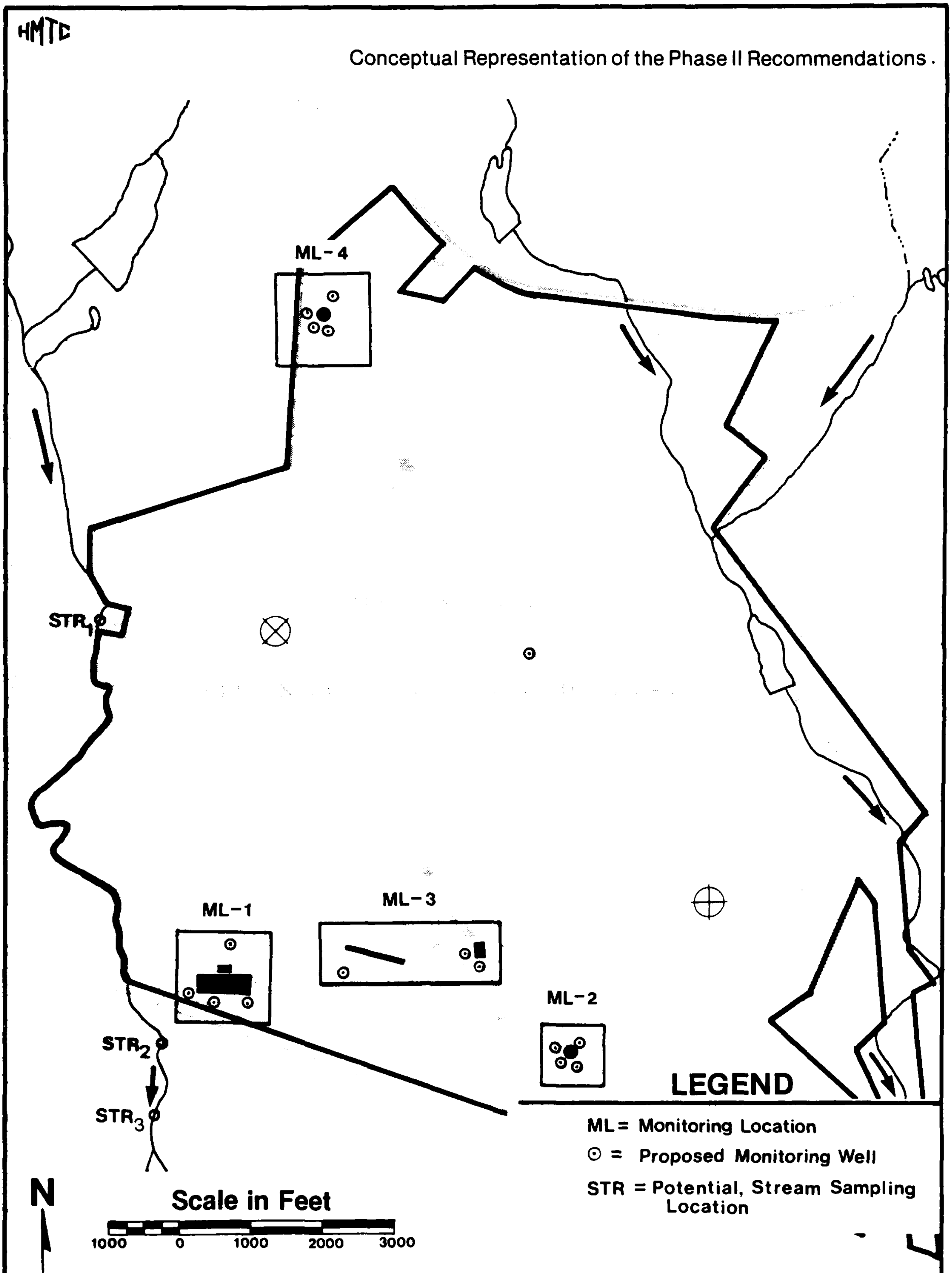
No. 2, which is the No. 5 Fire Department Training Area. The center of this monitoring location is approximately 600 feet southeast of the Munitions/ Weapons facility (Building No. 257). The third location is at site No. 4, which is the Y-Area Waste Storage Site. This monitoring location is approximately coincident with the area near the intersection of Mississippi Road and South Carolina Road. The fourth location is at site No. 5, which is the oil dump site. This monitoring location is near the extreme northern boundary of McEntire ANG Base, at the end of the service road along which on-base housing was located.

At each of these locations to be monitored, it is anticipated that four monitoring wells will be necessary. Three of these wells should be installed down-gradient of the suspected waste disposal/spill site(s) and one should be located up-gradient.

Each well should be carefully logged during drilling so that the locations of the shallow subsurface gravels can be determined. If the gravel is present, it is expected that it will occur at a depth of from 20 to 50 feet below surface and have a thickness of from 6 inches to 15 feet. Well screens for the monitoring wells should be placed at elevations coincident with the gravel layers.

If this gravel is not present, the monitoring well should be extended to the depth necessary to intersect and screen the confined sandy aquifers of the Tuscaloosa Formation. This depth is likely to be from 80 to 160 feet below surface. The annular space for all monitoring wells must be sealed to prevent downward migration of potential contaminants along the monitoring well casings.

Ground water from each screened interval for all wells should be collected and analyzed for volatile organic carbon species, oil and grease, total organic halogens, phenols, and heavy metals. If the results of analysis of water samples from the shallow gravel aquifer are positive, then surface water samples should be collected from Cedar Creek. These surface water samples should also be analyzed for the above constituents to determine whether offsite migration of contaminants is occurring. If the results of analysis of water samples from the sandy portions of the Tuscaloosa Formation are positive, then water samples from the McEntire ANG Base wells and off-base domestic wells near the base boundary should be analyzed for the above constituents.


HMTC
Conceptual Representation of the Phase II Recommendations.
ML-4
STR1
ML-1
ML-3
ML-2
STR2
STR3
LEGEND
ML= Monitoring Location
⊙ = Proposed Monitoring Well
STR = Potential, Stream Sampling Location
N
Scale in Feet
1000
0
1000
2000
3000

I. INTRODUCTION

I. INTRODUCTION

A. Background

The South Carolina Air National Guard (SCANG) fulfills a vital role of defense by training and maintaining the 169th Tactical Fighter Group at a combat readiness level commensurate with the needs of the Tactical Air Command. This involves over 5,000 flying hours of intensive training each year for aircrews. Additionally, the 240th Combat Communications Squadron maintains combat readiness for world-wide commitment to the Air Force Communications Command. Both units are also on call to the State of South Carolina in time of emergency. Full-time preparedness to discharge these responsibilities necessitates that SCANG be engaged in a variety of operations, some of which involve the use of toxic and hazardous materials.

In 1975, DOD began its IRP to assess past activities on DOD installations related to storage and disposal of toxic and hazardous materials. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous materials disposal sites and to control hazards to health and welfare that may have resulted from these past activities.

Subsequent to the initiation of DOD's IRP, Congress created the Resource Conservation and Recovery Act (RCRA) of 1976 as the primary means of governing disposal of hazardous wastes. Under Sections 3012 and 6003 of the act, Federal agencies, such as DOD, are directed to assist the U.S. Environmental Protection Agency (EPA) and state agencies to inventory past disposal sites and to make the information available to the requesting agencies. Similarly, Congress created the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 for the purpose of assessing and alleviating the negative health and environmental impacts resulting from uncontrolled hazardous waste dump sites. On August 14, 1981, in Executive Order 12316, the President delegated certain authority specified in CERCLA to the Secretary of Defense. The current DOD IRP policy is contained in DEQPPM 81-5 dated 11 December 1981. DEQPPM 81-5 reissued and amplified all previous directives and memoranda regarding the IRP such that the IRP is presently in compliance with the requirements of RCRA and CERCLA.

To conduct the IRP Hazardous Materials Disposal Sites Records Search for McEntire ANG Base, HMTC was retained on September 8, 1983, under Contract DLA900-82-C-4426 with funds provided by the ANG.

The Records Search comprises Phase I of the DOD IRP and is intended to review installation records to identify possible hazardous waste-contaminated sites and to assess the potential for contaminant migration from the installation. Phase II (not part of this contract) consists of follow-on field work recommended in Phase I. Phase II consists of a preliminary survey to confirm or rule out the presence and/or migration of contaminants and, if necessary, additional field work to determine the extent and magnitude of the contaminant migration. Phase III (not part of the contract) consists of development of any required new technology to abate unique contamination problems. Phase IV (not part of this contract) includes those efforts to evaluate alternatives for remedial actions and any efforts required to control identified hazardous conditions.

B. Authority

The identification of hazardous material disposal sites at Air Force installations was directed by 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 Air Force installations with existing environmental regulations. The identification of hazardous material disposal sites at selected ANG Bases/Installations was directed by the Civil Engineering Division in a letter from the Air Directorate NGB/DE dated 18 March 1981.

C. Purpose

The purpose of the Phase I Records Search is to identify and evaluate suspected problems associated with past hazardous materials handling procedures, disposal sites, and spill sites on DOD facilities. The existence and potential for migration of hazardous material contaminants was evaluated at McEntire ANG Base by reviewing existing environmental information, analyzing installation records, and conducting interviews with past and present employees at McEntire ANG Base. Pertinent information includes the history of operations, with special emphasis on past hazardous materials management procedures, the geological and hydrogeological conditions that may facilitate migration of the suspected contaminants, and the ecological settings that indicated environmentally sensitive habitats or evidence of environmental stress.

D. Scope

The scope of this Records Search phase of the McEntire IRP included:

- Preperformance meeting
- Onsite base visit
- Meeting with personnel from various agencies of the State of South Carolina
- Review and analysis of all information obtained
- Report preparation
- Preparation of report to include recommendations for further action.

The preperformance meeting was held at HMTC's office in Rockville, Maryland, on September 8, 1983. Present at this meeting were representatives of the Air National Guard Support Center (ANGSC), Defense Logistics Agency (DLA), McEntire ANG Base, and HMTC. The purpose of this preperformance meeting was to review the intent and requirements of the Records Search phase of the IRP, to clarify the responsibilities of the involved parties, and to exchange preliminary background data pertinent to McEntire ANG Base.

The onsite visit and meetings with South Carolina State Agency personnel were conducted during the period September 19-22, 1983. The titles of the government agencies are summarized in Appendix A . The HMTC Records Search Team consisted of the individuals listed below. Appendix B contains the resumes of these team members:

1. Mr. Torsten Rothman, P.E., Project Manager (M.S. Environmental Health Engineering, 1969)
2. Mr. William Eaton, Hydrogeologist (M.S. Environmental Sciences, 1983)

3. Mr. Jan Scopel, Chemical Engineer (B.S. Chemical Engineering, 1979)

4. Mr. Marcus Peterson, Ecologist (M.S. Water Resources Management, 1983)

Individuals from the ANG who assisted in the McEntire ANG Base Records Search included:

1. Mr. Harold E. Lindenhofen, ANGSC, ANG Program Manager, IRP (M.S. Chemistry, 1970)

2. Captain James R. Berry, McEntire ANG Base, Base Civil Engineer

3. Lieutenant Zollie Green, McEntire ANG Base, Deputy Base Civil Engineer

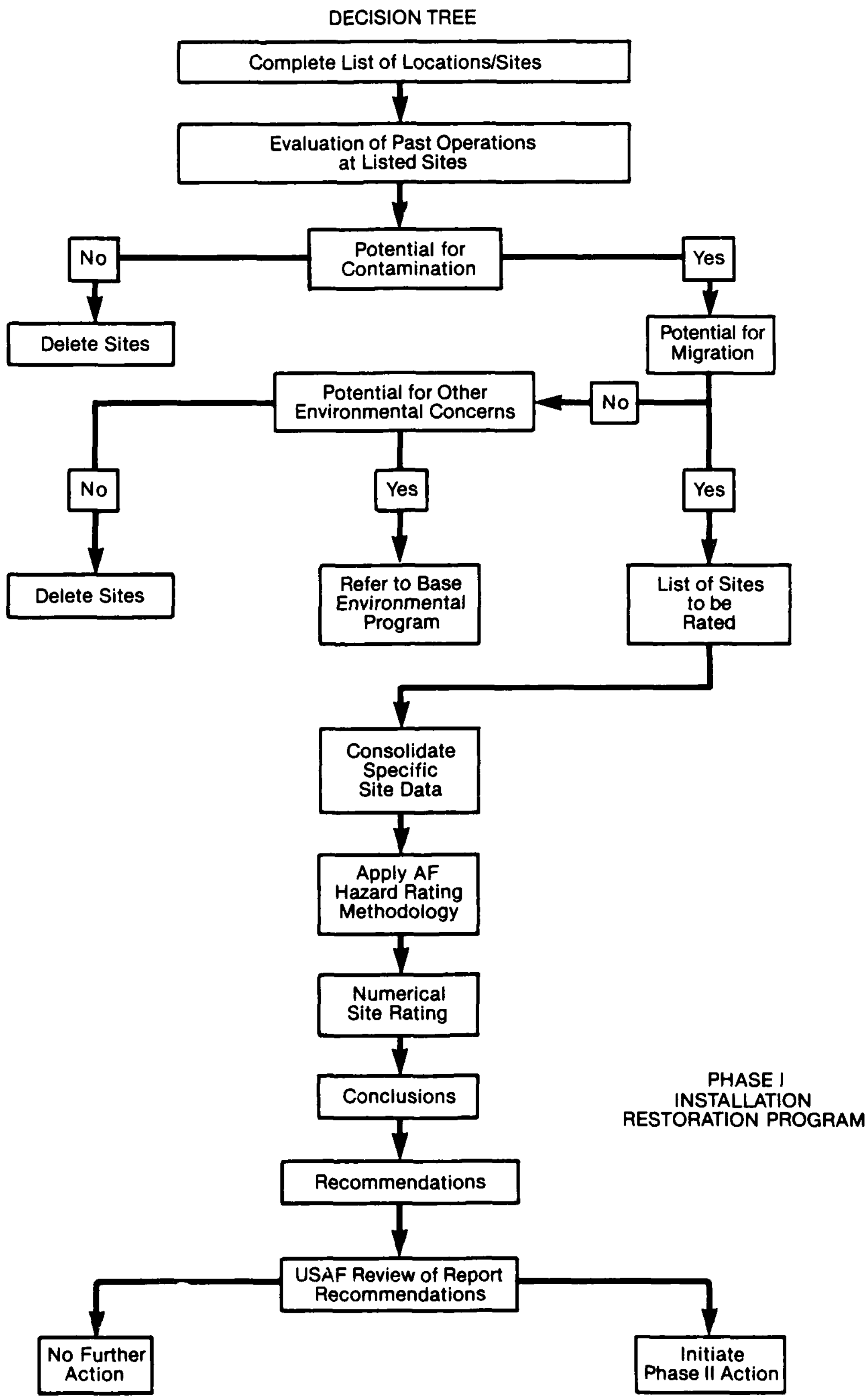
E. Methodology

Figure 1 is a flow chart of the Records Search methodology utilized in the present study. Such a guideline helped to ensure a thorough and objective evaluation. The evaluation began by identifying all sites or locations on McEntire ANG Base where hazardous materials were used. Subsequently, an evaluation of past and present operating procedures at the identified sites/locations was made to determine whether or not environmental contamination may have occurred.

Identification of hazardous materials sites/locations and evaluation of the contamination potential was facilitated by extensive interviews with past and present base employees familiar with the various operating areas of the base. Appendix C lists the identification numbers of the 23 people interviewed, their principal areas of knowledge, and their years of experience at the installation. Additionally, historic blueprints of the base and available records contained in shop files and real property files were reviewed as a means to supplement information obtained from the interviews. A general ground tour of identified sites was made by the Records Search Team to gather site-specific information helpful for determining the potential for contamination and contaminant(s) migration. Such information included presence of nearby drainage ditches or surface-water bodies and contamination or leachate migration.

If an activity was identified that indicated a potential to have contaminated the environment, then the site/location where this activity took place was evaluated to determine the potential for migration of the contaminant(s). Using the first 3 steps in Figure 1, 6 of the original 12 sites were eliminated from further consideration. Those sites characterized as having the potential for contaminant(s) migration were assessed in detail, using the USAF Hazard Rating Methodology, as described in Appendix D. The site rating indicates the relative potential for environmental impact at each site. For those sites showing a significant potential, recommendations were made to quantify the potential contaminant migration problem under Phase II of the IRP.

FIGURE 1.
Records Search Methodology Flow Chart.



II. INSTALLATION DESCRIPTION

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A. Location and Size

McEntire ANG Base is located approximately 12 miles east of Columbia, SC, in Richland County. The Greater Columbia area, with a population of over 300,000, has expanded eastward to approximately nine miles from the base boundary. McEntire consists of 2,387 acres at an elevation of 251 feet above sea level, with the airfield at approximately 33°55' N latitude and 80°48' W longitude.

A regional locator map that indicates the location of McEntire ANG Base within Richland County, SC, is presented in Figure 2, and vicinity and site maps are provided in Figures 3 and 4, respectively.

B. Organization and History

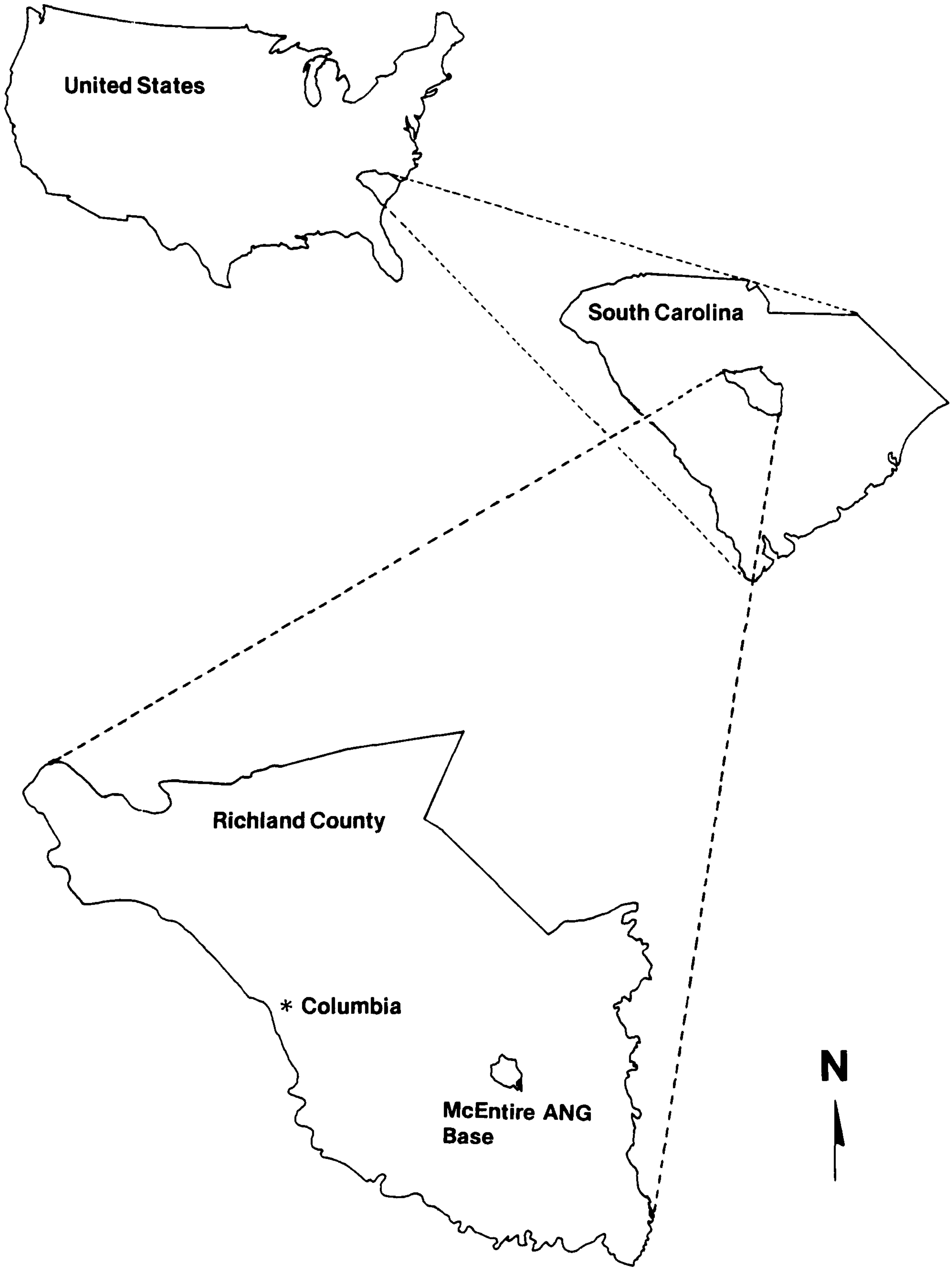
The land area now known as McEntire ANG Base was purchased by the Federal Government in 1941. Congaree Army Air Field, as it was then designated, was constructed in 1941-42, primarily for use as an attack fighter training field for the U.S. Army Air Corps.

The field was transferred to the Navy Department on July 1, 1944, and was designated Congaree Air Base. The base was operated by the U.S. Marine Corps as an advanced fighter training base until the spring of 1946 when the field was placed on inactive status. The Navy Department issued the State of South Carolina an operator's permit in October 1946. The base was transferred by the Navy Department to the U.S. Air Force on November 8, 1955. The base was renamed Congaree Air National Guard Base in April 1960 and redesignated McEntire National Guard Base on October 16, 1961. The South Carolina Air National Guard has had control of the base since October 1946.

The airfield complex consists of three runways; one is 9,000 feet and two are 4,500 feet each in length. Original structures remaining and the newly constructed facilities are used for either operations, maintenance, or training and are fully occupied and in use. The base has no community support facilities, base housing, or full-time messing or billeting facilities.

