AD-A231 783

INSTALLATION RESTORATION PROGRAM

1

# PRELIMINARY ASSESSMENT

## 130th Tactical Airlift Group
## West Virginia Air National Guard
## Yeager Airport
## Charleston, West Virginia
## March 1989



AIR NATIONAL GUARD



HAZWRAP SUPPORT CONTRACTOR OFFICE
Oak Ridge, Tennessee 37831
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# INSTALLATION RESTORATION PROGRAM
# PRELIMINARY ASSESSMENT

## 130th TACTICAL AIRLIFT GROUP
## WEST VIRGINIA AIR NATIONAL GUARD
## YEAGER AIRPORT
## CHARLESTON, WEST VIRGINIA

March 1989

Prepared for

Air National Guard Support Center
National Guard Bureau
Andrews Air Force Base, Maryland 20331-6008

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ANG | Air National Guard |
| ANGB | Air National Guard Base |
| ANGSC | Air National Guard Support Center |
| BLS | below land surface |
| CDE | Clymer Dekalb complex (30-40%) |
| CDF | Clymer Dekalb complex (40-70%) |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| DEQPPM | Defense Environmental Quality Program Policy Memorandum |
| DERP | Defense Environmental Restoration Program |
| DoD | U.S. Department of Defense |
| FS | Feasibility Study |
| FTA | Fire Training Area |
| GlC | Gilpin silt loam (10-20% slopes) |
| GlD | Gilpin silt loam (20-30% slopes) |
| GlE | Gilpin silt loam (30-40% slopes) |
| HARM | Hazardous Assessment Rating Methodology |
| HAZWRAP | Hazardous Waste Remedial Actions Program |
| HW/HM | hazardous wastes/hazardous materials |
| IRP | Installation Restoration Program |
| MOGAS | motor gasoline |
| MSL | mean sea level |
| NATO | North Atlantic Treaty Organization |
| NCP | National Contingency Plan |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priority List |
| NWS | National Weather Service |
| PA | Preliminary Assessment |
| POL | petroleum, oil, and lubricant |
| RA | Remedial Action |
| RCRA | Resource Conservation and Recovery Act of 1976 |
| R&D | Research and Development |
| RD | Remedial Design |
| RI | Remedial Investigation |

## LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

| | |
|---|---|
| SARA | Superfund Amendments and Reauthorization Act (CERCLA) |
| SCS | Soil Conservation Service |
| SI | Site Inspection |
| TAG | Tactical Airlift Group |
| UC | Udorthents Complex |
| USEPA | U.S. Environmental Protection Agency |
| USGS | U.S. Geological Survey |
| UST | underground storage tank |
| WVDNR | West Virginia Department of Natural Resources |

## EXECUTIVE SUMMARY

### A. INTRODUCTION

PEER Consultants, P.C., was retained by the Hazardous Waste Remedial Actions Program (HAZWRAP) Support Contractor Office in August 1988 to conduct an Installation Restoration Program (IRP) Preliminary Assessment of the 130th Tactical Airlift Group (TAG), West Virginia Air National Guard, Yeager Airport, Charleston, West Virginia, under Contract No. DE-AC05-870R21705. The Preliminary Assessment (PA) included:

- an on-site visit, including interviews with 25 Air National Guard Base (ANGB) employees conducted by PEER personnel August 28 through September 2, 1988;

- the acquisition and analysis of pertinent information and records on past hazardous materials use and past hazardous wastes generation and disposal at the ANGB;

- the acquisition and analysis of available geologic, hydrologic, meteorologic, and environmental data from pertinent federal, state, and local agencies; and

- the identification of sites on the ANGB that may be contaminated with hazardous materials/hazardous wastes.

### B. MAJOR FINDINGS

The major operations of the 130th TAG that have used and disposed of hazardous materials/hazardous wastes include aircraft maintenance; ground vehicle maintenance; aerospace ground equipment; fire department training; and petroleum, oil, and lubricant (POL) management and distribution. The operations involved such activities as corrosion control, nondestructive inspection, fuel cell maintenance, and engine maintenance. Varying quantities of waste oils, recovered fuels, spent cleaners, strippers, and solvents were generated and disposed of by these activities.