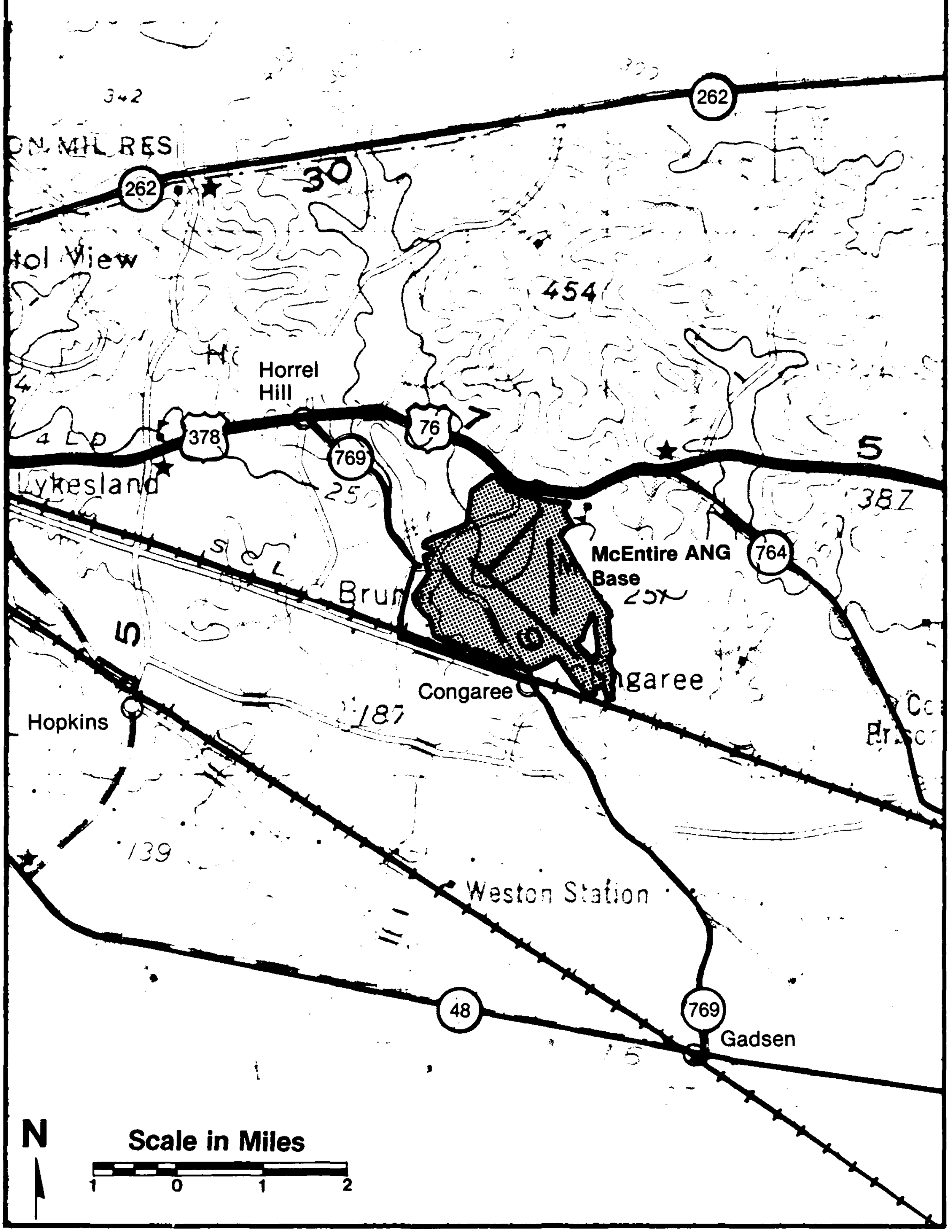
HMTC

FIGURE 2.
Location of McEntire ANGB Within Richland County, South Carolina.



HMTC

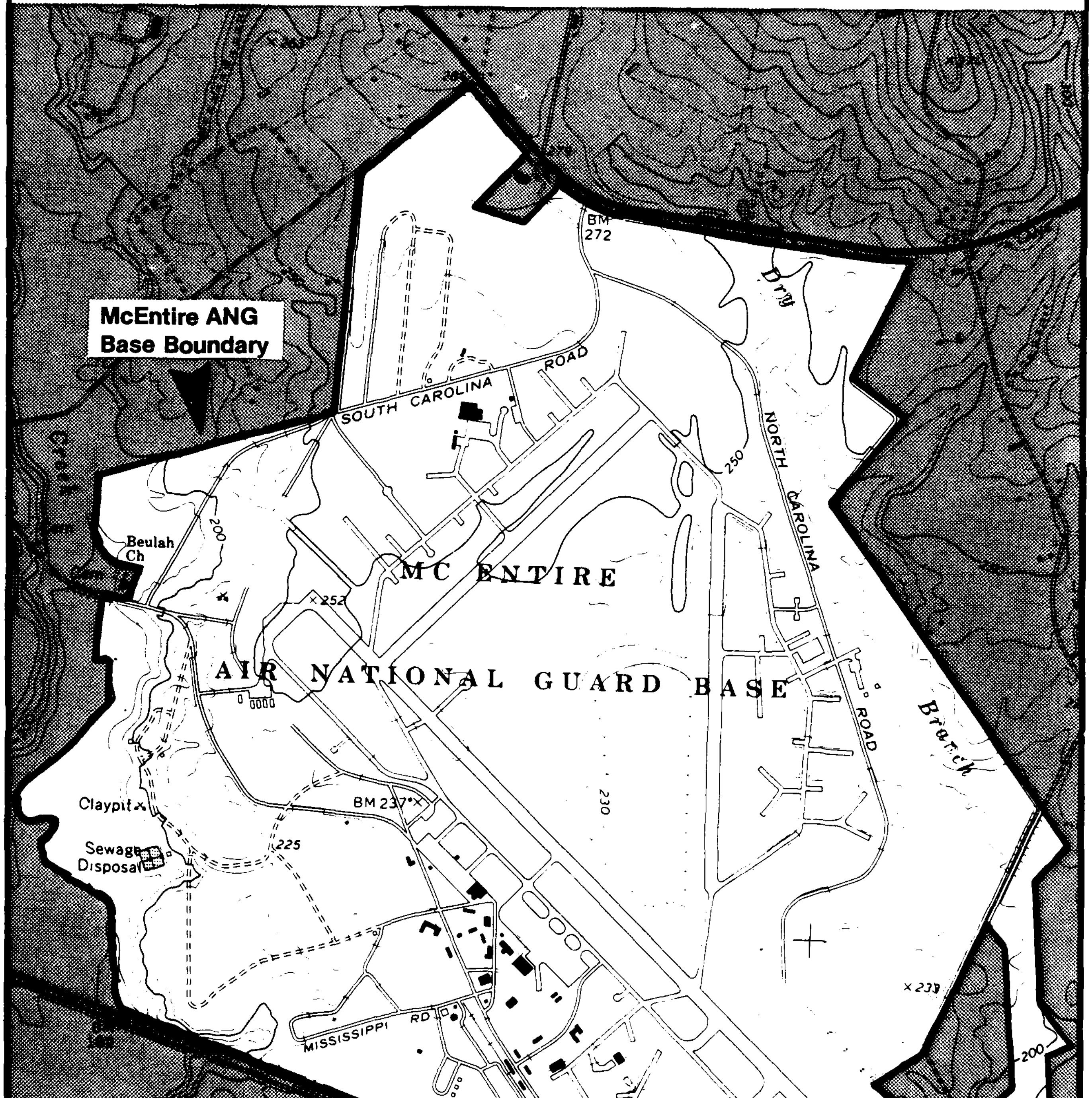
FIGURE 3.
Vicinity Map of McEntire ANGB.



Source: United States Geological Survey (U.S.G.S.)

HMTC

FIGURE 4.
Site Map of McEntire ANGB.



Source: U.S.G.S.

Fort Jackson, an Army installation located within the confines of the City of Columbia, and McEntire ANG Base are the two largest military installations in the Columbia area. Further details of the history of McEntire ANG Base are presented in Appendix K.

C. Mission

McEntire ANG Base is one of the six airbases wholly maintained and operated by the ANG. Currently, McEntire ANG Base is the home of the SCANG and serves as host for several small units. Army National Guard Aviation occupies portions of the base. The base also serves other Air Guard units, which use the air-ground gunnery range located 12 miles east of the base. U.S. Air Force aircraft from Shaw Air Force Base use the base as a transition field for practice landings and takeoffs. In addition, McEntire ANG Base provides transient aircraft services to the Columbia and Fort Jackson area.

The host unit for the McEntire ANG Base is the 169th Tactical Fighter Group. The mission of this unit is to train a tactical fighter squadron and associated units to readiness for recall and immediate deployment in a Tactical Air Command fighter-bomber combat role. The base supports a normal contingent of 24 assigned tactical fighters and has recently converted its primary mission aircraft from the A-7D Corsair II to the F-16 "Fighting Falcon." SCANG also has a twin-engine C-131 support aircraft used for passenger and other executive transport. Other mission aircraft regularly assigned to McEntire ANG Base include the UH-1, OH-58, U-8, Cessna 150, and Cessna 172.

Day-to-day operation of SCANG is conducted for the most part by 250 to 300 Air Guard Technicians supplemented by active-duty personnel and state employees. The technicians are a highly skilled, permanent force that provides a source of expert training instructors and a means of maintaining continuity in the periods between Unit Training Assemblies (UTAS). The sole purpose of the technician force is to work full-time in helping the host unit achieve and maintain combat readiness and rapid mobilization capability. State employees support the day-to-day maintenance and security of all base facilities.

The host unit operates and maintains the installation and provides support for the following tenant units:

Headquarters, South Carolina Air National Guard - Approval of overall policies and training for all organizations of SCANG.

240th Air Traffic Control Flight - To attain and maintain an optimum effective capability to install, operate, and maintain air traffic control and navigational aid facilities in support of USAF operations, according to gaining command plans for utility in a national emergency.

240th Combat Communications Flight - To attain and maintain effective capability to install, operate, and maintain mobile communications in support of USAF operations, according to gaining command plans for utility in a national emergency.

Det 4 OLA 3rd Weather Squadron - To provide continuous meteorological watch service 24 hours/day, 7 days/week for weather observations and weather warning service to McEntire ANG Base.

Army Aviation Support Facility - Provides flight operation and maintenance support for all Army National Guard aircraft and provides proficiency training for Army National Guard aircrews.

51st Aviation Assault Company - Trains aircrews in operational support of Army units upon mobilization.

Fort Jackson Aero Club - Provides flight training for all members of a certified aero club. Provides maintenance on all club aircraft.

III. ENVIRONMENTAL SETTING

III. ENVIRONMENTAL SETTINGS

A. Meteorology

The climate in the area of McEntire ANG Base is generally classified as mild subtropical; therefore, summers tend to be hot and winters mild. Weather that is either extremely hot or cold is usually of short duration. According to the data presented in Table 1, the maximum and minimum temperatures observed each year and averaged over all years of observation for the vicinity of McEntire ANG Base are 75.4 and 51.5° F, respectively. The occasional short periods of high temperatures usually occur when the Bermuda High moves north, blocking the passage of cold fronts from the north. Similarly, the Blueridge Mountains to the northwest of the area tend to block the southward movement of cold air masses from the north, thereby occasionally encouraging unseasonably warm temperatures. Unseasonably cold temperatures most often occur when the Bermuda High moves to the south, thus allowing the southward migration of cold air masses.

Precipitation averages 46.36 inches per year and almost all of it occurs as rain. No snow falls during 38 percent of the winters. Most rain falls during summer, which is the wettest season. The next wettest season is winter. Most of this precipitation results from low pressure systems that develop over the Gulf of Mexico and track northeastward through the area. Autumn is the driest season; however, a portion of the hurricane season (June through October) occurs during autumn, and, therefore, severe heavy wind and precipitation may occur during this time period. Additional severe thunderstorms, tornados, and heavy precipitation may occur during spring when mixing of Maritime Tropical and Continental Polar air masses near McEntire ANG Base occurs. Maximum 24-hour precipitation is greatest (7.7 inches) during April and is least (2.3 inches) during November. Net precipitation (total precipitation minus evapotranspiration) is less than 20 inches per year.

Prevailing winds at McEntire ANG Base are generally from the southwest. The average annual windspeed is 7.0 miles per hour, although the months of March and April have higher average windspeeds of approximately 8.5 miles per hour.

HMTC

TABLE 1.
Summary of Meteorologic Data for the McEntire ANGB Vicinity.

	Temperature (°F) Normal: Daily Maximum	Daily Minimum	Monthly Average	Precipitation (inches) Water equivalent: Normal	Maximum monthly	Year of occurrence	Minimum Monthly	Year of occurrence	Maximum in 24 hrs.	Year of occurrence	Snow, ice pellets: Maximum monthly	Year of occurrence	Maximum in 24 hrs.	Year of occurrence
(a)					27		27		27		27			
J	56.9	33.9	45.4	3.44	7.62	1972	0.97	1949	2.82	1968	2.2	1973	2.2	1973
F	59.7	35.5	47.6	3.67	8.68	1961	1.12	1950	3.69	1962	16.0	1973	15.7	1973
M	66.5	41.9	54.2	4.67	10.89	1973	1.25	1949	3.59	1960	3.2	1960	2.8	1960
A	76.9	51.3	64.1	3.51	5.89	1958	0.91	1970	3.66	1956	0.0		0.0	
M	84.5	59.6	72.1	3.35	8.85	1967	0.29	1951	5.57	1967	0.0		0.0	
J	90.3	67.2	78.8	3.82	14.81	1973	1.26	1955	5.44	1973	0.0		0.0	
J	92.0	70.3	81.2	5.65	13.87	1959	1.15	1957	5.81	1959	0.0		0.0	
A	91.0	69.4	80.2	5.63	16.72	1949	1.11	1968	7.66	1949	0.0		0.0	
S	85.4	63.5	74.5	4.32	8.78	1953	0.76	1958	6.23	1953	0.0		0.0	
O	77.1	51.3	64.2	2.58	12.09	1959	T	1963	5.46	1964	0.0		0.0	
N	66.9	40.6	53.8	2.34	7.20	1957	0.41	1973	2.30	1963	T	1968	T	1968
D	57.9	34.1	46.0	3.38	7.43	1953	0.32	1955	3.18	1970	9.1	1958	8.8	1958
YR	75.4	51.5	63.5	46.36	16.72	AUG 1949	T	OCT 1963	7.66	AUG 1949	16.0	FEB 1973	15.7	FEB 1973

	Relative humidity (pct): 01 Hour of occurrence	07 Hour of occurrence	13 Hour of occurrence	19 Hour of occurrence	Wind: Mean Speed (m.p.h.)	Prevailing direction	Fastest observed: Speed (m.p.h.)	Direction (bearing)	Year	Mean number of days: Precipitation: .01 inch or more	Snow, Ice pellets: 1.0 inch or more	Thunderstorms	Heavy fog	Temperature °F Max.: 90° and above	Max.: 32° and below	Min.: 32° and below	Min.: 0° and below
(a)	8	8	8	8	26	14	21	21		27	27	27	26	8	8	8	8
J	82	84	57	68	7.1	SW	46	28	1964	10		1	3	0	1	15	0
F	75	81	48	57	7.7	SW	40	10	1966	10		2	2	0		16	0
M	74	83	48	53	8.4	SW	60	27	1954	11		3	2		0	6	0
A	77	84	45	50	8.5	SW	40	27	1961	8	0	4	1	2	0	1	0
M	84	88	59	61	7.1	SW	46	23	1958	9	0	6	1	5	0	0	0
J	88	89	54	63	6.8	SW	40	23	1957	9	0	9	2	14	0	0	0
J	89	91	57	71	6.6	SW	40	35	1965	12	0	14	2	20	0	0	0
A	92	94	60	75	6.0	SW	44	16	1961	11	0	10	2	14	0	0	0
S	93	95	57	76	6.2	NE	38	11	1959	8	0	4	3	8	0	0	0
O	89	92	52	75	6.2	NE	27	21	1968	6	0	1	3		0	1	0
N	84	88	49	71	6.5	SW	35	35	1967	7	0	1	3	0	0	9	0
D	81	86	56	72	6.7	WSW	30	29	1954	9			3	0	0	13	0
YR	84	88	53	66	7.0	SW	60	27	MAR 1954	110	1	54	27	65	1	62	0

Source = Local Climatological Data, Columbia, South Carolina, Revised Data Through 1975.

(a) = Length of record, years, through the current year unless otherwise noted, based on January data.

Note:

1. Means and extremes are from existing and comparable exposures.
2. Normals are based on the record for the interval 1941-1970.

B. Geology

1. Regional Geology

McEntire ANG Base is situated within the Coastal Plain physiographic province. Prior to deposition of the sediments that comprise the Coastal Plain province, the entire region from Columbia, SC, to the Atlantic Ocean was characterized as a relatively featureless plain that sloped gently to the east and was composed primarily of consolidated igneous and metamorphic rock types. During early Cretaceous time (approximately 150 million years ago) continental movements caused this featureless plain to become tilted toward the east with the fulcrum along the present north-south-trending Fall Zone that bisects Columbia, SC. As a result of tilting, a wedge-shaped basin was formed into which sediments derived from erosion of the Blue Ridge Mountain complex to the west could be deposited. It is these sediments that now directly underlie McEntire ANG Base. A study performed by Siple (1959) suggests that the planar bedrock surface on which these sediments rest, slopes toward the east at a rate of approximately 27 feet per mile.

Figure 5 is a regional geologic cross section across approximately 260 miles of North and South Carolina that illustrates the regional geologic setting for McEntire ANG Base and the position of the Coastal Plain sediments east of the Fall Line. Because the Coastal Plain sediments slope toward the east, the oldest sediments (those deposited first) crop out at the surface along the western margin of the Coastal Plain and the younger sediments are present at the surface along the eastern margin of the Coastal Plain.

This effect is illustrated by the regional geologic map of the South Carolina Coastal Plain in Figure 6 , wherein the Tuscaloosa Formation is shown to crop out along the extreme northwestern border of the Coastal Plain. Table 2 provides descriptions of the formations identified in Figure 6. Most of the sediments that underlie McEntire ANG Base are part of the Tuscaloosa Formation. Cooke (1936) describes the Tuscaloosa Formation as being primarily composed of light gray, white, or buff sand, generally cross-bedded with interfingering lenses of white, pink, or purplish clay. Based on the logs of deep borings that penetrate to pre-Cretaceous granite in Sumter County

FIGURE 5.
Regional Geologic Cross-Section of South Carolina.

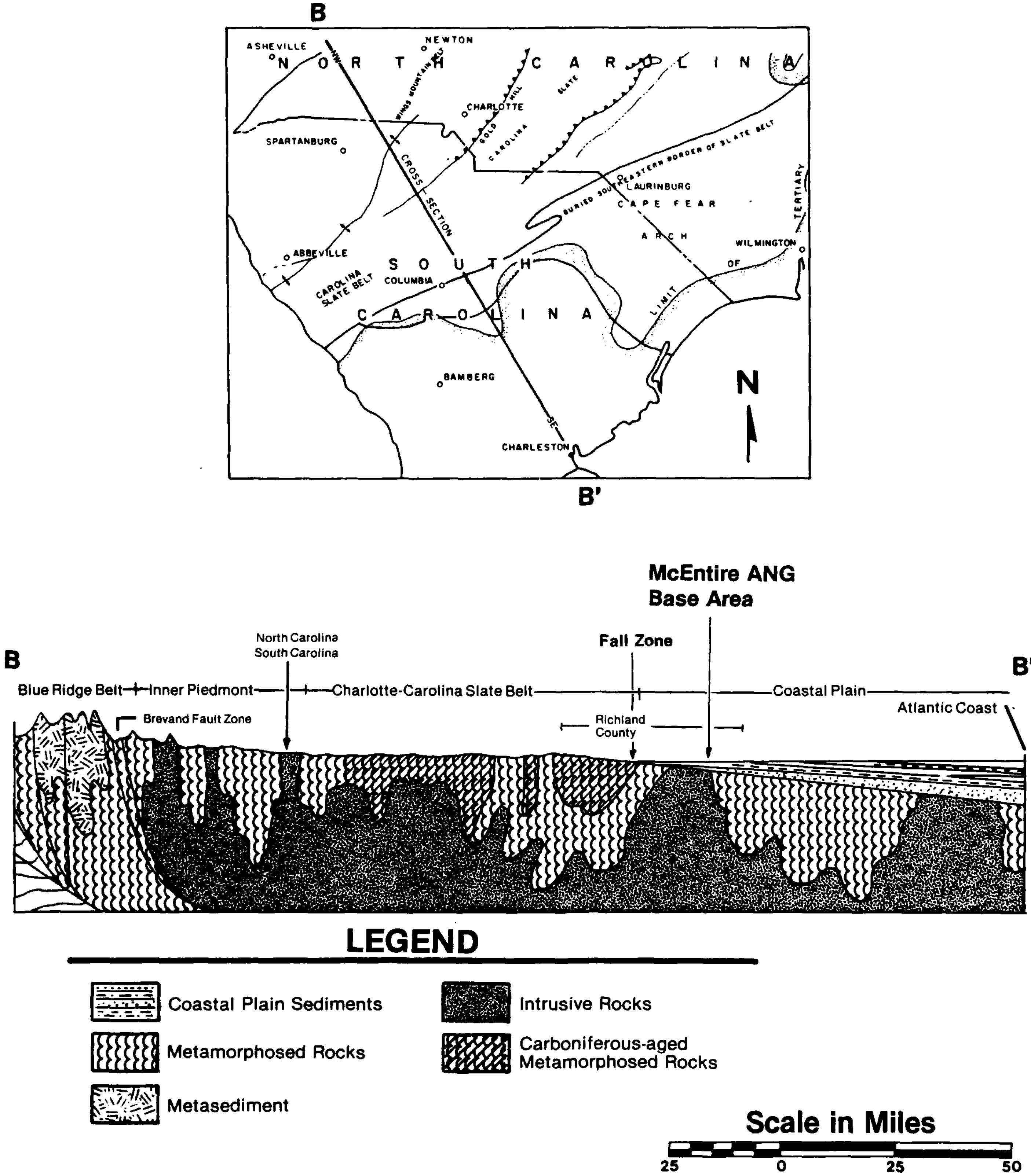


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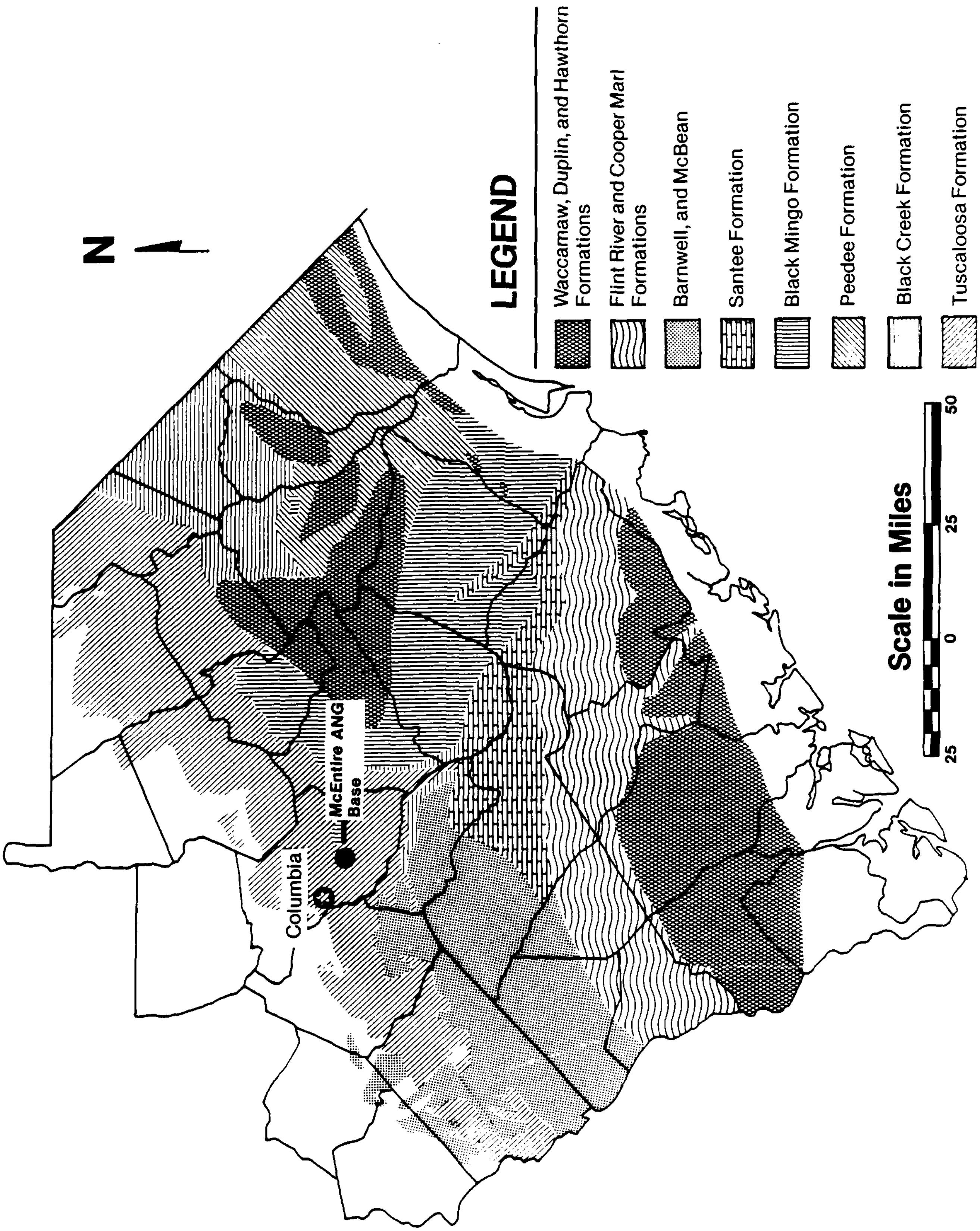
FIGURE 6.
Regional Geologic Map of the Coastal Plain of South Carolina.



(Adapted from Cooke, 1936)

TABLE 2.

Descriptions of the Geologic Formations that Comprise the Coastal Plain of South Carolina.

SYSTEM	SERIES	TIME (Millions of Years Ago)	FORMATION	Approximate Thickness (ft.)	DESCRIPTION
TERTIARY	PLIOCENE (Tp)		Waccamaw	25	- Interbedded layers of sand and marine shells.
	MIOCENE (Tm)	11	Duplin	20	- Shell marl.
			Hawthorn	160	- Sandy phophatic marl and soft limestone with interbedded brittle shale.
	OLIGOCENE (Ta)	25	Flint River	50	- Reddish-yellow sand with inclusions of yellow vitreous chert.
	EOCENE (Te)	40	Cooper Marl	100-200	- Grayish-green marl commonly containing 75 percent lime carbonate and 2 to 5 percent lime phosphate.
			Barnwell	100	- Fine to coarse reddish pebbly sand, generally massive but in placed cross-bedded and mottled with gray.
			McBean	100	- Fine to medium-graned, light greenish yellow sand, thin beds of greenish glauconitic marl, laminated flaky clay, fuller's earth, and lenses of silicified limestone.
			Santee	180-230	- Pure white to creamy yellow, soft, homogeneous limestone containing few bedding planes
			Black Mingo	100	- Yellow-red, fossiliferous, laminated sandy shale with interbedded dark clay, shale, or fuller's earth.
CRETACEOUS	Upper Cretaceous (KU)	70	Pedee	800	- Gray sandy marl interbedded with thin ledges of hard marlstone
			Black Creek	450	- Unctuous black shaley clays enclosing interlaminations of extremely thin micaceous seams and occasional fine-grained sand.
			Tuscaloosa	250-300	- Light-gray, white, or buff, cross-bedded sand with interfingering lenses of white, pink, or purplish clay.

and considering the rate of eastward slope of the planar surface of these pre-Cretaceous rocks, the thickness of the Tuscaloosa Formation underlying McEntire ANG Base is estimated to be less than 300 feet.

2. Local Geology

Several exploratory borings were drilled by the South Carolina State Development Board, Division of Geology, in the area immediately west of McEntire ANG Base. Logs of these wells and the logs of water wells drilled on and close to McEntire ANG Base indicate the presence of shallow Pleistocene and Pliocene-aged sediments (less than 11 million years old) composed of sandy marine terrace gravels and recent alluvium consisting of gravel, sand, and clay. These near-surface terrace deposits overlie the Tuscaloosa Formation and locally are classified by Cooke as the Coharie Terrace Formation, which was deposited when sea level was approximately 215 feet above its present elevation. The effect of these shallow deposits on the site hydrology is discussed in the hydrology section of this report. Except where well-defined gravel lenses are present, these sediments are difficult to differentiate from sediments of the Cretaceous-aged Tuscaloosa Formation. For this reason, and because of the lack of surface exposures of any of these sediments, a detailed geologic map that differentiates between these deposits in the area of McEntire ANG Base is not presented.

The majority of soils at McEntire ANG Base that developed on the formations described above are classified within the Orangeburg, Coxville, or Norfolk Soil series. The Orangeburg series consists of deep, well-drained, moderately permeable soils that formed in thick loamy marine sediment. These soils usually are present on broad ridges and interstream divides on uplands in the Coastal Plain province. Typically, the surface layer is brown loamy sand about 8 inches thick. The subsurface layer is yellowishbrown loamy sand about 4 inches thick. The subsoil is yellowish-red sandy loam to a depth of 18 inches; below this, to a depth of 90 inches, it is yellowish-red and red sandy clay loam. The soil is strongly acid or medium acid in the surface and subsurface layers and strongly acid or very strongly acid in the subsoil. Organic matter content is low. Permeability is moderate, and available water capacity is medium. Runoff is slow.

The Coxville series consists of deep, nearly level, poorly drained, moderately slowly permeable soils that formed in thick beds of clayey marine sediment. Generally, these soils occupy shallow, elliptical depressions on broad, smooth, interstream divides. Typically, the surface layer is dark-gray, fine sandy loam about 7 inches thick. The subsurface layer is light brownish-gray fine sandy loam about 2 inches thick. The subsoil to a depth of 80 inches is 56 inches of gray sandy clay that has brownish and reddish mottles and 15 inches of gray sandy clay loam that has yellowish-red mottles. This soil is strongly acidic throughout. Organic matter content is medium. Permeability is moderately slow, and available water capacity is medium. The water table is high most of the year if this soil is undrained. The root zone is deep and readily penetrated by plant roots. This soil is used for crops, pasture, and woodland, and most areas have been drained.

The Norfolk series consists of deep, nearly level to gently sloping, well-drained, moderately permeable soils that formed in thick loamy marine sediment. Typically, the surface layer is dark grayish-brown loamy sand about 10 inches thick. The subsurface layer is yellowish-brown loamy sand about 7 inches thick. The subsoil to a depth of 75 inches is yellowish-brown sandy clay loam. This soil is strongly acid or very strongly acid throughout, except in areas where the surface layer is limed. Organic matter content is low. Permeability is moderate, and available water capacity is medium. The root zone is deep and easily penetrated by plant roots. Runoff is medium, and erosion occurs relatively easily.

Figure 7 illustrates the locations of these and other soils present on or near McEntire ANG Base. Table 3 summarizes important physical and chemical properties of these soils such as permeability, potential for erosion, and hydrologic classification. Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field--particularly soil structure, porosity, and gradation or texture--that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Erosion factors are used to predict the erodibility of a

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FIGURE 7.
Map of Soils at McEntire ANGB.

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See table 3 for description of soil types

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

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TABLE 3.
Properties of the Soils Present at McEntire ANGB.

Soil Classification	Permeability Change with Depth(in/hr)	Depth (in)	Erosion Factor	Hydrologic Group	Mean Overall Permeability (in/per)
Ca - Cantey loam	0.60-2.00 0.06-0.20 0.06-0.60	0-5 5-57 57-81	Slight	D	0.24-0.93
Cx - Coxville fine sandy loam	0.60-2.00 0.20-0.60	0-9 9-65	Slight	D	0.40-1.30
DoB - Dothan loamy sand, 2 to 6 percent slopes	2.00-6.00 0.60-2.00 0.20-0.60	0-17 17-37 37-78	Slight	B	0.93-2.90
FuB - Fuguay sand, 2 to 6 percent slopes	6.00 0.60-2.00 0.06-0.20	0-35 35-48 48-75	Slight	B	2.20-2.70
GoA - Goldsboro sandy loam, 0 to 2 percent slopes	2.00-6.00 0.60-2.00	0-13 13-80	Slight	B	1.30-4.00
Jo - Johnston loam	2.00-6.00 6.00-20.00	0-38 38-66	Slight	D[a]	2.00-6.00 4.00-13.00
LuB - Lucy loamy sand, 2 to 6 percent slopes	6.00 2.00-6.00 0.60-2.00	0-26 26-32 32-75	Slight	A	2.90-4.70
NoA & NoB - Norfolk loamy sand, 0 to 2 and 2 to 6 percent slopes	2.00-6.00 0.60-2.00	0-17 17-75	Slight	B	1.30-4.00
OoA, B, & C - Orangeburg loamy sand, 0 to 2, 2 to 6 , 6 to 10 percent slopes	2.00 - 6.00 2.00 - 6.00 2.00 - 6.00 2.00 - 6.00	0-12 12-18 18-57 57-90	Slight	B	1.30-4.00
Ps - Persanti very fine sandy loam	0.20 - 2.00 0.06 - 0.20	0-5 5-75	Slight	C	0.13-1.10
Ra - Rains sandy loam	2.00 - 6.00 0.60 - 0.20 0.60 - 0.20 0.60 - 0.20	0-12 12-46 46-62 62-68	Slight	B/D	0.95-1.65
VaC & D - Vaucluse loamy sand, 6 to 10 and 10 to 15 percent slopes	6.00 - 2.00 0.60 - 6.00 0.06 - 0.20 2.00 - 6.00	0-15 15-29 29-58 58-72	Slight	C	2.20-3.60

[a]Despite the sandy, permeable nature of the Johnston loam, it is classified within the 'D' hydrologic group because it most frequently occurs where the depth to the ground watertable is very shallow; and therefore, this soil is frequently saturated.

soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor is a measure of the susceptibility of the soil to erosion by water. Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms. The four hydrologic soil groups are:

- Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well-drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

- Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well-drained or well-drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

- Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

- Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

C. Hydrology

1. Surface Water

McEntire ANG Base is located within the Congaree River drainage basin. The Congaree River begins at Columbia, SC, where the Broad and Saluda Rivers meet. Approximately 24 miles southeast of McEntire ANG Base, the Congaree and Wateree Rivers meet and flow into Lake Marion. Locally, surface runoff from McEntire ANG Base flows directly into either Cedar Creek or Dry Branch. Cedar Creek is coincident with the western boundary of McEntire ANG Base. Dry Branch is approximately coincident with the eastern boundary of McEntire ANG Base, although it is located within the base boundary for a distance of approximately 1.5 miles. Figure 8 illustrates the directions of

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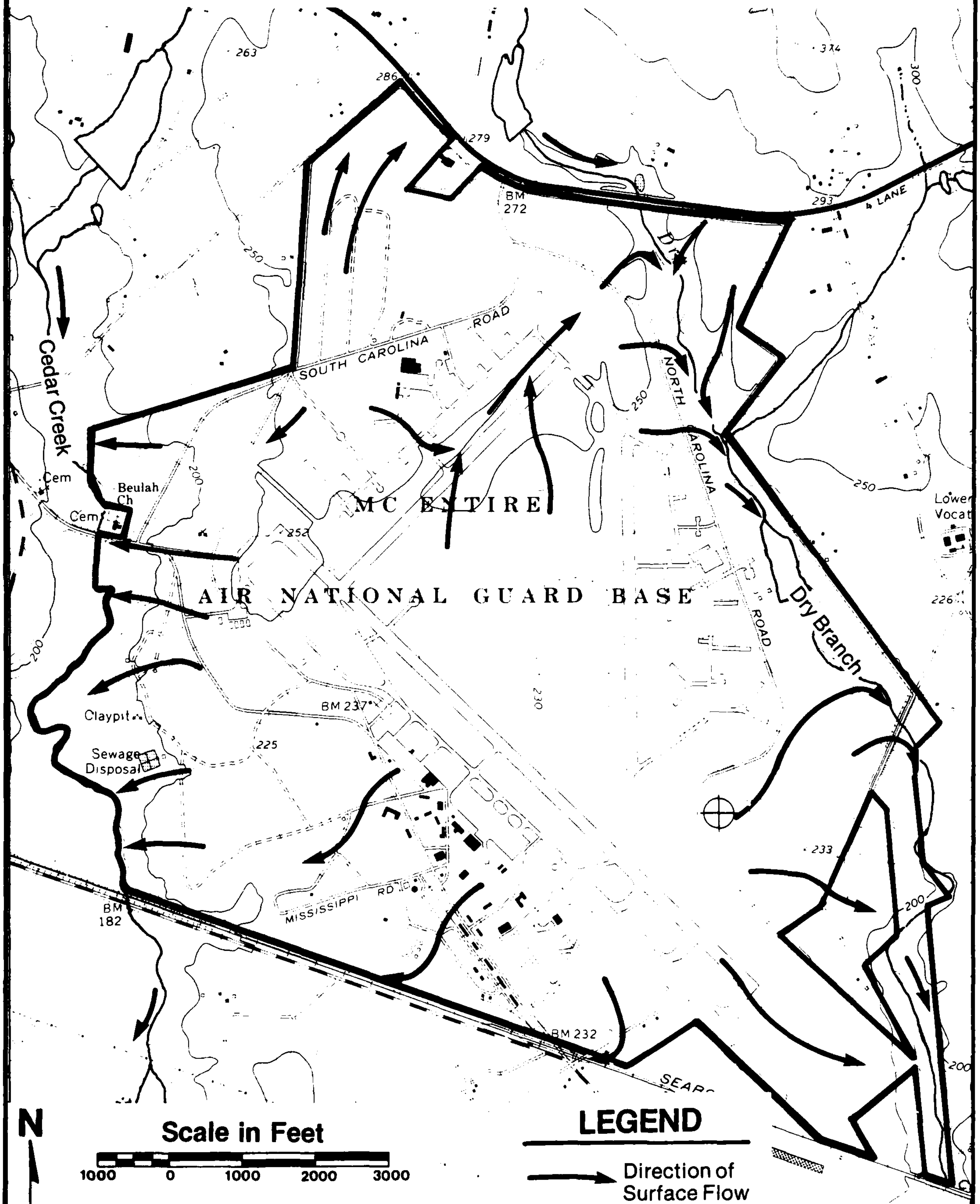
FIGURE 8.
Surface Drainage Map.



Source: U.S.G.S.

surface drainage at McEntire ANG Base, as determined from interpretation of topographic maps, aerial photographs, and field reconnaissance of the base. Other local tributaries to the Congaree River that are near McEntire ANG Base are Cabin Branch and Toms Creek, which are approximately 1.5 miles east and 1.5 miles west of the base, respectively. All of the above tributaries of the Congaree River flow from north to south.

The State of South Carolina has developed a stream classification system based on various water quality standards such as turbidity, temperature, pH, fecal coliform, dissolved oxygen, and the presence of treated industrial waters or refuse. On the basis of these parameters, eight classifications of surface water have been developed. These classifications are summarized in Table 4. Cedar Creek and Dry Branch are Class A streams; however, no chemistry data for either of these streams is available. Groundwater chemistry data is presented in the following sub-section titled 'Ground Water.' The shaded areas in Figure 9 indicate the maximum extent of floodwater from Cedar Creek and Dry Branch as a result of a 100-year flood; and, therefore, these shaded areas also indicate the maximum probable extent of Class A water near McEntire ANG Base. For a tributary that has not been individually classified, the State of South Carolina automatically assigns to this tributary the same classification as the streams into which the tributary flows. With respect to McEntire ANG Base, the closest surface water treatment plant intake site is the one owned by the industrial enterprise called Carolina Eastman. It is located along the Congaree River approximately 8 miles upriver of the point where Cedar Creek enters the Congaree River. There are no surface water treatment plant intake sites downstream from McEntire ANG Base.

2. Ground Water

All water used by McEntire ANG Base and the surrounding nearby residents is acquired from wells that tap underlying aquifers. Regional groundwater flow within the deep, extensive aquifers is from west to east. Recharge occurs at the higher elevations of the Coastal Plain sediments, near the Fall Zone, and then the ground water moves eastward to lower elevations, due to the force of gravity. On the regional scale the composite groundwater flow component is horizontal due to the horizontal attitude of the layers of sandy

TABLE 4.
Summary of Stream Classification Criteria.

STREAM CLASSIFICATION	CRITERIA
AA	Freshwaters which constitute an outstanding recreational or ecological resource and those waters suitable as a source for drinking water supply purposes with treatment levels as specified by the Department. Suitable also for uses listed in Class A and Class B.
A-TROUT	Freshwaters suitable for supporting reproducing trout populations and/or essential to trout reproduction, growth and survival. Suitable also for uses listed in Class A and Class B.
A	Freshwaters suitable for primary contact recreation. Also suitable for uses listed in Class B.
B	Freshwaters suitable for secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with requirements of the Department. Suitable for fishing, survival and propagation of fish, and other fauna and flora. Suitable also for industrial and agricultural uses.
SAA	Tidal salt waters which constitute an outstanding recreational or ecological resource and/or waters suitable for uses that require the absence of pollution. Suitable also for uses listed in Class SA, Class SB, and Class SC.
SA	Tidal salt waters suitable for harvesting of clams, mussels, or oysters for market purposes or human consumption except within buffer zones designated by the Department. These buffer zones are consistent with this classification. Suitable also for uses listed in Class SB and Class SC.
SB	Tidal salt waters suitable for primary contact recreation. Suitable also for uses listed in Class SC with the same exception.
SC	Tidal salt waters suitable for secondary contact recreation, crabbing, and fishing, except harvesting of clams, mussels, or oysters for market purposes or human consumption. Also suitable for the survival and propagation of marine fauna and flora.

Source: South Carolina Water Resources Commission

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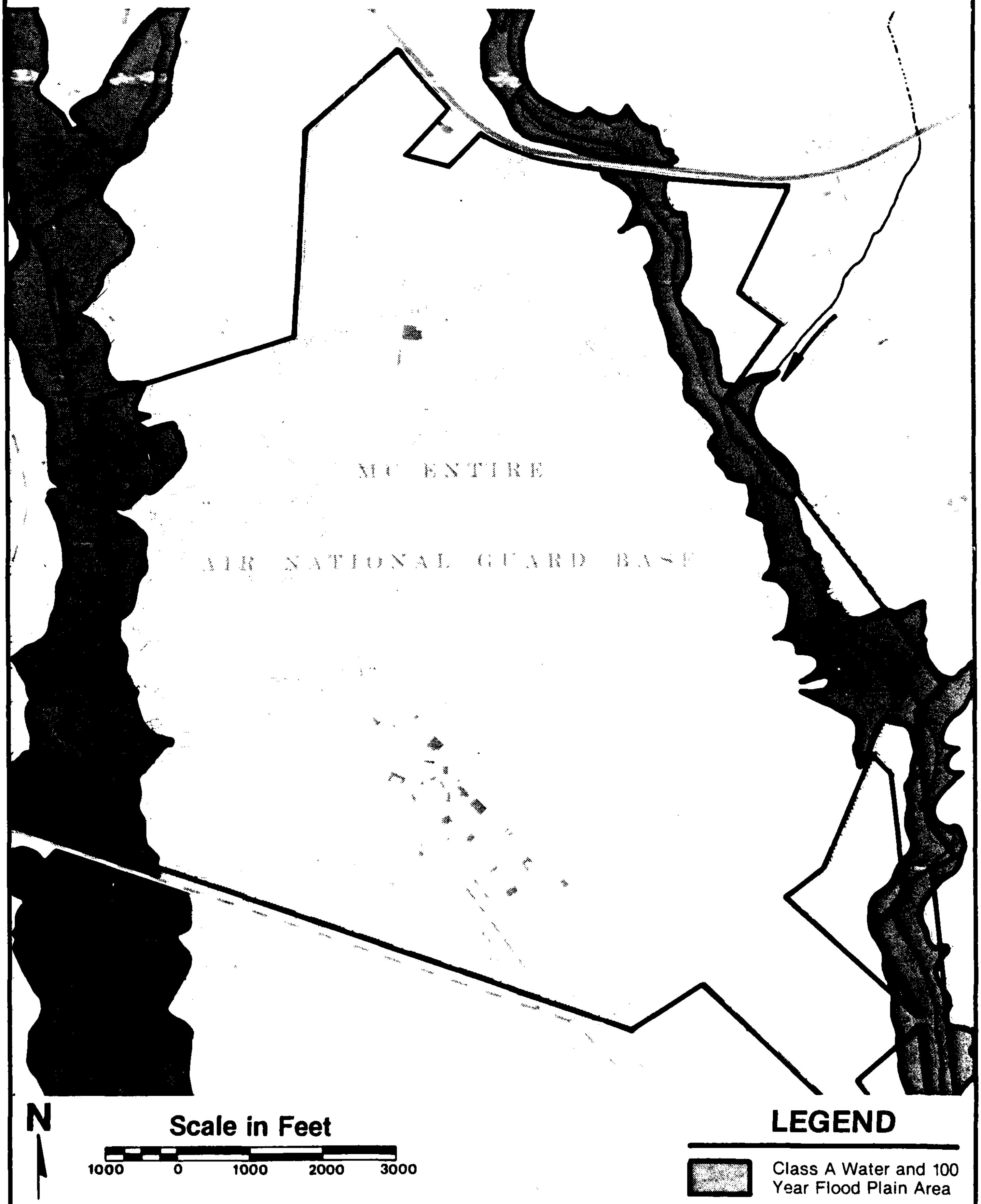
FIGURE 9.
Surface Water Classification Map and Extent of 100 Year Flood Plain.



Source: U.S.G.S., South Carolina Water Resources Commission and clayey sediments that transmit and confine the ground water, respectively. As the ground water moves toward the east, it tends to become harder and more alkaline due to chemical interaction with the sediments through which it flows. Locally, vertical components of groundwater flow may be present due to groundwater pumping or discontinuities within confining horizontal clay layers. Such vertical components may facilitate contamination of ground water by downward migration of surface contamination and can only be evaluated by considering the local hydrogeology.