Interviews with 25 ANGB personnel having an average tenure of 22 years, analysis of pertinent information and records, and a field survey resulted in the identification of four disposal/spill/storage sites on or near the ANGB. The sites are potentially contaminated with hazardous materials and/or hazardous wastes and were assigned a score according to the U.S. Air Force Hazard Assessment Rating Methodology (HARM). The four potentially contaminated sites (Figure ES) are as follows:

Site No. 1 - Waste Disposal Site No. 1
Site No. 2 - Waste Disposal Site No. 2
Site No. 3 - Former Fire Training Area (FTA)
Site No. 4 - Past Chemical Disposal at Engine Test Stand

## C. CONCLUSIONS

The sites on the Base identified as potentially contaminated are referenced as Sites 1-4. These sites have been further evaluated and assigned a HARM score.

Site No. 1 - Waste Disposal Site No. 1 (HARM Score - 47)

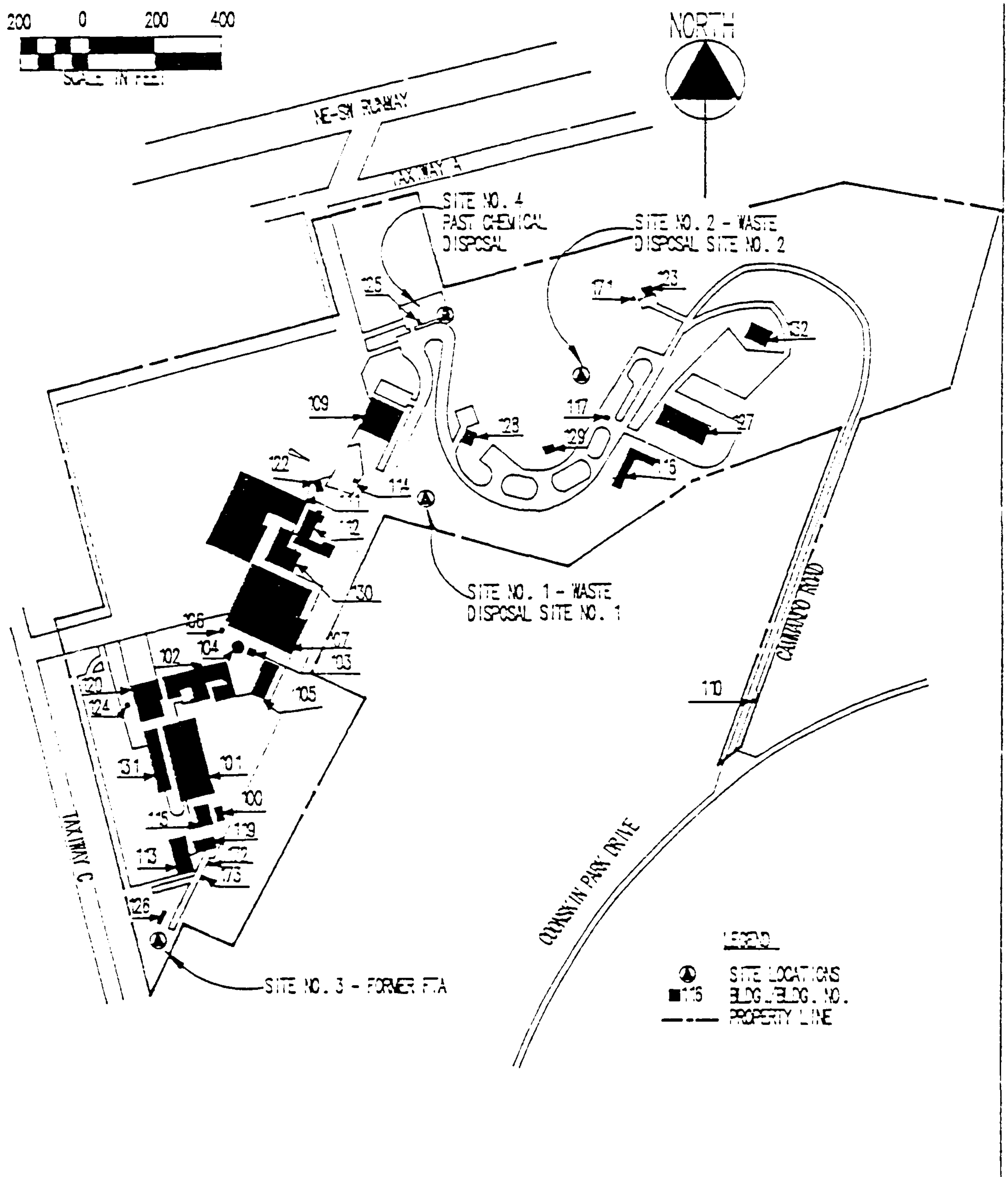
This site served as a refuse dump for 13 years. The wastes included general refuse from Base operations and some liquid contaminants, such as solvents and paint thinners.