A report is presently being prepared by the South Carolina Water Resources Commission (SCWRC) that will characterize the quality, depth, and direction of movement of ground water in the area of McEntire ANG Base; unfortunately, this report has not yet been published and no similar reports are currently available. To describe the subsurface hydrology at McEntire ANG Base, the Records Search Team acquired unpublished data from SCWRC, the South Carolina Geological and Geodetic Surveys, and the McEntire Base Civil Engineer regarding the locations, geologic logs, and construction and performance characteristics of nearby wells and test borings. Appendix F summarizes the most important information contained in the records of 14 different wells and borings on and near McEntire ANG Base. Figure 10 indicates the locations of these wells and borings. The monitoring well data in Appendix F are insufficient for illustrating the elevations of the piezometric surfaces (detailed directions of groundwater flow) that correspond with the aquifers underlying McEntire ANG Base. This insufficiency results from the small total number of wells and borings that were available for monitoring and the low frequency with which water level observations were made. However, general interpretation of the data summarized in Appendix F is possible and follows. This interpretation identifies the depths to the major aquifers and the probable directions of groundwater flow within these aquifers. Below is a summary of the groundwater chemistry observed for well W1 on 5/17/83, as reported by SWRC:

pH = 5.6
Chloride = 3.64 mg/ℓ
Fluoride = 0.02 mg/ℓ
Sulfate = 2.89 mg/ℓ
Calcium (total) = 0.92 mg/ℓ
Iron (total) = 219 μg/ℓ
Magnesium (total) = 0.45 mg/ℓ
Potassium (total) = 0.27 mg/ℓ
Silica (dissolved) = 5.56 mg/ℓ
Silicon (dissolved) = 2.60 mg/ℓ
Sodium (total) = 3.9 mg/ℓ
Specific Conductance = 25 μ mhos/cm

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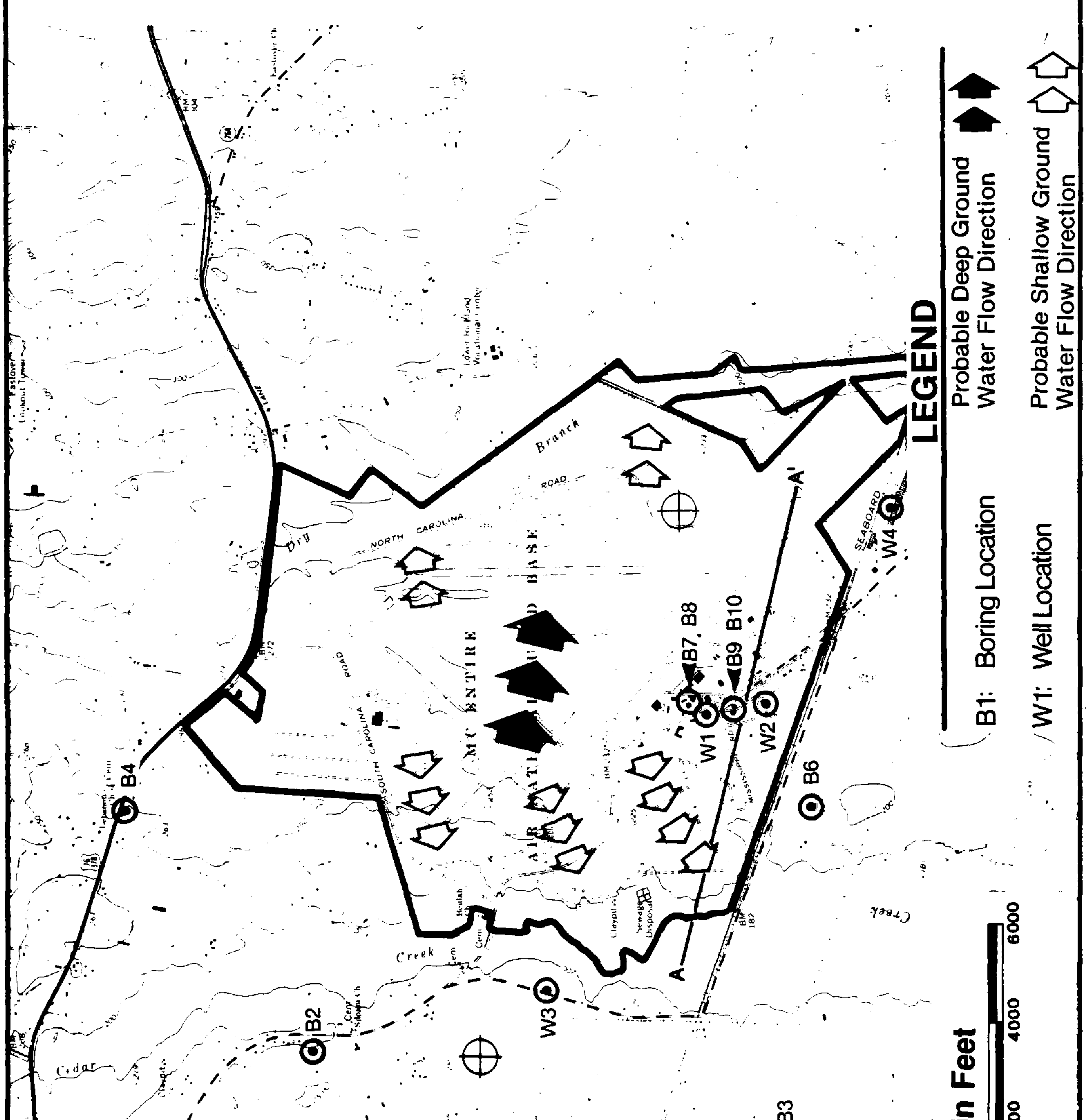
FIGURE 10.
Locations of Monitored Wells and Borings Near McEntire ANGB.



Source: U.S.G.S.

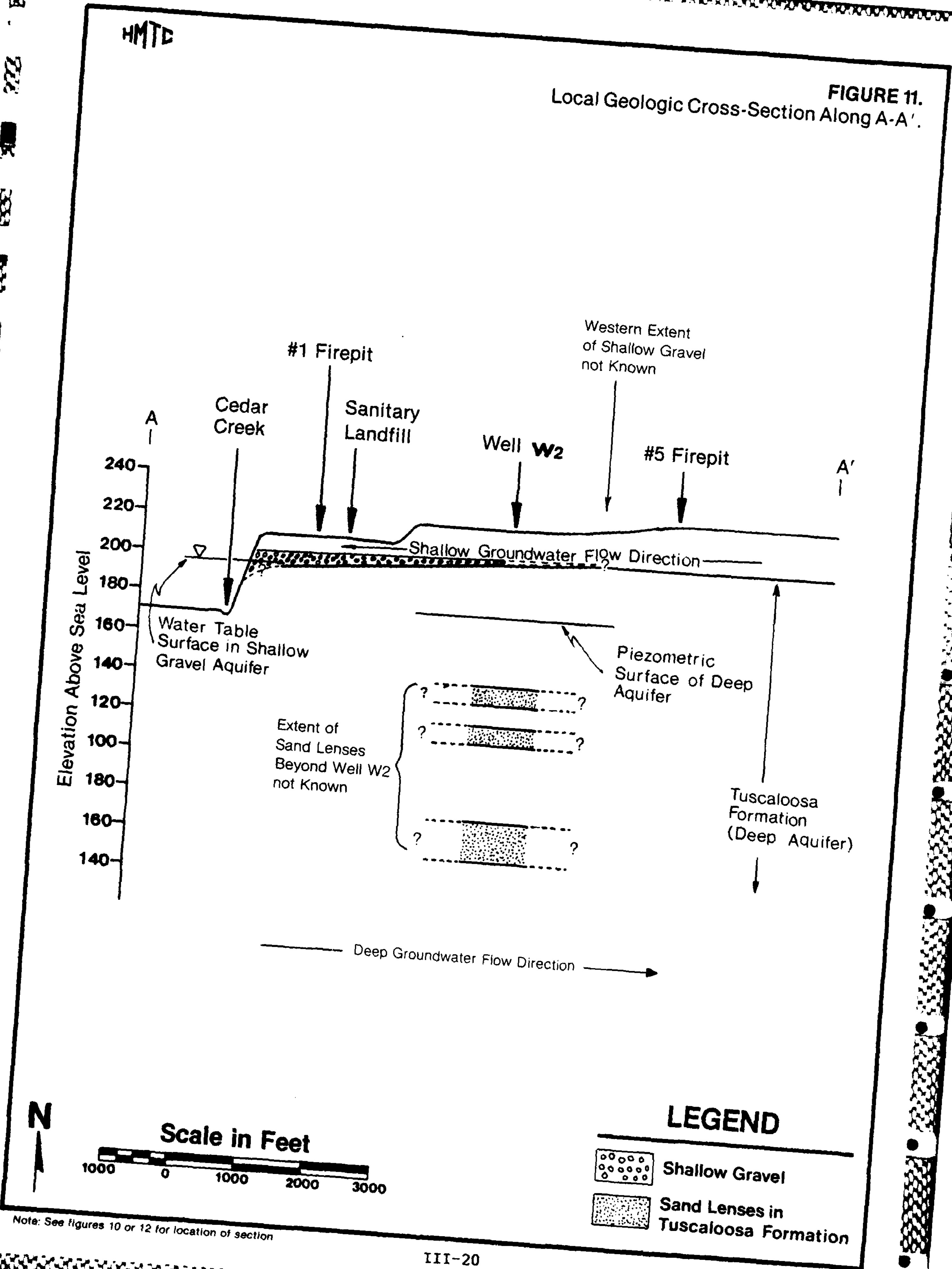
The most important aquifers underlying McEntire ANG Base are the sandy portions of the Tuscaloosa Formation, as indicated by monitoring wells W1, W2, and W4. The elevations of these sand lenses vary throughout the interval from 60 to 140 feet above mean sea level (MSL), which is approximately 90 to 160 feet below land surface at McEntire ANG Base. The static water elevations recorded in the above wells, whose screened intervals are coincident with the sandy lenses, varies from 175 to 203 feet above MSL, or from 45 to 30 feet below land surface. These data indicate that these sandy lenses are hydraulically pressurized relative to the overlying confining clay layers as evidenced by the fact that the static water elevations in wells hydraulically connected with the sandy zones is above the elevation of the top of the sandy zones. These sand zones, therefore, may appropriately be classified as artesian aquifers. The probability that they would become contaminated by surface contaminants is low because the natural pressure gradient is upward and away from the sandy aquifers within the Tuscaloosa Formation.

Strict interpretation of the water level elevations in wells W1, W2, and W4 suggests that the groundwater flow direction within the Tuscaloosa Formation underlying McEntire ANG Base is from east to west. However, these data are highly unreliable for the purposes of determining groundwater flow direction because only one observation for each well is generally available, and the observations for various wells are separated by a time period of up to 26 years. Therefore, distorting effects such as historical changes in regional groundwater elevations, seasonal fluctuations, and effects of localized groundwater pumping cannot be evaluated. A more reliable estimation of the direction of flow of ground water within the Tuscaloosa Formation underlying McEntire ANG Base is that it moves from west to east in response to an eastwardly decline in the hydraulic head within the Tuscaloosa Formation. Local fluctuations of this flow direction in response to heavy pumping of wells such as the McEntire ANG Base wells is likely, in which case groundwater movement would be toward the pumped wells.

The shallow exploratory borings to the west of McEntire ANG Base that were mentioned indicate the presence of a shallow gravel aquifer. This aquifer may become confined with increasing distance from Cedar Creek; however, it is not confined within the flood plain of Cedar Creek due to past erosion of overlying sediments by Cedar Creek. This aquifer is composed of a layer of gravel that varies from a minimum thickness of 6 inches in boring B5 to a maximum observed thickness of 8 feet in boring B2, and is thought to mark the base of the Pleistocene sediments that overlie the Tuscaloosa Formation. No gravel is present in the logs of borings B1 or B4. Figure 11 is a geologic cross section along the section A-A', identified in Figure 10 (this chapter) and in Figure 12 (chapter IV). This cross section illustrates the subsurface geometry of the gravel aquifer and the probable directions of groundwater migration within this gravel and the underlying Tuscaloosa Formation, based on the elevations of the corresponding piezometric surfaces.

The shallow gravel aquifer is not artesian, as evidenced by the fact that the static water elevation in the shallow borings that were open to this aquifer were not at a higher elevation than the top of the gravel layer. Therefore, this aquifer is more susceptible to contamination by surface contaminants. The limited data obtained on wells used for drinking water purposes indicates that this aquifer is not used as a source of drinking water. However, only drilling records for a small fraction of the water wells in the area are available. Any hand-dug well in the area overlying these shallow gravels almost certainly draws water from these gravels. The groundwater flow direction within the gravels underlying the western boundary of McEntire ANG Base is southwestward, toward Cedar Creek. This estimate is based on the water level elevation observed in boring B6 and the elevation changes of Cedar Creek. Due to the silty and clayey nature of the soils overlying the shallow gravel aquifer, or overlying the Tuscaloosa Formation at those locations where the shallow gravel aquifer is not present, very shallow and temporary perched water tables may develop subsequent to very rainy periods. In these instances, the temporary perched water tables would develop over the top of the soil zones with high clay content. The direction of movement of ground water within these temporarily perched aquifers would be approximately coincident with the directions of surface drainage runoff indicated in Figure 8.

FIGURE 11.
Local Geologic Cross-Section Along A-A'.



Note: See figures 10 or 12 for location of section

Except for the potential contamination of shallow, hand-dug water wells, the most important impact the contamination of these gravels might have is the subsequent transmission of the contaminants to Cedar Creek, due to the fact that these gravels are probably exposed along the valley floor and walls of Cedar Creek. Exposure of the gravels in the valley of Cedar Creek is likely because the elevation of the bottom of Cedar Creek is coincident with the elevation of the gravel layer observed in the test borings. If the gravel is exposed, then ground water within the gravel will readily discharge to Cedar Creek. Groundwater discharge to Cedar Creek is indicated by the swampy conditions along the Creek.

D. Environmentally Sensitive Conditions

1. Vegetation and Wildlife

Of the 2,387 acres comprising McEntire ANG Base, 1,200 are classified as semi-improved, 750 as unimproved, and the remaining are improved. Most of the land consists of abandoned farmlands and previously cutover woodlands. There is currently no acreage under grazing or agricultural outlease; however, a forest management plan directed toward harvesting and reforestation was adopted in 1965 to improve species composition and timber quality. Controlled burning is also undertaken in winter months to improve wildlife habitat.

There are three major types of terrestrial wildlife habitat located on the base. The bottomland hardwoods type consists of mature timber stands that support deer and squirrel populations. The upland pine/hardwood habitats support a special association of deer, rabbits, and squirrels. Prescribed burning is undertaken to improve habitat for quail and rabbits. An association of dove, quail, and rabbits is found in the open fields/brush habitat. These populations have risen in number since intensive mowing was selectively reduced in open areas.

There are two managed fish ponds on the base, which total 15 acres. One pond of 1.2 acres is not managed for fish but has had wood duck boxes installed. Although there are no actual wetlands on the base, a major portion of the bottomland hardwood habitat is situated in the flood plain of Cedar Creek. Further details on base flora and fauna are provided in Appendix G.

2. Threatened and Endangered Species

The following species are present or are likely to be present within a 50-mile radius of McEntire ANG Base, and have been listed as being threatened or endangered by the U.S. Fish and Wildlife Service and the South Carolina Wildlife and Marine Resources Department:

- o Eastern cougar
- o American alligator
- o American ivory-billed woodpecker
- o Red-cockaded woodpecker
- o Backman's warbler.

Of these, only the American alligator has been observed on or near the base, in the vicinity of Cedar Creek.

There is a remote possibility that the following threatened or endangered species may appear on-base:

- o American peregrine falcon
- o Southern bald eagle
- o Kirtland's warbler.

Should these species appear on-base, however, they would appear as occasional visitors only. Contact between birds and aircraft may take place on occasion, and could impact the listed bird species. However, bird strikes involving threatened or endangered species have not been reported at McEntire ANG Base. Additional environmental setting information is presented in Appendix G.

IV. FINDINGS

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A. Activity Review

Table 5 summarizes the activities at McEntire ANG Base that have required the use of industrial chemicals and management of the resultant waste materials. A review of base records and interviews with past and present base employees resulted in the identification of specific operations within each activity in which the majority of industrial chemicals are handled and hazardous wastes are generated. A brief description of these operations and best estimates of the quantities of wastes generated by each is provided below. Where available, information on specific past operations and industrial chemicals use is included. However, sufficient information in these areas was lacking in many cases. Table 6 summarizes the major operations associated with each activity, provides estimates of the quantities of waste currently being generated by these operations, and describes the past and current disposal routes for the wastes. If an operation is not listed in Table 6, then, on a best-estimate basis, that operation produces negligible quantities of wastes requiring ultimate disposal. For example, extremely small volumes of methylethylketone are used on occasion; however, it commonly evaporates subsequent to use and; therefore, does not present a disposal problem in these instances. Conversely, if a particularly volatile compound is listed, then the quantity represents an estimate of the amount actually disposed of according to the method shown. Appendix H contains additional operations information in the form of a detailed listing of base operations, their locations, and whether they generate hazardous waste.

1. Aircraft Maintenance

a. Pneudraulic Shop

The Pneudraulic Shop is located in Building No. 253. This shop services and repairs all aircraft pneumatic and hydraulic equipment. Wastes generated from this area include PD-680 (15 gal/mo) and hydraulic fluid (20 gal/mo).

TABLE 5.
Summary of Activities at McEntire ANGB Which Use Hazardous Materials.

Activity	Performing Organization
Aircraft Maintenance	169th Consolidated Aircraft
- Pneudraulic Shop	Maintenance Squadron
- Fabrication Section	Army Aviation
- Flight Line/Base Flight	
- Engine Shop	
- Engine Test Facilities	
- Tire Repair and Reclamation	
- Non-Destructive Inspection Lab	
Ground-Vehicle Maintenance	169th Consolidated Aircraft
Maintenance Squadron	
Motor Pool	
Army Aviation	
Fuel Management	POL
Motor Pool	
Army Aviation	
Fire Protection	Fire Department
Utilities Operation	Civil Engineering
Pest Management	

HMTC

TABLE 6.

Shops Which Generate Hazardous Waste/Used Hazardous Materials.

Shop Name	Bldg. No.	Hazardous Waste/Used Hazardous Material	Estimated Quantity	Method* of Treatment/Storage/Disposal ----1950----1960----1970----1980----Present
Pneudraulic Shop	253	PD-680	15 gal/mo	FIRE TR → DPDO
		Hydraulic Fluid	20 gal/mo	
Corrosion Control	60	Paint	4 gal/mo	LAND FL → CNTRCT
Machine Shop		Paint Strippers	4 gal/mo	
Structural Repair		Paint Thinners	4 gal/mo	SSTP
Welding		Cutting Fluid/Coolant	1/2 gal/mo	
Engine Shop	253	PD-680	1 gal/mo	
		Aircraft Oil	12 gal/mo	FIRE TR → DPDO
		JP-4	8 gal/mo	
NDI	60	Fixer	7 gal/mo	SSTP → RECOVERY
		Developer	10 gal/mo	SSTP
		Kerosene	1 gal/mo	
		Penetrant	2 gal/mo	
		Emulsifier	2 gal/mo	FIRE TR → DPDO
		Waste Lube Oil	10 gal/mo	
		Methylethylketone	1 gal/mo	
		Trichloroethane	1 gal/mo	
Flightline/ Base Flight	253/ 60	Aircraft Oil	50 gal/mo	FIRE TR → DPDO
		Hydraulic Fluid	10 gal/mo	
		PD-680	25 gal/mo	STORM DR
		Aircraft Cleaner	9 gal/mo	
Tire Repair and Reclamation	253	Paint Stripper (B & B)	18 gal/mo	LAND FL → CNTRCT
		PD-680	35 gal/mo	FIRE TR → DPDO
Paint Shop		Chromic Acid	1 gal/mo	
		Epoxy Paint	1 gal/mo	
		Polyurethane Paint	1 gal/mo	
		Thinner	1/4 gal/mo	LAND FL → CNTRCT
		Aldoine	1 gal/mo	
		Toluene	3 gal/mo	
		Methylethylketone	6 gal/mo	
AGE	200	PD-680/Varsol/Gunk	76 gal/mo	OWS/STDR
		JP-4/MOGAS[a]/AVGAS[b]	4 gal/mo	FIRE TR
		Hydraulic Fluid	20 gal/mo	
		Engine Oil	20 gal/mo	FIRE TR → DPDO
		Aircraft Oil	2 gal/mo	
		Transmission Fluid	1 gal/mo	
		Battery Acid	3 gal/mo	NEUTRL & OWS/STDR
Motor Pool	210/ 200	PD-680/Varsol/Gunk	10 gal/mo	OWS/STDR → SSTP
		Methylethylketone	5 gal/mo	FIRE TR → DPDO
		Paint Thinner	1 gal/mo	
		JP-4	3 gal/mo	FIRE TR
		Engine Oil	40 gal/mo	FIRE TR → DPDO
		Brake Fluid	1 gal/mo	
		Antifreeze	120 gal/mo	OWS/STDR → SSTP
		Paint	1/2 gal/mo	LAND FL → CNTRCT
		Battery Acid	2 gal/mo	NEUTRL & OWS/STDR → NEUTRL & SSTP
POL	183	JP-4/AVGAS	300 gal/mo	FIRE TR → DPDO
Army Aviation	165	Waste Oil	65 gal/mo	CNTRCT
		Hydraulic Fluid	2 gal/mo	
		Gunk/Varsol	50 gal/mo	
		Trichloroethane	25 gal/mo	OWS/STDR
		Battery Acid	1 gal/mo	
		JP-4/AVGAS	20 gal/mo	FIRE TR

*RECOVERY - Precious metal recovery.
STDR/OWS - Storm drain to Oil/Water separator to Cedar Ck.
SSTP - Sanitary Sewage Treat Plant to Cedar Ck.
FIRE TR - Fire Dept. Training Exercises.
LANDFL - On-base Landfill.
NEUTRL - Neutralization and to drain.
CNTRCT - Outside Service Contract to off-base facility
DPDO - Defense Property Disposal Office.

[a]MOGAS - Automobile gasoline
[b]AVGAS - Aviation gasoline

b. Fabrication Section

Located in Building No. 60, the Fabrication Section consists of the Corrosion Control, Machine, Structural Repair, and Welding Shops. Corrosion control activities, which account for essentially all waste generated in this section, include cleaning, sanding, stripping, priming, repainting, and stenciling aircraft and ground support equipment. Wastes generated in this shop include paint thinners (4 gal/mo), paints (4 gal/mo), and paint strippers (4 gal/mo). Spent cutting fluids/coolants (1/2 gal/mo) are generated in the Machine Shop.

c. Flight Line/Base Flight

General aircraft maintenance is conducted on the flight line and base flight. Wastes generated from these areas include PD-680 (25 gal/mo), aircraft cleaner (9 gal/mo), hydraulic fluid (10 gal/mo), and waste aircraft oil (50 gal/mo).

d. Engine Shop

The Engine Shop is located in Building No. 253. This shop generates PD-680 (1 gal/mo), synthetic aircraft oil (12 gal/mo), and JP-4 (8 gal/mo).

e. Engine Test Facilities

The engine test cell is located on a concrete pad in a covered structure with no walls (Building 225). The test facility is used to examine the performance of repaired jet engines before they are returned to the aircraft. A portable JP-4 tank adjacent to the structure provides fuel to the engines undergoing tests, and a blast barrier is situated outside the structures to prevent groundfires. A second engine test area is located on a concrete apron adjacent to the taxiway of runway 18/36. This facility is used to tie down aircraft while engines are tested in place. Portable JP-4 tanks are placed near the apron only when engine tests are being performed. No significant wastes are generated from these areas because the JP-4 fuel is either consumed during tests or left in the portable storage tanks.

f. Tire Repair and Reclamation

The Tire Repair and Reclamation Shop is located in Building No. 253. Waste materials generated from this shop include PD-680 (35 gal/mo) and paint remover (18 gal/mo).

g. Non-destructive Inspection (NDI) Laboratory

The NDI Laboratory is located in Building No. 60. Nondestructive testing methods, including X-ray, magnaflux, and ultrasound, are performed to determine material defects of aircraft structures, component parts, and related ground equipment. Wastes generated from this area include kerosene (1 gal/ mo), penetrants (2 gal/mo), emulsifiers (2 gal/mo), developers (10 gal/mo), fixers (7 gal/mo), waste oils (10 gal/mo), MEK (1 gal/mo), and trichloroethane (1 gal/mo).

2. Ground Vehicle Maintenance

Vehicle maintenance is performed in the Motor Pool (Building 210), in the Aerospace Ground Equipment (AGE) Shop (Building 200), and at the Army Aviation facility (Building 165). Wastes generated in the Motor Pool include paints (1/2 gal/mo), paint thinners (1 gal/mo), ethylene glycol (120 gal/mo), brake fluid (1 gal/mo), battery acid (2 gal/mo), MEK solvent (5 gal/mo), PD-680/Versol/Gunk degreasing compounds (10 gal/mo), JP-4 (3 gal/mo) and engine oil (40 gal/mo). Used battery acid is first neutralized and then released to the sanitary sewer. Waste solvents and oil are turned into supply for disposal through DPDO. The AGE Shop is responsible for repair, maintenance, and periodic inspection of all aerospace ground equipment. Wastes generated from this include PD-680 (76 gal/mo), JP-4, AVGAS and MOGAS fuels (4 gal/mo), hydraulic fluid (20 gal/mo), engine oil (20 gal/mo), air-craft oil (2 gal/mo), transmission fluid (1 gal/mo), and battery acid (3 gal/mo). Quantities of materials generated by the Army Aviation facility during ground vehicle maintenance are covered in Section 7, "Army Aviation" of this report.

3. Fuels Management

Fuels stored and dispensed at McEntire ANG Base include JP-4 jet fuel, No. 2 fuel oil, AVGAS 130, and MOGAS (regular and unleaded). JP-4 is stored in 6-25,000 gallon underground tanks at the POL Facility (Building 183), pumped into tank trucks, and dispensed directly to aircraft. Army Aviation has its own 1,000-gallon underground storage tank for No. 2 fuel oil near Building 165. AVGAS 130 is stored in a tank truck and dispensed to aircraft. Diesel fuel is stored in a 6,000-gallon underground tank near Building 210. MOGAS is stored and dispensed at the base Motor Pool, Building 210. Petroleum and synthetic lubricating oils are used in both aircraft and ground vehicles. A fuels laboratory is located in Building 183. Laboratory wastes are collected in a holding tank and turned into the Supply Office. Appendix I contains an inventory of base fuel storage tanks.

4. Civil Engineering

a. Water Utilities

The water supply system consists of two deep wells, a concrete storage tank, treatment facility, pumping stations, and a distribution system. Chemicals on hand at the water treatment plant (Building 254) include laboratory reagents and chlorine compounds.

b. Electrical Utilities and Heating

The electric distribution system consists of overhead transmission lines and transformers. All electric transformers at McEntire ANG Base have been analyzed for polychlorinated biphenyls (PCBs), and the PCB-containing transformers have been removed from service. No known incidents involving a PCB spill have occurred.

Each building has its own heating plant and is fueled with No. 2 fuel oil. The base originally used coal-fired boilers; the coal storage area was located near Building 99.

c. Pesticides

Prior to 1977, there were no records available on pest management or pesticide/herbicide use, although information from the interviews confirms their use at least back to the 1960's. This interview information indicates that small amounts of waste solvents; 2,4,5-trichloro- phenoxyacetic acid (2,4,5-T); and UROX were used for weed and fire ant control around lights in the ramp areas, fence lines, sand bed filters of the sanitary treatment plant and central runway area. Empty, unrinsed pesticide and herbicide containers were disposed at the sanitary landfill.

The brand names of pesticides and herbicides presently in use include Diazinon, Spectracide, and Cleanite to control fire ants; Assault and Soil-Stem for weed control; and Certimate and Warfarin for indoor pesticide control. Used containers are rinsed with water, punctured, crushed, and placed in dumpsters for removal to an off-base sanitary landfill. The rinsate is applied at the aforementioned application sites. There are no outdated or EPA-cancelled pesticide/herbicide stocks requiring disposal.

5. Wastewater Treatment

a. Sanitary Wastewater Treatment Plant

The sanitary wastewater treatment facilities at McEntire ANG Base are located on a slope overlooking the flood plain of Cedar Creek. The facilities have afforded primary wastewater treatment continuously since 1941 when the Congaree Army Air Field first opened. Originally designed to accommodate a base contingent of 3,000 soldiers, the treatment plant has been consistently underused (i.e., insufficient flow for design) since the SCANG occupied the airfield in 1947. The sanitary treatment plant consists of a large Imhoff tank, a secondary holding tank, and four sand beds with an underlying tile-drain system. A ditch at the base of the sand beds conveys plant effluents directly to Cedar Creek, which forms the western boundary of the base. Domestic wastes and drainage from serviced shops enter the Imhoff tank directly from the sewage collection system. Wastes are digested by bacteria in the tank while the effluent flows gradually from a standpipe into the holding tank. The effluent passes through a standpipe in the second tank directly to one of the four 18- to 24-inch-thick sand beds. Wastewater filters through the sand beds into the tile-drain system and is released to the drainage ditch. A 1979 inspection performed by the South Carolina Department of Health and Environmental Control noted "a short circuit from the piping leading to the intermittent sand filters straight to the under-drain system." Interviews conducted with past and present base personnel brought forth no recollections of any major spill residues or slugs of hazardous materials having passed through the sanitary treatment plant. Also, no signs of visible contamination were ever observed in the sand beds used to filter the treated effluent. During the present site inspection, the Imhoff tank and holding tank were free of visible leakage and appeared to be in satisfactory working order. The sand beds were dry and showed no evidence of contamination.

b. Oil/Water Separators

Five oil/water separators are currently in use at McEntire ANG Base. An inventory and description of each separator is provided in Appendix J. Four of the separators are located at vehicle and aircraft washracks and the aircraft hanger to intercept oil/fuel discharges into the storm drain system. The fifth separator, installed in 1981, is located at the "new" Motor Pool (Building 210) and discharges to the sanitary sewer system rather than to the storm drain. Separated waste oil from the older separators is pumped into drums; the new separator uses a weir system to overflow into an underground storage tank. Oil is then pumped from the tank into drums. The drums are stored temporarily on-base prior to being shipped to the DPDO, Fort Jackson.

6. Fire Department Training

Fire Department training activities have been conducted at several sites on-base since the first SCANG units assumed occupancy in 1947. The initial Fire Department Training Area No. 1 was a shallow, airplane-shaped trench located along the roadside in the vicinity of the base landfill. Firefighting exercises took place two or three times monthly at this site from 1947 until the mid-fifties. One 55-gallon drum of mixed hydrocarbon solvents, waste motor oils, and contaminated 100-octane fuel was ignited during a typical exercise. The next Fire Department Training Area (No. 2) was operated from the mid-fifties until 1967. It was located in the field between the taxiway and runway 22/4 near the ANG aviation facilities. According to the personnel interviewed, approximately 20 exercises in total, each employing about 300 gallons of mixed oils, fuels, and solvents, were conducted at this site prior to its closure. Fire Department Training Area No. 3 was operated from 1967 until 1969 in a cleared area situated near the main taxiway between Building 90 and the aircraft washrack. Approximately eight exercises, each involving about 300 gallons of contaminated fuels and oils, were performed at this location. Fire Department training exercises were shifted in 1969 to an area (No. 4) in a field across Mississippi Road from the current engine test cell facility (Bldg. 225). A total of four exercises were conducted during which an estimated total of 1,200 gallons of waste oils and contaminated JP-4 fuel were consumed. Use of this site was discontinued at the end of one year and the area was filled in with dirt. Operations at the current training area (No.5), located south of the main taxiway, were initiated in 1970 and continue to date. This location was chosen so that fire crews could remain near operational facilities during training exercises and respond rapidly in the event of an actual emergency. Approximately 60 excercises have been performed at this location to date, each using from 300 to 1,800 gallons of JP-4 mixed with an average of 5 percent oil.

As a standard procedure, all training areas were filled with water prior to exercises in order to float the ignited fuels over the entire surface. Early exercises involved the use of pressurized water and/or protein foam extinguishing agents, while later excercises were conducted with chlorobromomethane, potassium bicarbonate, bromodifluoromethane, or aqueous film-forming foam. The empty 55-gallon drums resulting from each exercise were left at the side of the training area for removal by Base Supply personnel. They were then washed with soap and water at the Motor Pool washrack prior to delivery to DPDO, Fort Jackson. There is no evidence that any base operations other than the Fire Department used the training areas for purposes of liquid waste disposal. Estimates provided by the Air Force indicate that between 70 and 90 percent of all combustible liquid wastes disposed of in Fire Department Training Areas are usually consumed by the fire (8).

7. Army Aviation

The Army National Guard operates the Army Aviation Support Facility (AASF) located in Building 165. Maintenance performed at the AASF includes engine overhauls and airframe maintenance on assigned helicopters. Hazardous materials used are of the same types used in other aircraft maintenance operations. Quantities of waste material generated by the AASF during ground and airframe maintenance include engine oil (65 gal/mo), hydraulic fluid (2 gal/mo), degreasing compound - Gunk/Varsol (50 gal/mo), 1,1,1-trichloroethane (25 gal/mo), battery acid (1 gal/mo), and contaminated JP-4/AVGAS fuels (20 gal/mo). Contaminated fuels are turned over to the Fire Department.

8. Support Activities

a. Ordnance Disposal

Currently there are no ordnance disposal operations conducted at McEntire ANG Base.

b. Health Clinic

A small clinical laboratory is located in Building 170. The laboratory performs routine clinical functions and X-ray development. Most wastes are disposed of in the sanitary sewer system. X-ray developers and fixers are sent to DPDO in Fort Jackson for silver recovery.

9. Hazardous Waste Storage

A total of five hazardous waste storage sites have been employed at various times at McEntire ANG Base to contain waste oils, solvents, contaminated fuels, antifreeze, and miscellaneous liquid wastes prior to disposal.

a. Y-Area

The first storage site, commonly referred to as the 'Y-area,' was located immediately adjacent to the current main hangar (Building 253) on a concrete apron. Fifty-five-gallon drums of the waste liquids were stored there on drum racks from 1947 until 1974. The filled drums were periodically transferred to the Fire Department for use in firefighting training exercises.

b. Motor Pool Storage Area

The second waste storage facility was a portable 600-gallon tank located near the former Motor Pool. The tank was used during the mid-1970's by Motor Pool personnel to store waste oils and fluids. This tank was periodically pumped dry, and the contents were transported offsite by a contractor.

c. Underground Tank (New Motor Pool)

The third waste storage area was used during the same period as the portable tank by other base units needing to dispose of liquid wastes. It consisted of an underground tank, located near the new Moto Pool, that had originally been used to store gasoline. Use of this tank for hazardous waste storage was discontinued in 1976. The location of the tank has been paved over, and it is now beneath the new Motor Pool.

d. Underground Tank (Engine Test Cell)

An underground tank placed in a field near the engine test cell (Building 225) was the fourth site used to store wastes prior to removal by the contractor. Serving all base units, this tank was used until 1982 when the current hazardous waste storage impoundment was constructed. The tank was unearthed in the summer of 1983, and no visible evidence of leakage or ground contamination was observed.

e. Current Storage Area

The current waste storage area, located across the road from the engine test cell, consists of a large concrete platform surrounded by an elevated concrete berm. The area is enclosed by cyclone fencing and is kept locked. Waste liquids are segregated according to compatibility in color-coded 55-gallon drums and removed quarterly by DPDO, Fort Jackson. During the site inspection, the contents of several drums had partially spilled over onto the concrete platform, leaving a 1- to 2-inch-thick pool of waste oil and rainwater within the enclosure. This spill was reported to the appropriate Base Personnel, was cleaned up, and action was taken to preclude its reoccurrence. Additionally, this spillage was effectively contained by the concrete berm except in one location at the rear of the platform where the liquid had seeped through a crack in the berm and saturated a small patch of ground. There were no drainage ditches located nearby to collect runoff from this spill area, and the surrounding vegetation appreared to prevent further surface migration of the waste liquid.

B. Disposal/Spill Site Identification, Evaluation, and Hazard Assessment

The interviews with the 23 base personnel (Appendix C) and subsequent site surveys resulted in the identification of 12 past disposal/spill sites. Of these 12 sites, 6 have been determined to have the potential for contaminant migration (as determined in step 3 of Figure 1) and, therefore, have been further evaluated using the Air Force's Hazard Assessment Rating Methodology (HARM). Of the 6 rated sites, 4 represent hazardous materials disposal sites and 2 represent hazardous materials spill sites. The rated disposal sites are the Y-area waste storage area, the sanitary landfill, the No. 1 Fire Department Training Area, and the No. 5 Fire Department Training Area. The rated spill sites are the C-141 fuel spill site and the oil dump site. The locations of all of these sites are illustrated in Figure 12, and each was evaluated using the USAF HARM System (Appendix D).

A preliminary screening was performed on the 12 identified past disposal and spill sites based on the information obtained from the interviews and available records from the base and outside agencies. Using the decision tree process described in the Methodology Section, a determination was made as to whether a potential exists for contaminant migration from these sites. Of the 12 identified sites, 6 were identified as having contaminant migration potential. The other 6 sites did <u>not</u> have significant potential for contaminant migration and; therefore, were eliminated from further evaluation. The 6 sites with the potential for contaminant migration were then rated using the HARM system, which was developed for specific application to the Air Force Installation Restoration Program. The HARM system considers four aspects of the hazard posed by a specific site: the waste and its characteristics, the potential pathways for waste contaminant migration, the potential receptors of the contamination, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that

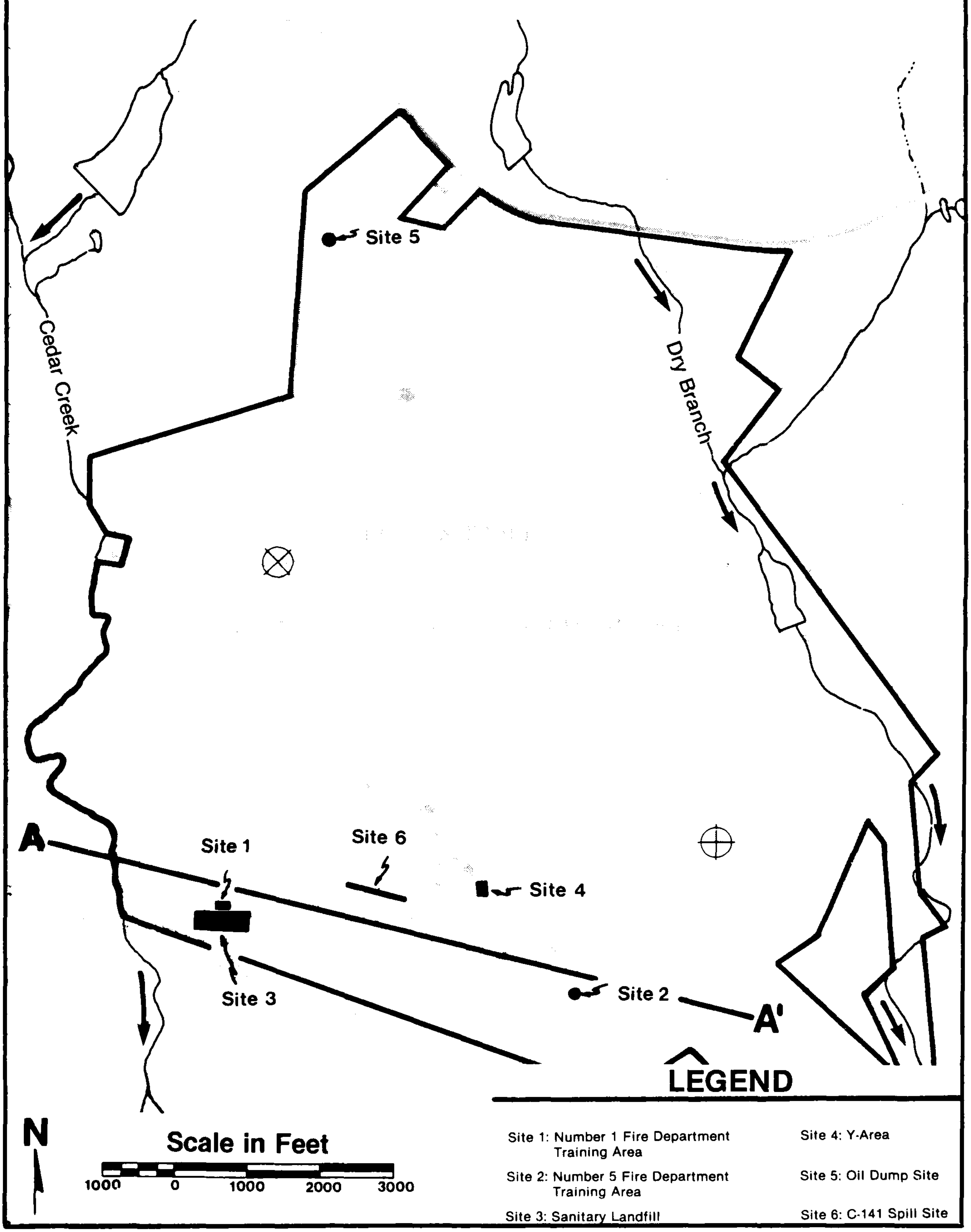


FIGURE 12.
Locations of the Rated Waste Disposal and Spill Sites.

are used in the overall hazard rating. Copies of the completed rating forms are included in Appendix E. A summary of the overall hazard ratings is given in Table 7.

The six sites that were not rated were eliminated from additional consideration primarily because the amount (less than one gallon) of waste reportedly disposed of at these sites was so small that very little or no migration potential exists, and, therefore, these sites are considered to pose no environmental threat. Additionally, some of the interviewees indicated that for some of these sites there were no recollections of hazardous materials having been disposed of or spilled. The locations and descriptions of the six unrated sites are presented under the subheading "Miscellaneous Unrated Sites" on page IV-19. The sites are (1) Borrow Pit/Unofficial Dump Sites, (2) other Fire Department Training Areas, (3) Drainage System, (4) former Gasoline Station, (5) Herbicide Spill, and (6) Building 225 Engine Test Cell.

The following is a description of each rated site, including a brief description of the rating results.

1. Disposal Sites

a. Site No. 1 (HARM Score: 67)

Site No. 1 is the area of the No. 1 Fire Department Training Area. No visible traces of this training area remain; however, reports indicate that an estimated 16,000 gallons of liquid waste material was disposed of in this area during the period 1947-1955. Of these 16,000 gallons that were transported to this site for disposal, it is estimated that 80 percent was consumed in the fires; therefore, only 3,200 gallons is estimated to have remained at the site. The approximate location of Site No. 1 is shown in Figure 12. It received an overall HARM score of 67. The receptors subscore of 53 is primarily because of the following four factors: (1) the distance to the nearest well is less than 3,000 feet, (2) the distance to the installation boundary is less than 1,000 feet, (3) there is a pristine natural wetland area within a one-mile radius of the site, and (4) the population

TABLE 7.
Summary of Results of Site Ratings.

Priority	Site No.	Site Description	Subscores: Receptors	Subscores: Waste Characteristics	Subscores: Pathway	Subscores: Waste Mgmt. Practices	Overall Score
1st	2	No. 5 Fire Training Area	49	90	67	1.00	69
2nd	1	No. 1 Fire Training Area	53	80	67	1.00	67
3rd	3	Sanitary Landfill	53	54	72	0.95	57
4th	4	Y-Area Storage Site	49	54	74	0.95	56
5th	5	Oil Dump Site	53	40	74	1.00	56
6th	6	C-141 Spill	49	48	74	0.95	54

served by ground water within three miles of the site exceeds 1,000, as reported in the 1980 census data provided by the Central Midlands Regional Planning Council. The waste characteristics subscore is 80 because of the medium total amount of waste (3,200 gallons) estimated to have remained at this site. Also, the hazard rating of this material is high due to the low flash point (<80°F) of the aviation gasoline and similar liquids present in the waste. The pathways subscore is 67 because of the following four factors: (1) the depth to ground water is probably less than 10 feet, (2) net precipitation is greater than 20 inches, (3) rainfall intensity exceeds 50 thunderstorms per year, and (4) soil permeability is moderately high.

b. Site No. 2 (HARM Score: 69)

Site No. 2 is the current location of the Fire Department Training Area (Training Area No. 5), where a total of approximately 63,000 gallons of waste was reportedly brought for disposal. The receptors subscore is 49 primarily because of the following four factors: (1) the distance to the nearest well is less than 3,000 feet, (2) the distance to the installation boundary is less than 1,000 feet, (3) there is a pristine natural wetland area within a one mile radius of the site, and (4) the population served by ground water within three miles of the site exceeds 1,000. The waste characteristics subscore is 90 because of the large total amount of residual waste (12,300 gallons) remaining at this site subsequent to burning. Also, the hazard rating of this material is high due to the low flash point (<80°F) of the materials present in the waste. The pathways subscore is 67 because of the following three factors: (1) net precipitation is greater than 20 inches, (2) rainfall intensity exceeds 50 thunderstorms per year, and (3) soil permeability is moderately high. This training area contains standing water, burned scrap metal, and floating fuel residues that impart a pronounced hydrocarbon odor downwind of the site. An estimated 63,000 gallons of waste material has been disposed of in this area since 1970. Assuming that 80 percent of this volume was consumed by fire, only 12,600 would have remained at the site. Natural vegetation has been cleared from several feet around the perimeter, and visible discoloring of the soil is apparent up to 2-3 feet outside of the pit.

c. Site No. 3 (HARM Score: 57)

Site No. 3 is the location of the sanitary landfill. The receptors, waste characteristics, and pathways subscores were 53, 54, and 72, respectively. The sanitary landfill is located at the end of Arizona Road near the railway forming the southern boundary of the base. It was operated from 1947 until its closure in 1980. Open burning of trash was a standard procedure at the landfill for two decades. Between 5 and 30 gallons of waste motor oil, lubicating oils, and fuel were routinely added to the refuse each week to stimulate and maintain the fires; however, the predominant solid wastes placed in the landfill were paper and domestic refuse, old wood from demolished structures, general construction rubble, and a variety of empty or partially filled small (5- to 20-gallon) containers. Assuming an average disposal volume of 15 gallons per week, and the 33-year lifespan of the landfill, plus the probability that at least 90 percent of this waste was destroyed by fire, then a total waste residual of approximately 2,600 gallons may have remained at this site. Ninety percent of the liquid waste deposited in the landfill is assumed to have been destroyed by fire, as compared to only 80 percent for the fire department training areas because, at the landfill no attempt was made to extinquish the fires. These containers were mostly empty solvent, and paint and pesticide cans, although many contained hardened paint or polyurethane. For an undetermined period, (from at least 1960 until 1970), approximately 15 gallons per year of used paints, strippers,

and thinners from the Motor Pool were packaged in 5-gallon containers and placed in the landfill. The practice of burning was discontinued in 1967 when burial procedures were instituted. Two parallel trenches (14 feet wide, 8 feet deep, and several hundred feet long) were excavated, and trash was unloaded from dumpsters and compacted and covered with dirt using heavy equipment until the trenches were gradually filled in. A few incidents of spontaneous combustion reportedly occurred during the initial period of landfilling operations, but there is no evidence that any other unusual events took place in subsequent years. Landfilling operations ceased in 1980 when trash removal services were procured from a private contractor.