Site No. 2 - Waste Disposal Site No. 2 (HARM Score - 68)

Site No. 2 served as a disposal point mainly for construction debris, but also for liquid contaminants, such as fuels and solvents, and sewage sludge. Several drums of unknown substance(s) were at the site.

LOCATION OF HARM SCORED SITES | FIGURE ES.

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA (SOURCE: BASE FILES)



Site No. 3 - Former Fire Training Area (FTA) (HARM Score - 47)

A fire training area located on the Base was in operation for about 9 years. Jet fuel and gasoline were used to ignite fires in an unlined pit. The pit is presently covered with fill material with no evidence of residual fuel.

Site No. 4 - Past Chemical Disposal at Engine Test Stand (HARM Score - 55)

About 100 gallons of a liquid solvent were disposed directly on the ground in 1981. All of the liquid was reportedly absorbed into the ground.

D. RECOMMENDATIONS

Because of the potential for contaminant migration, it is recommended that further investigation be implemented.

# I. INTRODUCTION

## A. BACKGROUND

The 130th Tactical Airlift Group (TAG), West Virginia Air National Guard, is located at Yeager Airport, Charleston, West Virginia (hereinafter referred to as the Base). The Base has been in service since 1947, and over the years the types of military aircraft based and serviced there have varied. Because of the use of hazardous materials and disposal of hazardous wastes, the Department of Defense (DoD) has implemented its Installation Restoration Program (IRP).

THE INSTALLATION RESTORATION PROGRAM

The DoD IRP is a comprehensive program designed to:

- o Identify and fully evaluate suspected problems associated with past hazardous waste disposal and/or spill sites on DoD installations, and

- o Control hazards to human health, welfare, and the environment that may have resulted from these past practices.

During June 1980, DoD issued a Defense Environmental Quality Program Policy Memorandum (DEQPPM 80-6) requiring identification of past hazardous waste disposal sites on DoD installations. The policy was issued in response to the Resource Conservation and Recovery Act of 1976 (RCRA) and in anticipation of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, Public Law 96-510) commonly known as "Superfund." In August 1981, the President delegated certain authority specified under CERCLA to the Secretary of Defense via Executive Order (EO 12316). As a result of EO 12316, DoD revised the IRP by issuing DEQPPM 81-5 on December 11, 1981, which reissued and amplified all previous directives and memoranda.

Although the DoD IRP and the U.S. Environmental Protection Agency (USEPA) Superfund programs were essentially the same, differences in the definition of program phases and lines of authority resulted in some confusion between DoD and state and federal regulatory agencies. These difficulties were rectified via passage of the Superfund Amendments and Reauthorization Act (SARA, PL-99-499) of 1986. On January 23, 1987, Presidential Executive Order EO 12580 was issued. EO 12580 effectively revoked EO 12316 and implemented the changes promulgated by SARA.

The most important changes effected by SARA included the following:

- Section 120 of SARA provides that federal facilities, including those in DoD, are subject to all the provisions of CERCLA/SARA concerning site assessment, evaluation under the National Contingency Plan (NCP) (40 CFR 300), listing on the National Priorities List (NPL), and removal or remedial actions. DoD must therefore comply with all the procedural and substantive requirements (guidelines, rules, regulations, and criteria) promulgated by the USEPA under Superfund authority.