Visual inspection of the area revealed that the site has been used infrequently since closure for limited dumping purposes. Items scattered in localized areas of the landfill site included an empty 5-gallon paint thinner can, several small motor oil and antifreeze containers, a refrigerant filter canister, several dozen 50-ml vials filled with an organidin dry solution, and several small piles of waste runway seam-sealing strips. No visible contamination of the soil or evident plant growth reduction was observed in any portion of the former landfill site. There is no evidence that any empty or full 55-gallon drums, battery casings, or radioactive wastes of any kind were ever placed in the landfill. The bottoms of the trenches are red clay, and ground water was apparently never encountered during landfill operations.

d. Site No. 5 (HARM Score: 56)

Site No. 5 is the oil dump site. The receptors, waste characteristics, and pathways subscores were 53, 40, and 74, respectively. This unauthorized oil dumping site was discovered at the end of an abandoned road near the northern base boundary. This area had been the site of the officers' quarters when the Army Air Corps controlled the base, but the structures were removed before 1947 and this portion of the base was never further developed. The visible oil patch measured approximately 30 feet in width and 100 feet in length and was free of most vegetation. Stunted plant growth was observed around the periphery of the spill site. The oily substance was consolidated with sand throughout the greater portion of the area, and was most obvious in saturated leaf litter. A distinct hydrocarbon odor was apparent immediately downwind of the area. Erosion of the flat surface appeared minimal and there was no obvious pathway for runoff to exit the area in a concentrated flow. This site was not mentioned during any of the interviews; therefore, no estimates of the volume of material disposed of at this site are available. The size of the visible oil patch suggests a small total volume of waste.

2. Spill Sites

a. Site No. 4 (HARM Score: 56)

Site No. 4 is the Y-area waste storage facility. The receptors, waste characteristics, and pathways subscores were 49, 54, and 74, respectively. The ground surrounding the concrete pad was reportedly saturated due to chronic, minor spillage throughout the history at the site, and remains so today. Vegetative growth is sparse in the saturated zones; however, ground erosion is minimal and there are no direct pathways for runoff to enter a nearby drainage ditch. Since no large spills resulting from major accidents were reported for this site, it is estimated that only a medium total volume of waste was spilled at this site throughout the history of its operation.

b. Site No. 6 (HARM Score: 54)

Site No. 6 is the C-141 spill area. The receptors, waste characteristics, and pathways subscores were 49, 48 and 74, respectively. This site was rated because it represents the only major hazardous liquid spill on record at McEntire ANG Base. It occurred on the afternoon of March 7, 1982, when an estimated 9,000 gallons of JP-4 was released from a burning C-141 aircraft. Most of the fuel was consumed in the fire on the ramp, but some entered underground storm conduits and flowed into an open drainage ditch running parallel to Mississippi Road. As the fuel burned, an earthen dam was constructed approximately one-half mile from the spill site immediately upstream of the confluence with a second drainage ditch. The fires were extinguished that evening. On the following day, the residual amounts of fuel observed downstream of the dam and a portion of the fuel behind the dam were collected using absorbent pads. After consultation with the South Carolina Department of Health and Environmental Control (DHEC), the majority of the remaining fuel was burned and the rest absorbed. It is probable that less than 5 percent (450 gallons) of the original 9,000 gallons remained at this site subsequent to the burning and cleanup efforts. An inspection performed by the DHEC representative confirmed that no fuel had left the base. At the time the original earthen dam was broken, a straw dike was constructed and remained for several weeks to absorb any remaining fuel. A current visual examina- tion of the drainage ditch revealed no traces of hydrocarbon contamination in the water, sediments, or adjacent vegetation.

C. Miscellaneous Unrated Sites

There are six miscellaneous unrated sites. These six sites were eliminated from additional consideration primarily because the amount of waste reportedly disposed of at these sites was so small that very little or no migration potential exists; therefore, these sites are considered to pose no environmental threat. Additionally, some of the interviewees indicated that, for some of these sites, there were no recollections of hazardous materials having been disposed or spilled.

1. Disposal Sites

a. Borrow Pit/Unofficial Dump Sites

A large borrow pit is located near the alert barns at the northern end of the main runway. This site has been used for the disposal of construction debris since SCANG units arrived in 1947. Materials placed in the shallow, flat surface of the pit consisted primarily of concrete rubble, wooden palettes, tree stumps, and brush cuttings. No burial or open burning of refuse or hazardous liquid wastes was conducted at this site. A visual inspection of the borrow pit revealed one empty 5-gallon container with no label, an empty cardboard barrel, some plastic sheeting, and a pile of waste runway seam-sealing strips amid the widely scattered construction debris. The surface of the pit consisted of hard red clay that had undergone considerable erosion and compaction, thereby preventing recolonization by vegetation. There was no evidence of surface contamination in any area of the pit.

A few unofficial dump sites were discovered in a brushy, upland area near the sanitary wastewater treatment plant and the western base boundary. Located in the same general vicinity, these few sites contained mostly brush cuttings, waste wood, and some scrap metal. However, they also contained a few empty paint cans and about a dozen containers of asphalt sealer from which some of the tarlike contents had dripped and hardened. Vegetation growth was dense throughout these sites, and there was no evidence of any significant contamination or ground disturbance.

b. Other Fire Department Training Areas

Three Fire Department Training Areas, in addition to the two that have been rated, were used as hazardous materials disposal sites. These three sites include Fire Department Training Areas Nos. 2 and 3, and the Fire

Department Training Area in the field across Mississippi Road from the engine test facility in Building 225. The history and descriptions of these sites have been presented in the Activity Review section of this report.

2. Spill Sites

a. Drainage System

A visual inspection was performed of the drainage ditches surrounding runways, taxiways, and parking ramps of the airfield complex. The only location showing any evidence of hydrocarbon contamination was a short segment of ditch situated immediately downstream of an oil/water separator (OWS) outfall. The OWS, located between the aircraft washrack and Building 90, appeared in good working order. The OWS effluent entering the drainage ditch from an underground conduit was odorless and had no visible hydrocarbon sheen. The water in the ditch appeared similarly uncontaminated; however, small amounts of oil were easily dispersed over the water surface by disturbing the vegetation on the banks of the ditch. No such visible sheen was evident in riparian vegetation upstream of the OWS outfall or downstream approximately 20 feet from the outfall. More than half of the drainage ditches within the base boundaries were found to be dry at the time of inspection.

b. Former Gasoline Station

Interviews with former base personnel revealed that an undetermined amount of 100-octane fuel leaked from a truck trailer in the vicinity of the former gasoline station during the late 1940's. The possibility also was raised that gasoline had leaked from the two underground tanks at the station. Located across the street from base headquarters, the area has long since been paved over and is now a parking lot. The gasoline tanks were reportedly pumped dry and filled with water before the area was paved.

c. Herbicide Spill

The only known pesticide spill at McEntire ANG Base was described during an interview. In the late 1960's, approximately 100 gallons of the selective herbicide UROX was inadvertently released to a drainage ditch upland from the Cedar Creek flood plain. Several pine trees bordering the ditch near the spill area were reportedly killed. However, due to conditions of minimal flow, no evidence of vegetation damage was observed further downstream at that time or during the site survey.

d. Building 225 Engine Test Cell

The Building 225 engine test cell has been a source of chronic, minor JP-4 spillage in the vicinity of the fuel tanks used to supply the engines during tests. Visible contamination of the soil at the engine test cell (Building 225) is confined to the area immediately surrounding the portable fuel tank. Vegetation growth is very poor in this zone, yet the flat surface showed no evidence of being prone to erosion or directed runoff. Also, there are no drainage ditches near this location.

V. CONCLUSIONS

V. CONCLUSIONS

- Information obtained through interviews with 23 past and present base personnel, review of base records, and field observations has resulted in the identification of 12 past disposal and/or spill sites on McEntire ANG Base.

- Of these 12 sites, 6 have been determined to have the potential for contaminant migration, and, therefore, have been further evaluated using the Air Forces's Hazard Assessment Rating Methodology. Table 7 presents a priority listing of these waste disposal and spill sites and their associated hazard assessment scores. Site Nos. 2 and 5 presently exhibit varying degrees of environmental stress.

- No evidence of off-base environmental stress resulting from past disposal of waste materials was observed in the immediate vicinity around McEntire ANG Base. Because the shallow aquifer discharges to Cedar Creek, it is extremely unlikely that any off-base domestic wells that draw water from the shallow aquifer will have become contaminated, even if the on-base shallow aquifer has received contaminants. Additionally, it is highly unlikely that any of the aforementioned base activities have resulted in contamination of any off-base groundwater supplies obtained from the deep aquifer.

- No direct or indirect evidence of groundwater contamination was discovered. However, a moderate potential for migration of contaminants off base exits along the western boundary of the base due to the close proximity of several of the disposal/spill sites to one another and their close proximity to a shallow subsurface gravel aquifer which is below the western boundary of the base and which discharges into Cedar Creek.

- The identified waste disposal/spill sites are confined to a relatively small area of McEntire ANG Base and are generally aligned in directions nearly parallel to the anticipated direction of shallow ground water flow. Therefore, the probability is high that, <u>if</u> contamination from these sites has reached the shallow ground water, the total land-surface area below which the ground water is contaminated will be small.

- Because it is anticipated that only a relatively small subsurface area may be negatively impacted, no more than 4 sets of shallow monitoring wells (16 total) will be required for Phase II of the IRP as indicated in the following recommendations.

VI. RECOMMENDATIONS

VI. RECOMMENDATIONS

The overall hazard potential resulting from previous disposal practices and spills at McEntire ANG Base is relatively low; however, the existing potential for contaminant migration necessitates monitoring of selected areas. Four locations are indicated in Figure 13 where shallow groundwater monitoring wells should be installed. The primary purposes for these wells are to:

- o Determine whether the shallow gravel aquifer is present under the area of investigation and, therefore, whether the potential for subsurface migration of contamination at the monitored area exists.
- o If the gravel aquifer is present, facilitate analysis of the shallow ground water under and down-gradient of the site. If the shallow aquifier is not present, facilitate analysis of ground water from the deep aquifer.
- o Determine the direction and rate of contaminant migration if contamination is discovered within either the shallow or deep aquifers underlying the monitoring locations.

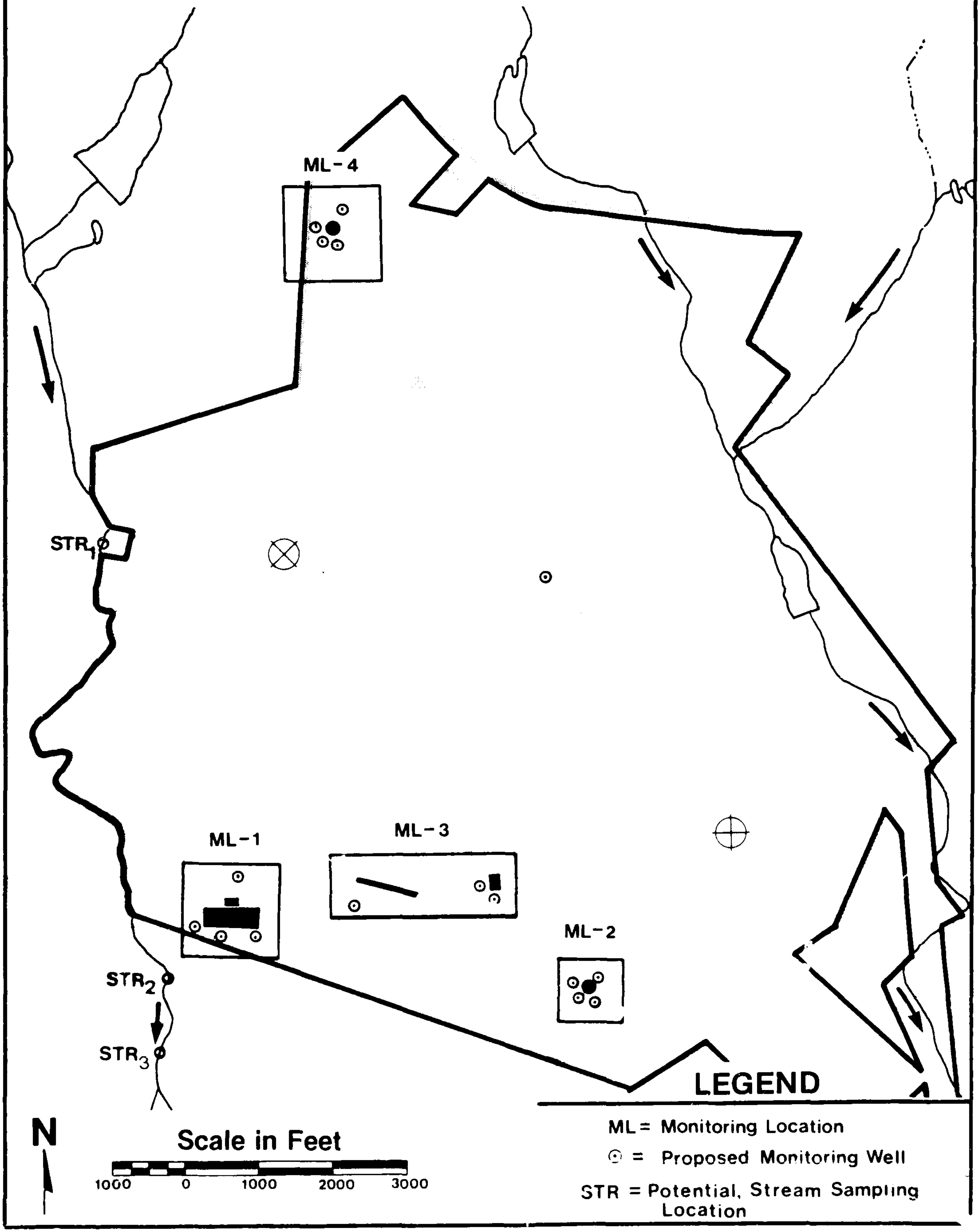
A. Locations To Be Monitored

Four locations are recommended where shallow groundwater monitoring wells should be installed. These locations are indicated in Figure 13. The first location is in the vicinity of disposal/spill sites 1 and 3, which, are the No. 1 Fire Department Training Area and the sanitary landfill, respectively. The second location is at site No. 2, which is the No. 5 Fire Department Training Area. The third location encompasses site Nos. 4 and 6, which are the Y-Area Waste Storage Site and the C-141 spill site. The fourth location is at site No. 5, which is the oil dump site.

At each of these locations to be monitored, four monitoring wells should be installed. Three of these wells should be installed down-gradient of the suspected waste disposal/spill site(s) and one should be located up-gradient. The approximate locations of these recommended monitoring wells are shown in Figure 13.

HMTC

FIGURE 13.
Conceptual Representation of the Phase II Recommendations.



B. General Monitoring Well Construction Criteria

1. Each well should be carefully logged during drilling so that the locations of the shallow subsurface gravels can be determined. If the gravel is present, it is expected that it will occur at a depth of from 20 to 50 feet below surface and have a thickness of from 6 inches to 15 feet. Well screens for the monitoring wells should be placed at elevations coincident with the gravel layers.

2. If this gravel is not present, the monitoring well should be extended to the depth necessary to intersect and screen the confined sandy aquifers of the Tuscaloosa Formation. This depth is likely to be from 80 to 160 feet below the surface.

C. Sampling Criteria

Ground water from each screened interval for all wells should be collected and analyzed for volatile organic carbon species, oil and grease, total organic halogens, phenols, and heavy metals. If the results of analysis of water samples from the shallow gravel aquifer are positive, then surface water samples should be collected from Cedar Creek at the approximate locations illustrated in Figure 13. These surface water samples should also be analyzed for the above constituents to determine whether offsite migration of contaminants is occurring. If the results of analysis of water samples from the sandy portions of the Tuscaloosa Formation are positive, then water samples from the McEntire ANG Base wells and domestic wells near the base boundary should be analyzed for the above constituents.

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS USED IN THE TEXT

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS USED IN THE TEXT

AFB	Air Force Base
AGE	Aerospace Ground Equipment
ANG	Air National Guard
ANGSC	Air National Guard Service Center
AVGAS	Aviation Gasoline
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DHEC	Department of Health and Environmental Control
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DLA	Defense Logistics Agency
DOD	Department of Defense
DPDO	Defense Property Disposal Office
EPA	Environmental Protection Agency
°F	Degrees Fahrenheit
gal/mo	gallons per month
gal/yr	gallons per year
HARM	Hazard Assessment Rating Methodology
HMTC	Hazardous Materials Technical Center
IRP	Installation Restoration Program
JP	Jet Petroleum
MEK	Methylethylketone
MOGAS	Motor Gasoline
MSL	Mean Sea Level
NDI	Nondestructive Inspection
No.	Number

OWS	Oil-Water Separator
PCB	Polychlorinated Biphenyl
PD	Petroleum Distillate
POL	Petroleum, Oils, and Lubricants
ppm	Parts per Million
RCRA	Resource Conservation and Recovery Act
SCANG	South Carolina Air National Guard
SCWRC	South Carolina Water Resources Commission
USAF	United States Air Force
UTAS	Unit Training Assemblies

GLOSSARY OF TERMS

GLOSSARY OF TERMS

1. ALLUVIUM - A general term for clay, slit, sand, gravel, or similar unconsolidated detrital material deposited during comparatively recent geologic time by a stream or other body of running water as a sorted or semisorted sediment in the bed of the stream or on its flood plain or delta.

2. AQUIFER - A geologic formation, or group of formations, that contains sufficient saturated permeable material to conduct ground water to yield economically significant quantities of ground water to wells and springs.

3. BERMUDA HIGH - The high pressure area, normally located over Bermuda, which results from the descent of cool air along the northern boundary of the northern, equatorial Hadley Cell.

4. CONFINING STRATA - A strata of impermeable or distinctly less permeable material stratagraphically adjacent to one or more aquifers.

5. CONTAMINANT - As defined by section 104(a)(2) of CERCLA, shall include, but not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformation, in such organisms of their offspring.

6. DEVELOPER - A chemical used to make images visible on exposed film; typically sodium hydroxide or sodium sulfite.

7. DISCHARGE - The process involved in the draining or seepage of water out of a groundwater aquifer.

8. DOWN-GRADIENT - A direction that is hydraulically down-slope; the direction in which ground water flows.

9. EMULSIFIER - A substance used to hold very fine oily or resinous liquid suspended in another liquid; in photography, a suspension of silver salt in gelatin used to coat plates and film.

10. EVAPOTRANSPIRATION - Evaporation of water from the ground surface and transpiration through vegetation.

11. FALL ZONE - The north-south trending area along the eastern United States that marks the boundary between the Piedmont Physiographic Province to the west, and the Coastal Plain Physiographic Province to the east.

12. FIXER - A photographic chemical wash solution, usually of sodium sulfite, that prevents discoloration of photographic film.

13. HAZARDOUS WASTE - A solid or liquid waste that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may:

(a) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible, illness; or

(b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed.

14. IMHOFF TANK - A tank in which the solids in sanitary sewage are removed by sedimentation and undergo digestion in a separate compartment.

15. MIGRATION (Contaminant) - The movement of contaminants through pathways (ground water, surface water, soil, and air).

16. ORDNANCE - Any form of artillery, weapons, or ammunition used in warfare.

17. PCB (Polychlorinated Biphenyl) - A chemically and thermally stable toxic organic compound that, when introduced into the environment, persists for long periods of time, is not readily biodegradable, and is biologically accumulative.

18. PD-680 - A petroleum distillate used as a safety cleaning solvent. Two types of PD-680 solvent have been used: Type I, having a flash point of 100° F; and Type II, having a flashpoint of 140° F.

19. PERMEABILITY - The capacity of a porous rock, sediment, or soil for transmitting a fluid without impairment of the structure of the medium; it is a measure of the relative ease of fluid flow under unequal pressure.

20. PIEZOMETRIC SURFACE - An imaginary surface that is coincident with the elevation to which water from a pumped or nonpumped aquifer would rise in a well hydraulically connected to that aquifer.

21. STATIC WATER ELEVATION - The elevation to which water from a nonpumped aquifer would rise in a well hydraulically connected to that aquifer.

22. STRATA - Distinguishable horizontal layers separated vertically from other layers.

23. SURFACE WATER - All water exposed at the ground surface, including streams, rivers, ponds, and lakes.

24. UP-GRADIENT - A direction that is hydraulically up-slope.

25. WATER TABLE - The upper limit of the portion of the ground wholly saturated with water.

26. WETLAND - An area subject to permanent or prolonged inundation or saturation that exhibits plant communities adapted to this environment.

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REFERENCES

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APPENDICES

APPENDIX A.

OUTSIDE AGENCY CONTACT LIST

OUTSIDE AGENCY CONTACT LIST

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   Columbia, South Carolina
   John C. Purvis (State Climatologist)
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3. Research and Statistical Services Division
   Geological and Geodetic Surveys
   Columbia, South Carolina
   Alan Zupan (Geologist)
   (803) 758-6431

4. United States Geological Survey
   Water Resources Division
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5. South Carolina Division of Health and Environmental Control
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   Gary Padgett (Manager of Assessment and Development)
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6. South Carolina Division of Health and Environmental Control
   Division of Engineering Programs and Development
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   Chris Staton (Environmental Engineer Associate)
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7. South Carolina Division of Health and Environmental Control
   District Office
   State Park, South Carolina
   Ed McVowell (Solid & Hazardous Waste Consultant)
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8. South Carolina Division of Health and Environmental Control
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10. Central Midlands Regional Planning Council
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11. University of South Carolina
Department of Geology
Columbia, South Carolina
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12. Coleman Well Drilling
Hopkins, South Carolina
William Coleman (Owner)
(803) 776-2136

APPENDIX B.

RESUMES OF SEARCH TEAM MEMBERS

RESUMES OF SEARCH TEAM MEMBERS

TORSTEN ROTHMAN

Senior Environmental Engineer

EDUCATION

M.S., environmental health engineering, University of Texas
B.Ch.E., Rensselaer Polytechnic Institute

EXPERIENCE

Mr. Rothman has twenty-four years of experience in all aspects of environmental health engineering, hazardous wastes and solid wastes management, environmental impact analysis, wastewater treatment, and air pollution evaluation and control. This includes twenty years as an Air Force bioenvironmental engineer with service at base level, major command, research and consulting laboratories and USAF headquarters. In-depth knowledge and understanding of Air Force operations, organization and the occupational safety and health programs.

Mr. Rothman managed the implementation of the National Environmental Policy Act for the U.S. Air Force and directed and managed the preparation and filing of over 15 Environmental Impact Statements. The subjects of these impact statements covered a broad spectrum of biophysical and socioeconomic issues. Mr. Rothman was responsible for technical adequacy, accuracy and completeness, as well as procedural compliance of all documents. He also served on the staff of the Air Force Surgeon General as an advisor on all aspects of environmental health engineering and directed the development of Air Force policy for compliance with Federal regulations in areas of wastewater, solid waste, air pollution and drinking water.

Mr. Rothman's Bioenvironmental Engineering experience includes the provision of a full range of occupational and environmental health services to various Air Force installations. These services included conducting numerous industrial hygiene, medical and industrial ionizing radiation, wastewater, and environmental protection studies and membership in a Disaster Response Force responsible for medical surveillance of nuclear, biological and chemical decontamination procedures and personnel protection and monitoring.

Mr. Rothman's municipal wastewater experience includes in-depth studies on trickling filter and activated sludge municipal wastewater treatment plants. Most of these studies were performed while he was a consultant to the Pacific-area Air Force Installations regarding all aspects of environmental health engineering. Related studies include research on solid waste management practices and combustion products of plastics commonly found in municipal refuse.

Presently Mr. Rothman serves as Director of the Hazardous Materials Technical Center, a center of expertise for information on all aspects of hazardous materials/hazardous waste management including safety and health, transportation, storage, handling and disposal. The types of projects that Mr. Rothman routinely manages include those involved with environmental engineering, hazardous waste management, sanitary engineering and waste treatment.

CERTIFICATION

Diplomate, American Academy of Environmental Engineers
Professional Engineer (environmental health), Texas

HONORS

Sigma Xi, Research Society of America
Chi Epsilon, Civil Engineering Honorary
Phi Kappa Phi, Scholastic Honorary
Registry of International Consultants, American Public Health Association
Member Emeritus of American Conference of Governmental Industrial Hygienists

WILLIAM EATON

HYDROGEOLOGIST

EDUCATION

M.S., environmental sciences, University of Virginia
B.A., geology, Susquehanna University

EXPERIENCE

Mr. Eaton's primary experience is in the areas of geologic and ground water investigation of sites that were contaminated by hazardous or toxic organic and inorganic chemical substances. These investigations have included emergency response to ruptured surface petroleum storage tanks and sub-surface pipelines. In such instances Mr. Eaton directed on-site remedial actions including the proper location and installation of subsurface containment barriers and nested piezometers designed to sample various confined aquifers. Similar studies involved the investigation of hazardous waste dump sites and the development of contract design specifications for excavation of the buried waste and sealing of the contaminated area.

Investigation of nonpoint sources of chemical contamination have also been conducted by Mr. Eaton. Typically, these studies have involved implementation of a regional scale physical and chemical ground water monitoring scheme and subsequent analysis of the data to pinpoint the probable sources of contamination and contaminant migration directions and rates. Where applicable, consultations were held with the interested parties in order to advise them of alternatives for minimizing the impact of the contamination.

Mr. Eaton has been the primary investigator and author of several reports dealing with the development of ground water resources for municipal, industrial, and domestic purposes. These studies included the design and analysis of pump-test data to determine the hydrogeologic characteristics of the tested aquifers. Such investigations have been performed in bedrock aquifers and unconsolidated, confined and unconfined aquifers.

HONORS

Sigma Xi, Research Society of America

PUBLICATIONS

"Microbial Mineralization of ^{14}C-Labeled Bromobenzene," Presented at the National Meeting of the American Society of Microbiology; New Orleans, Louisiana, March, 1983.

MARCUS A. PETERSON

EDUCATION

M.S., water resource management, University of Quebec, 1983
B.A., biology, University of New Brunswick, 1976

EXPERIENCE

Mr. Peterson's responsibilities at Dynamac Corporation involve feasibility studies dealing with the thermal destruction of hazardous waste. He has participated in site surveys of hazardous waste management practices and incineration facilities at U.S. Navy bases, evaluated current incineration technologies, documented emerging trends in thermal destruction R&D, and defined the regulatory environment for waste co-firing and incineration applications by the U.S. Navy.

Mr. Peterson's past experience includes the direction of a contract to analyze and evaluate U.S. Department of Energy environmental information systems and compliance overview efforts. He developed options and recommendations for improving the environmental and radiological surveillance practiced at DOE nuclear weapons facilities. He also recommended changes to internal DOE Orders to support improvements in monitoring and reporting and data reporting procedures.

Previously, Mr. Peterson was assigned the technical coordination of a U.S. Fish and Wildlife Service contract to prepare a bibliography and eight ecosystem-specific reports dealing with the effects of air pollution and acid rain on fish, wildlife and habitat. As part of this project, he compiled the bibliography of more than 2,000 references and authored both the introductory volume of the series and reports concerning ecological impacts on grasslands, urban ecosystems, and critical habitats of endangered species.

Prior to his employment at Dynamac, Mr. Peterson analyzed Flood Insurance Studies for technical accuracy under a contract with the Federal Insurance Administration. He compiled a bibliography on social impact assessment for the Ministry of Natural Resources of the Government of Quebec, and analyzed various impact assessment methodologies for application to specific scientific and technical articles from French to English for water science researchers in Quebec.

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

International Association for Impact Assessment

PUBLICATIONS

Peterson, M.A., 1982. The effects of air pollution and acid rain on fish, wildlife, and their habitats - introduction. U.S. Fish and Wildlife Service, Biological Services Program, Eastern Energy and Land Use Team, FWS/OBS-80/40.3. 181 pp.

Peterson, M.A., 1982. The effects of air pollution and acid rain on fish, wildlife, and their habitats - grasslands. U.S. Fish and Wildlife Service, Biological Services Program, Eastern Energy and Land Use Team, FWS/OBS-80/40.7. 63 pp.

Peterson, M.A., 1982. The effects of air pollution and acid rain on fish, wildlife, and their habitats - urban ecosystems. U.S. Fish and Wildlife Service, Biological Services Program, Eastern Energy and Land Use Team, FWS/OBS-80/40.10. 89 pp.

Peterson, M.A., 1982. The effects of air pollution and acid rain on fish, wildlife, and their habitats - critical habitats of threatened and endangered species. U.S. Fish and Wildlife Service, Biological Services Program, Eastern Energy and Land Use Team, FWS/OBS-80/40.11. 55 pp.

JAN SCOPEL

:m:cal engineering, University of Maryland

:l s responsibilities at Dynamac Corporation involve providing ise Logistics Agency's Hazardous Materials Technical Center in:cal expertise for the analysis and application of technical indards, guidelines, and regulations for the manufacture and inagement of chemicals and hazardous materials and wastes.

:l's experience in hazardous materials includes a records id regulatory agency interview to identify, review and compliance with environmental monitoring and reporting :nts of the Department of Energy's Hanford, Washington and its, Colorado nuclear weapons and fuel reprocessing :s. Reviews of the hazardous and radioactive waste management of these facilities were conducted.

:l served as project chemical engineer for a program to ind validate a computer model and data base of a number of :hemical unit processes. The objective of the program was to jeneric and specific hazardous chemical pollutants by waste juantity and points of separation.

:l's experience also includes the identification, characteri- id assessment of existing and emerging engineering control jy for reducing occupational exposure to hazardous and toxic ; and physical agents associated with synfuel processes and ir/-using industries. These studies were conducted for the Iistitute for Occupational Safety and Health and required a surveys across the U.S. and involved development of :e visit protocol, review of plant operating data records and vs with plant management and operators.

:l conducted a search of specifications on all military l sive trains for the U.S. Army, Chemical Systems Laboratory :t rize chemical and mechanical components for incorporation in tions compatibility model.

APPENDIX C.

LIST OF INTERVIEWEE IDENTIFICATION NUMBERS

LIST OF INTERVIEWEE IDENTIFICATION NUMBERS

Interviewee Number	Primary Duty Assignment	Years Associated with McEntire ANGB
1	Aircraft Maintenance	29
2	Aircraft Maintenance	23
3	Flightline	29
4	Civil Engineering	15
5	Civil Engineering	6
6	Civil Engineering	22
7	Flightline	33
8	Civil Engineering	30
9	Base Maintenance	34
10	Motor Pool	23
11	Fire Department	22
12	Motor Pool	23
13	Aircraft Maintenance	32
14	Base Contracting	36
15	Fire Department	23
16	Base Supply	20
17	POL Storage	8
18	NDI/Paint Shop	7
19	Machine Shop	27
20	Environmental Systems	8
21	NDI/Flightline	27
22	Flightline	29
23	Environmental Systems	2

APPENDIX D.

USAF HAZARD ASSESSMENT RATING METHODOLOGY

USAF HAZARD ASSESSMENT RATING METHODOLOGY

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

> "develop and maintain a priority listing of contaminated installations and facilites 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 priorites for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with representatives from the USAF Occupational and Environmental Health Laboratory (OEHL), the Air Force Engineering and Services Center (AFESC), Engineering-Science (ES) and CH_2M Hill.

After us g 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 of this report). The site rating form and the rating factor guideline are provided at the end of this appendix.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, the potential pathways for contamination migration, and any efforts that were made to contain the wastes resulting from a spill.

The receptors 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. Scores for sites at which there is no containment are not reduced. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE ______

LOCATION ______

DATE OF OPERATION OR OCCURRENCE ______

OWNER/OPERATOR ______

COMMENTS/DESCRIPTION ______

SITE RATED BY ______

1. RECEPTORS

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

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

11. 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 Suoscore 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		3		
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

1. **RECEPTORS CATEGORY**

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

Table 1--Continued

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

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

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)	S = Suspected confidence level
o Verbal reports from interviewer (at least 2) or written information from the records	o No verbal reports or conflicting verbal reports and no written information from the records
o Knowledge of types and quantities of wastes generated by shops and other areas on base	o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site

A-3 Hazard Rating

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

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

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

II. WASTE CHARACTERISTICS--Continued

Waste Characteristics Matrix

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

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, bu. the site is greatly suspected of being a source of contamination.

B-1 Potential for Surface Water Contamination

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to +20 inches	Greater than +20 inches	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay (>10^{-2} cm/sec)	15% to 30% clay (10 to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay (>10^{-6} cm/sec)	6
Rainfall intensity based on 1-year 24-hour rainfall	<1.0 inch	1.0 to 2.0 inches	2.1 to 3.0 inches	>3.0 inches	8
(Thunderstorms)	0-5 0	6-35 30	36-49 60	>50 100	

B-2 Potential for Flooding

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

B-3 Potential for Ground-Water Contamination

Rating Factors	0	1	2	3	Multiplier
Depth to ground water	Greater than 500 feet	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to + 20 inches	Greater than +20 inches	6
Soil permeability	Greater than 50% clay (>10^{-6} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay (<10^{-2} cm/sec)	8

Table 1--Continued

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

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

IV. WASTE MANAGEMENT PRACTICES CATEGORY

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

B. Waste Management Practices Factor

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

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

Guidelines for fully contained:

Landfills:

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

Spills:

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

Surface Impoundments:

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

Fire Protection Training Areas:

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

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1, or III-6-3, then leave blank for calculation of factor score and maximum possible score.

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APPENDIX E.

SITE RATING FORMS

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 1: Number 1 Fire Department Training Area

LOCATION: McEntire ANGB, Adjacent to Landfill

DATE OF OPERATION OR OCCURRENCE: 1947 to mid-1950's

OWNER/OPERATOR: McEntire Fire Department

COMMENTS/DESCRIPTION: Fuel/Waste Oil/Solvents burn area

SITE RATED BY: Hazardous Materials Technical Center

1. 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	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	0	9	0	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	95	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 53

II. WASTE CHARACTERISTICS

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

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

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

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

100 x 1.0 = 80

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

80 x 1 = 80

III. PATHWAYS

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

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

Subscore 0

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	3	16	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	3	8	24	24
Subtotals			72	108

Subscore (100 X factor score subtotal/maximum score subtotal) 67

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	3	8	24	24
Net precipitation	3	6	18	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	2	8	16	24
Subtotals			74	114

Subscore (100 X factor score subtotal/maximum score subtotal) 65

C. Highest pathway subscore.

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

Pathways Subscore 67

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	53
Waste Characteristics	80
Pathways	67

Total 200 divided by 3 = 67 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

67 x 1.0 = 67

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 2: Number 5 Fire Department Training Area

LOCATION: McEntire ANGB, 150 yards S.E. of Bldg. 257, south of main taxiway

DATE OF OPERATION OR OCCURRENCE: 1970 to present

OWNER/OPERATOR: McEntire Fire Department

COMMENTS/DESCRIPTION: Fuel burn area

SITE RATED BY: Hazardous Materials Technical Center

1. 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	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	0	9	0	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	89	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 49

11. WASTE CHARACTERISTICS

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

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

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

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

100 x .9 = 90

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

90 x 1.0 = 90

III. PATHWAYS

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

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

Subscore 0

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	3	16	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	3	8	24	24
		Subtotals	72	108

Subscore (100 X factor score subtotal/maximum score subtotal) 67

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	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	50	114

Subscore (100 X factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore.

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

Pathways Subscore 67

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	49
Waste Characteristics	90
Pathways	67

Total 206 divided by 3 = 67 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

69 x 1.0 = 69

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Site No. 3: Sanitary Landfill

LOCATION Southern perimeter at the end of Arizon Road, near rail tracks

DATE OF OPERATION OR OCCURRENCE 1947 to 1980

OWNER/OPERATOR Civil Engineering

COMMENTS/DESCRIPTION Two parallel trenches 14' x 8' X 600'

SITE RATED BY Hazardous Materials Technical Center

1. 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	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	0	9	0	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	95	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 53

11. WASTE CHARACTERISTICS

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

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

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

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

60 x .9 = 54

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

54 x 1.0 = 54

III. PATHWAYS

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

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

Subscore 0

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	3	16	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	3	8	24	24
Subtotals			72	108

Subscore (100 X factor score subtotal/maximum score subtotal) 67

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	3	8	24	24
Net precipitation	3	6	18	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
Subtotals			82	114

Subscore (100 X factor score subtotal/maximum score subtotal) 72

C. Highest pathway subscore.

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

Pathways Subscore 72

IV. WASTE MANAGEMENT PRACTICES

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

Receptors 53
Waste Characteristics 54
Pathways 72

Total 179 divided by 3 = 60
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

60 x .95 = 57

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Site No. 4: Y-Area Waste Storage Site

LOCATION McEntire ANGB, Immediately adjacent to main hanger, Bldg. 253

DATE OF OPERATION OR OCCURRENCE 1947 to 1974

OWNER/OPERATOR McEntire Fire Department/Civil Engineering

COMMENTS/DESCRIPTION Hazardous Materials Technical Center

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	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	0	9	0	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	89	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 49

II. WASTE CHARACTERISTICS

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

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

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

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

60 x 0.9 = 54

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

54 x 1.0 = 54

III. PATHWAYS

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

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

Subscore 0

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	3	8	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	3	8	24	24
		Subtotals	64	108

Subscore (100 X factor score subtotal/maximum score subtotal) 74

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	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	50	114

Subscore (100 X factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore.

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

Pathways Subscore 74

IV. WASTE MANAGEMENT PRACTICES

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

Receptors 49
Waste Characteristics 54
Pathways 74

Total 177 divided by 3 = 59
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

59 x .95 = 56

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Site No. 5: Oil Dump Site

LOCATION McEntire ANGB, Old Officers' Quarters Area, end of road

DATE OF OPERATION OR OCCURRENCE unknown

OWNER/OPERATOR unknown

COMMENTS/DESCRIPTION unauthorized site

SITE RATED BY Hazardous Materials Technical Center

1. 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	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	0	9	0	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	95	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 53

11. WASTE CHARACTERISTICS

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

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

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

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

50 x .8 = 40

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

40 x 1 = 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 0

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	3	8	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	3	8	24	24
		Subtotals	64	108

Subscore (100 X factor score subtotal/maximum score subtotal) 74

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	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	50	114

Subscore (100 X factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore.

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

Pathways Subscore 74

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	53
Waste Characteristics	40
Pathways	74

Total 167 divided by 3 = 56 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

56 x 1.0 = 56

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Site No. 6: C-141 Spill

LOCATION McEntire ANGB, between Arizona and Mississippi Roads

DATE OF OPERATION OR OCCURRENCE March 1982

OWNER/OPERATOR 169th Civil Engineering Flight

COMMENTS/DESCRIPTION ditch segment dammed to contain ramp fuel spill

SITE RATED BY Hazardous Materials Technical Center

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	3	10	30	30
C. Land use/zoning within 1 mile radius	1	3	3	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	0	9	0	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	89	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 49

II. WASTE CHARACTERISTICS

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

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

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

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

60 x .8 = 48

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

48 x 1.0 = 48

III. PATHWAYS

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

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

Subscore 0

B. Rate the migration potential for 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	3	8	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	3	8	24	24
Subtotals			64	108

Subscore (100 X factor score subtotal/maximum score subtotal) 74

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	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			50	114

Subscore (100 X factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore.

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

Pathways Subscore 74

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	49
Waste Characteristics	48
Pathways	74

Total 171 divided by 3 = 57
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

57 X .95 = 54

APPENDIX F.

SUMMARY OF WELL AND BOREHOLE MONITORING AND CONSTRUCTION DATA

SUMMARY OF WELL AND BOREHOLE MONITORING AND CONSTRUCTION DATA

Well or Borehole (W/B) Identification Number	Depth of Bottom of W/B Below Ground Surface (Feet)	Elevation of Top of W/B (feet)	Elevation of Static Water Level (feet) and Date of Observation	Depth of Screened Interval Below Ground (feet)	Depth to Top of Gravel & Total Gravel Thickness (Depth-Thickness in feet)
B1	35	240	225 7/7/65	Not Screened	Not present
B2	50	240	215 7/13/65	Not Screened	35 - 8
B3	70	219	185 7/14/65	Not Screened	50 - 6
B4	50	235	215 7/16/65	Not Screened	Not present
B5	70	233	203 6/28/64	Not Screened	40 - 6 inches
B6	50	219	189 7/14/65	Not Screened	25 - 6
B7	25	233	Dry 5/24/76	Not Screened	25 - < 6 inches
B8	15	233	Dry 5/24/76	Not Screened	Not Present
B9	20	230	Dry 11/30/76	Not Screened	20 - < 6 inches
B10	20	230	Dry 11/30/76	Not Screened	20 - < 6 inches
W1	120	220	175 unknown	70 - 170	unknown
W2	160	220	175 12/5/42 12/10/42	80 - 85, 100 - 105, 150 - 160	unknown
W3	50	225	200 unknown	unknown	unknown
W4	160	220	179.25 1/18/66	119 - 127	unknown

APPENDIX G.

SUPPLEMENTAL ENVIRONMENTAL SETTING INFORMATION

SUPPLEMENTAL ENVIRONMENTAL SETTING INFORMATION

McEntire ANG Base is situated in the upper coastal plains of central South Carolina just east of the fall line separating the Piedmont Physiographic Province to the west from the Coastal Plains Province on the east. The fauna and flora of the area are typical of the Southeastern coastal plains region. The area surrounding McEntire ANG Base consists mainly of small farms. The small towns of Gadsden and Hopkins are located approximately five miles from the base and they have populations of less than one hundred people each. The town of Eastover, located eight miles east of McEntire ANGB, has a population of approximately one thousand. All of these towns have had little population growth during the last twenty years. Industrial land comprises a small fraction of the land area surrounding the base, but further expansion eastward could cause an increase in population and industrialization. Two light industrial plants have been established during the last five years and further light industrial expansion appears likely.

There are three housing areas in close proximity to McEntire ANG Base along Highway 76 and 378. These are the Hunting Creek Farms and Oak Ridge housing subdivisions and the Cedar Creek Mobile Home Park. Other than these three areas of concentrated housing, residential land use around McEntire ANG Base is sparse.

A wildlife survey was conducted in 1982 by the South Carolina Wildlife and Marine Resources Department as part of the Environmental Impact Assessment for the proposed replacement of the A-7D aircraft at McEntire ANGB with F-16 aircraft. No endangered species or critical habitats were found within the potential impact area of the F-16, which includes the entire base. The flora typical of the upper coastal plains of South Carolina is identified in Table 1 of this appendix. The principal wildlife species inhabiting the base are identified in Table 2 of this appendix. This table lists all species known to occur in the general area of the base, proof of presence in this area has not been documented for most of them.

Threatened or endangered species likely to be present within a 50-mile radius of McEntire ANG Base are the Eastern cougar, the American alligator, the red-cockaded woodpecker, the American ivory-billed woodpecker and Backman's warbler. Sightings of the American alligator have been reported in adjacent Cedar Creek, while nests of the red-cockaded woodpecker have been identified at nearby Fort Jackson. The American Peregrine falcon, Southern bald eagle and Kirtland's warbler may occasionally migrate through the area, but are not known to maintain nests within the base boundaries.

Table 1. Flora of the McEntire ANG Base Region

Major Native Trees and Shrubs

Common Name	Scientific Name
Longleaf pine	Pinus palustris
Shortleaf pine	Pinus echinata
Loblolly pine	Pinus taeda
Pond pine	Pinus regida
Virginia pine	Pinus virginiana
Slash pine	Pinus elliottii (introduced)
Turkey oak	Quercus catesbaei
Blackjack oak	Quercus marilandica
Post oak (dwarf)	Quercus stellata
Bluejack oak	Quercus cinerea
Southern red oak	Quercus falcata
Scarlet oak	Quercus coccinea
Water oak	Quercus nigra
Willow oak	Quercus phellos
White oak	Quercus alba
Live oak (dwarf)	Quercus virginiana
Black gum	Nyssa sylvatica
Sweet gum	Liquidambar styraciflua
Persimmon	Diospyros virginiana
Bitternut hickory	Carya cordiformis
Sand hickory	Carya pallida
Mockernut hickory	Carya tomentosa
Sassafras	Sassafras albidum
Red maple	Acer rubrum
Boxelder	Acer negundo
Sycamore	Plantanus occindentalis
Yellow poplar	Liriodendron tulipifera
Sourwood	Oxydendrum arboreum
Willow	Salix nigra
Swamp bay	Persea pubescens

Table 1. Flora of the McEntire ANG Base Region (Continued)

Major Native Trees and Shrubs (Continued)

Common Name	Scientific Name
Flowering dogwood	*Cornus florida*
Swamp dogwood	*Cornus alternifolia*
American holly	*Ilex opaca*
River birch	*Betula nigra*
Beech	*Fagus grandifolia*
Blue beech	*Carpinus caroliniana*
Iron wood	*Ostrya virginiana*
Eastern red cedar	*Juniperus virginiana*
Atlantic white cedar	*Chamaecyparis thyoides*
Red mulberry	*Morus rubra*
American elm	*Ulmus americana*
Alder	*Alnus spp*.
Eastern redbud	*Cercis canadensis*
Catalpa	*Catalpa bignonioides*
Black cherry	*Prunus serotina*
Chokecherry	*Prunus virginiana*
Wild plum	*Prunus spp*.
Hawthorne	*Crataegus spp.*
American beauty berry	*Calcarpa americana l*.
Gallberry	*Ilex spp*.
Blueberries	*Vacinnium spp*.
Azalea	*Rhododendron spp*.
Rhododendron	*Rhododendron maximum*
Virburnum	*Viburnum spp*.
Fringe tree	*Chionanthus virginicus l*.
Sweet shrub	*Calycanthus floridus*
Mountain laurel	*Kalmia latifolia*
Staghorn sumac	*Rhus typhina*
Smooth sumac	*Rhus glabra*
Poison ivy	*Rhus radicans*
Sweetbay	*Magnolia virginiana*

Table 1. Flora of the McEntire ANG Base Region (Continued)

<u>Major Grasses and Sedges</u> (Common name)

Johnson grass

Nutgrass

Bermuda grass

Various drop seed grasses

Crabgrass

Scerpus (several varieties)

Broom sedge

Dallis grass

Centipede grass

<u>Major Legumes</u> (Common name)

Beggarweed

Partridge pea

Wild pea (climbing or running)

Wild Sweet pea (bush)

Annual lespedezas

Shrub Lespedezas

<u>Partial List of Other Plants Found in the Region</u> (Common name)

Grape

Yellow jasmine

Japanese honeysuckle

Green brier

Virginia creeper

Kudzu (erosion plantings)

Ragweed

Pigweed

Mushrooms (several varieties)

Lichens (several varieties)

Switch cane

Duck weed

Coon tail

Spike rush

Milfoil

Water lilies (several varieties)

Cattail

Table 2a. Mammals of the McEntire ANG Base Region

Common Name	Scientific Name
White-tailed deer	Odocoileus virginianus
Gray squirrel	Sciurus carolinensis
Eastern cottontail	Sylvilagus floridanus
Marsh rabbit	Sylvilagus palustris
Gray fox	Urocyon cinereoargenteus
Red fox	Vulpes fulva
Bobcat	Lynx rufus
Short-tailed shrew	Blarina brevicauda
Eastern mole	Scalopus aquaticus
Eastern pipistrelle	Pipistrellus subflavus
Red bat	Lasiurus borealis
Hoary bat	Lasiurus cinereus
Evening bat	Nycticeius humeralis
Big-eared bat	Plectus reainesquii
Free-tailed bat	Tadarida brasiliensis
Southern flying squirrel	Glaucomys volans
Fox squirrel	Sciurus niger
Rice rat	Oryzomys palustris
Eastern wood rat	Neotoma floridana
Eastern harvest mouse	Reithrodontomys humulis
Cotton mouse	Peromyscus gossypinus
Hispid cotton rat	Sigmodon hispidus
Norway rat	Rattus norvegucus
Black rat	Rattus rattus
House mouse	Mus musculus
Muskrat	Ondatra zibethicus
River otter	Lutra canadensis
Raccoon	Procyon lotor
Long-tailed weasel	Mustela frenata
Mink	Mustela vison
Striped skunk	Mephitis mephitis

Table 2b. Marsupials of the McEntire ANG Base Region

Common Name	Scientific Name
Opossum	Didelphys marsupialis

Table 2c. Birds of the McEntire ANG Base Region

Common Name	Scientific Name
Bobwhite	Colinus virginianus
Mourning dove	Zenaidura macroura
Pied-billed grebe	Podilymbus podiceps
Water turkey	Anhinga anhinga
Great blue heron	Andea herodias
American egret	Casmerodius albus
Cattle egret	Bubulcus ibis
Louisiana heron	Hydranassa tricolor
Little blue heron	Florida caerulea
Green heron	Butorides virescens
Black-crowned night heron	Nycticorax nycticorax
Yellow-crowned night heron	Nyctanassa violacea
American bittern	Botaurus lentiginosus
Least bittern	Ixobrychus exilis
White ibis	Guara alba
Common mallard	Anas platyrhynchos
Black duck	Anas rubripes
Green-winged teal	Anas carolinensis
Blue-winged teal	Anas discors
Baldpate	Mareca americana
Shoveller	Spatula clypeata
Wood duck	Aix sponsa
Ring-necked duck	Aythya collaris
Lesser scaup	Aythya affinis
Hooded merganser	Lophodytes cocullatus
Turkey vulture	Cathartes aura
Black vulture	Coragyps atratus

Table 2c. Birds of the McEntire ANG Base Region (Continued)

Common Name	Scientific Name
Sharp-shinned hawk	Accipiter striatus
Cooper's hawk	Accipiter cooperii
Red-tailed hawk	Buteo jamaicensis
Red-shouldered hawk	Buteo lineatus
Marsh hawk	Circus cyaneus
Sparrow hawk	Falco sparverius
Florida gallinule	Gallinula chloropus
American coot	Fulica americana
Kildeer	Charadrius vociferus
American woodcock	Philohela minor
Wilson's snipe	Capella gallinago
Ground dove	Columbigallina passerina
Yellow-billed cuckoo	Coccyzus americanus
Barn owl	Tyto alba
Screech owl	Otus asio
Great horned owl	Bubo virginianus
Barred owl	Strix varia
Chuck-wills-widow	Caprimulgus carolinensis
Nighthawk	Chlordeiles minor
Chimney swift	Chaetrua pelagica
Ruby-throated hummingbird	Archilochus colubris
Belted kingfisher	Megaceryle alcyon
Flicker	Colaptes auratus
Pileated woodpecker	Dryocopus pileatus
Red-bellied woodpecker	Centurus carolinus
Red-headed woodpecker	Melanerpes erthrocephalus
Yellow-bellied sapsucker	Sphyrapicus varius
Hairy woodpecker	Dendrocopus villosus
Downy woodpecker	Dendrocopus pubescens
Eastern kingbird	Tyrannus tyrannus
Crested flycatcher	Myiarchus crinitus
Tree swallow	Iridoprocne bicolor

Table 2c. Birds of the McEntire ANG Base Region (Continued)

Common Name	Scientific Name
Barn swallow	*Hirundo rustica*
Purple martin	*Progne subis*
Blue jay	*Cyanocitta cristata*
Crow	*Corvus brachyrhynchos*
Fishcrow	*Corvus ossifragus*
Brown-headed nuthatch	*Sitta pusilla*
Carolina wren	*Thryothorus ludovicianus*
Mockingbird	*Mimus polyglottos*
Catbird	*Dumetella carolinensis*
Brown thrasher	*Toxostoma rufum*
Robin	*Turdus migratorius*
Wood thrush	*Hylochichla mustelina*
Hermit thrush	*Hylochichla guttata*
Eastern bluebird	*Sialia sialis*
Blue-gray gnatcatcher	*Polioptila caerulea*
Cedar waxwing	*Bombycilla cedrorum*
Loggerhead shrike	*Lanius ludovicianus*
Starling	*Sturnus vilgaris*
Parula warbler	*Parula americana*
Myrtle warbler	*Dendroica coronata*
English sparrow	*Passer domesticus*
Bobolink	*Dolichonyx oryzivorus*
Meadowlark	*Sturnella magna*
Red-wing blackbird	*Agelaius phoeniceus*
Purple grackle	*Quiscalus quiscula*
Eastern cowbird	*Molothrus ater*
Cardinal	*Richmondena cardinalis*
Rufous-sided towhee	*Pipilo erythropthalmus*
Slate-colored junco	*Junco hyemalis*
Field sparrow	*Spizella pusilla*
White-throated sparrow	*Zonotrichia albicollis*
Song sparrow	*Melospiza melodia*

Table 2d. Reptiles of the McEntire ANG Base Region

Common Name	Scientific Name
Turtles	
Common snapping turtle	Chelydra serpentina
Stinkpot	Sternotherus odoratus
Mud turtle	Kingsternon subrubrum
Spotted turtle	Clemmys guttata
Cooter	Pseudemys floridana
Chicken turtle	Deirochelys reticularia
Yellow-bellied turtle	Pseudemys scripta
Box turtle	Terrapene carolina
Spring softshell	Trionyx spiniferus
Lizards	
Green anole	Anolis carolinensis
Eastern fence lizard	Sceloporus undulatus
Eastern glass lizard	Ophisaurus ventralia
Slender glass lizard	Ophisaurus attenuatus
Six-lined race runner	Cnemidophorus sexlineatus
Ground skink	Lygosoma laterale
Five-lined skind	Eumeces fasciatus
Broad-headed skink	Eumeces laticeps
Southeastern five-lined skink	Eumeces inexpectatus
Snakes	
Red-bellied water snake	Natrix erythrogaster
Banded water snake	Natrix spiedon
Brown water snake	Natrix taxispilota

Table 2d. Reptiles of the McEntire ANG Base Region

Common Name	Scientific Name
	Snake (Continued)
Brown snake	Storeria dekayi
Common garter snake	Thamnophis sirtalis
Eastern ribbon snake	Thamnophis sauritus
Eastern hognose snake	Heterodon platyrhinos
Southern hognose snake	Heterodon simus
Eastern ringneck snake	Diadophis punctatus
Worm snake	Carphophis amoenus
Rainbow snake	Abastor erythrogrammus
Mud snake	Farancia abacura
Racer	Coluber constrictor
Coachwhip	Masticophis flagellum
Rough green snake	Opheodrys aestivus
Corn snake	Elaphne guttata
Rat snake	Elaphe obsoleta
Pine snake	Pituophis melanoleucus
Common kingsnake	Lampropeltis getulus
Scarlet kingsnake	Lampropeltis doliata
Brown kingsnake	Lampropeltis calligaster
Southeastern crowned snake	Tantilla coronata
*Eastern coral snake	Micrurus fulvius
*Copperhead	Agkistrodon contortrix
*Cottonmouth	Agkistrodon piscivorus
*Pigmy rattlesnake	Sistrurus miliarius
*Canebrake rattlesnake	Crotalus horridus

*Venomous

Table 2e. Amphibians of the McEntire ANG Base Region

Common Name	Scientific Name
Sirens	
Greater siren	Siren lacertina
Lesser siren	Siren intermedia
Waterdogs	
Dwarf waterdog	Necturus punctatus
Amphiuma	
Amphiuma	Amphiuma means
Newts & Salamanders	
Newt	Notophithalmus viridescens
Mabee's salamander	Ambystoma mabee
Spotted salamander	Ambystoma maculatum
Marbled salamander	Ambystoma opacus
Flatwoods salamander	Ambystoma cingulatum
Tiger salamander	Ambystoma tigrinum
Dusky salamander	Desmognathus fuscus
Many-lined salamander	Stereochilus marginatus
Slimy salamander	Plethodon glutinosus
Mud salamander	Pseudotriton montanus
Three-lined salamander	Eurycea longicauda
Two-lined salamander	Eurycea bislineata
Dwarf salamander	Manculus quadridigitatus
Toads	
Eastern spadefoot	Scaphiopus holbrooki
Southern toad	Bufo terrestris
Oak toad	Bufo quercicus
Tree frogs	
Pinewoods treefrog	Hyla femoralis
Grey treefrog	Hyla versicolor
Green treefrog	Hyla cinerea
Squirrel treefrog	Hyla squirella
Spring peeper	Hyla crucifer

Table 2e. Amphibians of the McEntire ANG Base Region

Common Name	Scientific Name
Barking treefrog	Hyla gratiosa
Little grass frog	Limnaoedes ocularis
Chorus frogs	
Ornate chorus frog	Pseudacris ornate
Southern chorus frog	Pseudacris nigrita
Brimley's chorus frog	Pseudacris brimleyi
Narrowmouth	
E. Narrow mouth toad	Gastrophryne carolinensis
Cricket frog	
Southern cricket frog	Acris gryllus
True frogs	
Leopard frog	Rana pipiens
Gopher frog	Rana areolata
Carpenter frog	Rana virgatipes
Green frog	Rana clamitans
Bullfrog	Rana catesbeiana

Table 5. Fish Inhabiting Managed Ponds on McEntire ANG Base

Common Name	Scientific Name
Bullhead catfish	Ictalurus sp.
Largemouth bass	Micropterus salmoides
Redear sunfish	Lepomis microlophus
Bluegill sunfish	Lepomis macrochirus

APPENDIX H.

DETAILED LISTING OF BASE OPERATIONS

DETAILED LISTING OF BASE OPERATIONS

OPERATION/Shop Name	Building Number	Handles Hazardous Materials	Generate Hazardous Waste	Current Waste Management Method
Photo Lab (CBPO)	253	X	X	DPDO
Base Flight/Transient Maintenance	60	X		
Hangar	253			
Aerospace Systems	253			
Aerospace Ground Equipemt	200	X	X	DPDO
Corrosion Control	60	X	X	DPDO
Egress Shop	253	X		
Electrical	253			
Engine Shop	251	X	X	DPDO
Engine Test Cell	225	X		
Fabrication	60	X		
Fuel Systems	253	X		
Machine Shop	60	X		
Metal Shop	60	X		
NDI Lab	60	X	X	DPDO
Parachute Shop	249			
Pneudraulics	253	X	X	DPDO
Structural Repair	60	X		
Welding Shop	60			
Avionics	216			
LOX/Environmental System Shop	253	X		
Tire Repair and Reclamation	253	X	X	DPDO
Motor Pool	210	X	X	DPDO
Flight Line	253	X		
Munitions Systems Maintenance	257	X		
Munitions Storage/Handling	242	X		
Clinic	170	X	X	DPDO
Fire Protection	60A	X	X	Training Exercises
Supply	80	X	X	DPDO
Fuels Management (POL)	183	X	X	DPDO
Pest Management	95	X		
Communications	249/258/68			
Army Aviation	165	X	X	DPDO
Weapons System Security	60			

APPENDIX I.

INVENTORY OF POL STORAGE TANKS

INVENTORY OF POL STORAGE TANKS

FUEL	LOCATION, FUNCTION	TANK CAPACITY (gal)	NUMBER, TYPE OF TANKS	PHYSICAL CONDITION (1/80)
JP-4	POL Area	25,000	6-Underground	Good
JP-4	POL Area	5,000	5-Trucks	Good
JP-4	Ready Aircraft	2,525	20-A7D	Good
JP-4	Ready Aircraft (ARNG)	230	20-UH-1	Good
JP-4	Ready Aircraft (ARNG)	78	20-OH-58	Good
JP-4/AVGAS	POL Area, Contaminated	10,000	1-Underground	Good
JP-4	Flight Line, Contaminated		Collector Tank	Unknown
AVGAS	POL Area	35,000	1-Underground	Good
AVGAS	POL Area	1,500	1-Truck	Good
AVGAS	Ready Aircraft	1,730	1-C-131	Good
AVGAS	Ready Aircraft (ARNG)	245	1-U-8	Good
AVGAS	Old ARNG 243	2,000	1-Underground	Pickled
AVGAS	Old ARNG 243	5,000	1-Underground	Pickled
MOGAS	Motor Pool	1,200	1-Truck	Good
Reg. Gasoline	Motor Pool	7,000	1-Underground	Good
Unleaded Reg Gas	Army Av. 165	1,000	1-Underground	Unknown
#2 Fuel Oil	Bldg 242	2,000	1-Underground	Good
#2 Fuel Oil	Bldg 200	4,000	1-Underground	Good
#2 Fuel Oil	Bldg 253	6,000	1-Underground	Good
#2 Fuel Oil	Bldg 253	550	1-Aboveground	Good
#2 Fuel Oil	Bldg 242	550	1-Aboveground	Good
#2 Fuel Oil	Bldg 90	550	1-Aboveground	Good
#2 Fuel Oil	Bldg 90	1,000	1-Aboveground	Good
#2 Fuel Oil	Bldg 84	1,000	1-Aboveground	Good
#2 Fuel Oil	Bldg 83	550	1-Aboveground	Good
#2 Fuel Oil	Bldg 80	1,000	1-Aboveground	Good
#2 Fuel Oil	Bldg 165	10,000	1-Underground	Unknown
#2 Fuel Oil	Bldg 99	550	1-Aboveground	Good
#2 Fuel Oil	Bldg 183	550	1-Aboveground	Good
#2 Fuel Oil	Bldg 244	550	1-Aboveground	Good
#2 Fuel Oil	Bldg 157	550	1-Aboveground	Good
#2 Fuel Oil	Bldg 60	3,000	1-Underground	Good
#2 Fuel Oil	Bldg 61	550	1-Aboveground	Good
#2 Fuel Oil	Bldg 170	1,000	1-Aboveground	Good
#2 Fuel Oil	Bldg 68	1,000	1-Agoveground	Good
#2 Fuel Oil	Bldg 258	550	1-Aboveground	Good
#2 Fuel Oil	Bldg 260	1,000	1-Aboveground	Good
#2 Fuel Oil	Bldg 95	550	1-Aboveground	Good
#2 Fuel Oil	Motor Pool	600	2-Mobile Trailers	Good
#2 Fuel Oil	Motor Pool	1,200	3-Trucks	Good

APPENDIX J.

INVENTORY OF OIL/WATER SEPARATORS

INVENTORY OF OIL/WATER SEPARATORS

Location	Facility Identification	NPDES I.D. (Permit # SC00000701)	Separator Type	Oil Water Disposal/Discharge
Taxiway 14/32	Aircraft Washrack	002	Baffled Chambers	DPDO/Storm Drain
Building 253	Hanger Floor Drain	003	Baffled Chambers	DPDO/Storm Drain
Building 246	Old Motor Pool Washrack	004	Baffled Chambers	DPDO/Storm Drain
Building 165	Army Aviation Washrack	005	Baffled Chambers	DPDO/Storm Drain
Building 210	New Motor Pool Washrack	Not required	Weirs	DPDO/Sanitary Sewer

APPENDIX K.
MCENTIRE ANGB HISTORICAL DETAILS

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The land area now known as McEntire Air National Guard Base was purchased by the Federal Government in 1941. Congaree Army Air Field, as it was then designated, was constructed in 1941-1942, primarily for use as an attack fighter training field for the U.S. Army Air Corps.

The field was transferred to the Navy Department on July 1, 1944 and was designated Congaree Air Base. The base was operated by the U.S. Marine Corps as an advanced fighter training base until the Spring of 1946 when the field was placed on an inactive status. The Navy Department issued the State of South Carolina an operator's permit in October 1946. The base was transferred by the Navy Department to the U.S. Air Force on November 8, 1955. The base was renamed Congaree Air National Guard Base in April 1960 and redesignated McEntire Air National Guard Base on October 16, 1961. The South Carolina Air National Guard has retained control of the base since October 1946.

On 9 December 1946 the South Carolina Air National Guard was started with 14 officers and 36 enlisted men. By mid 1947 the base was staffed by 44 full time employees (technicians). The first assigned aircraft consisted of 25 F-51s, four A-26s, two AT-6s, two L-5s and one C-47. On October 10, 1950 the entire SCANG was called to active duty as a result of the Korean Conflict. The guardsmen remained on active duty for 21 months. The fighter group converted to reconnaissance mission. The unit flew RF-80s for a while then returned to RF-51s. After the Korean Conflict, the unit received F-86 Sabre Jets, then converted to F-80 Shooting Stars. In 1958 the SCANG received F-86L's. On February 16, 1960, the South Carolina Air National Guard became the first Air Guard unit in the nation to receive supersonic fighters, the F-104 Starfighter.

The SCANG pilots were now flying first line aircraft capable of awesome speed and firepower. It wasn't long until the SCANG and its F-104s were needed by the USAF to bolster its regular forces in Europe during the Berlin Crisis. On 1 November 1961, 747 Air Guardsmen were called to active duty again. On 13 November 1961, C-124s with dismantled F-104s in their cargo compartments, rumbled down the runways - destination, Moron Air Base, Spain. By 24 November 1961, all F-104s had been transported to Spain, reassembled, made combat ready, and were flying tactical defense missions for USAFE.

During the Cuban Crisis in 1962, the United States Air Force recalled all Starfighters to bolster the active forces. F-102 Delta Daggers were the next aircraft received and the unit's mission became Air Defense - 24 hours a day - 365 days a year. This mission continued until early 1975. On 1 April 1975, the SCANG became a part of the Tactical Air Command (TAC), and the mission was changed to close air support and air interdiction. To accomplish this mission, the USAF provided the SCANG the world's deadliest and most accurate fighter bomber, the A-7D "Corsair II". In mid-1983, the F-16 "Fighting Falcon" became the primary mission aircraft at the SCANG.

APPENDIX L.

LOGS OF SELECTED WELLS/BORINGS

LOGS OF SELECTED WELLS/BORINGS

WELL W2

Depth Below Surface (ft.)	Description of Subsurface[a]
0-20	Sandy red clay
20-50	White clay
50-60	Hard red sandrock
60-65	Red sandy clay
65-70	White sand, some clay
70-80	Red sand, some clay
80-85	Red clay, traces of sand
85-90	Red sand, traces of clay
90-110	Fine reddish sand
110-120	Hard red clay
120-145	Dark brown clay
145-149	White clay and sand
149-160	Soft white sand

a - Description from Layne Atlantic Company, drillers.

BORING B6

Depth Below Surface (ft.)	Description of Subsurface[b]
0-1	Sand, medium to very coarse, loose dry, gray white; soil
1-14	Sand, medium to very coarse, clayey to very clayey, brick red; very tough drilling at 800 lbs. pressure
14-16	Gravel and very coarse sand; brick red to medium brown; contains subrounded to subangular quartz pebbles to 1 inch in diameter
16-19	Sand, medium to very coarse, clayey, light to medium tan
19-25	Gravel and very coarse sand, medium tan; contains subrounded to subangular quartz
25-50	Sand, coarse to very coarse, kaolinitic to very kaolinitic, micaceous, white; 5 to 7 foot thick bed of creamy white kaolin present at about 30-50 feet; bottom of boring at 50 feet in white micaceous kaolinitic sand

b - Descripiton from Division of Geology, South Carolina State Development Board