- Section 211 of SARA also provides continuing statutory authority for DoD to conduct its IRP as part of the Defense Environmental Restoration Program (DERP). This was accomplished by adding Chapter 160, Sections 2701-2707, to Title 10 United States Code (10 USC 160).

- SARA also stipulated that terminology used to describe or otherwise identify actions carried out under the IRP shall be substantially the same as the terminology of the regulations and guidelines issued by the USEPA under their Superfund authority.

As a result of SARA, the operational activities of the IRP are currently defined and described as follows:

Preliminary Assessment

The Preliminary Assessment (PA) consists of a records search and interview sessions designed to identify and evaluate past disposal and/or spill sites that might pose a potential and/or actual hazard to public health, welfare, or the environment.

Site Inspection/Remedial Investigation/Feasibility Study

The Site Inspection (SI) consists of confirmation and/or quantification of contamination at the sites identified as a result of the PA. The Remedial Investigation (RI) consists of field activities designed to further quantify the types and extent of contamination present, including migration pathways.

If applicable, a public health evaluation is performed to analyze the collected data. Field tests are required that may necessitate the installation of monitoring wells or the collection and analysis of water, soil, and/or sediment samples. Careful documentation and quality control procedures, in accordance with CERCLA/SARA guidelines, ensure the validity of data. Hydrogeologic studies are conducted to determine the underlying strata, groundwater flow rates, and direction of contaminant migration. The findings from these studies result in the selection of one or more of the following options:

- No further action - Investigations do not indicate harmful levels of contamination and do not pose a significant threat to human health or the environment. The site does not warrant further IRP action and a decision document will be prepared to close out the site.

- Long-term monitoring - Evaluations do not detect sufficient contamination to justify costly remedial actions. Long-term monitoring may be recommended to detect possible future problems.

- Feasibility Study (FS) - Investigations confirm the presence of contamination that may pose a threat to human health and/or the environment, and some form of remedial action is indicated. The FS is therefore designed and developed to identify and select the most appropriate remedial action. The FS may include individual sites, groups of sites, or all sites on an installation. Remedial alternatives are chosen according to engineering and cost feasibility, state and federal regulatory requirements, public health effects, and environmental impacts. The end result of the FS is the selection of the most appropriate remedial action by the Base with concurrence by state and federal regulatory agencies.

Remedial Design and Remedial Action

The Remedial Design (RD) involves formulation and approval of the engineering designs required to implement the selected remedial action (RA). RA is the actual implementation of the remedial alternative. It refers to the accomplishment of measures to eliminate the hazard or, at a minimum, reduce it to an acceptable limit. Covering a landfill with an impermeable cap, pumping and treating contaminated groundwater, installing a new water distribution system, and in situ biodegradation of contaminated soils are examples of RAs that might be selected. In some cases, after the RAs have been completed, a long-term monitoring system may be installed as a precautionary measure to detect any contaminant migration or to document the efficiency of remediation.

Research and Development

Research and Development (R&D) activities are not always applicable for an IRP site, but may be necessary if there is a requirement for additional R&D of control measures. R&D tasks may be initiated for sites that cannot be characterized or controlled through the application of currently available, proven technology. It can also, in some instances, be used for sites deemed suitable for evaluating new technologies.

Immediate Action Alternatives

At any point, it may be determined that a former waste disposal site poses an immediate threat to public health or the environment, thus necessitating prompt removal of the contaminant. Immediate actions, such as limiting access to the site, capping or removing contaminated soils, or providing an alternate water supply may suffice as effective control measures. Sites requiring immediate removal action maintain IRP status to determine the need for additional remedial planning or long-term monitoring. Removal measures or other appropriate RAs may be implemented during any phase of an IRP project.

## B. PURPOSE

The purpose of the PA is to identify and evaluate potential sites associated with past hazardous waste handling procedures, disposal sites, and spill sites on the Base and to assess the potential for the migration of hazardous contaminants. PEER Consultants, P.C., visited the Base, reviewed existing environmental information, analyzed the Base records concerning the use and generation of hazardous materials and hazardous wastes, and conducted interviews with Base personnel who were familiar with past hazardous materials management activities. Relevant information collected and analyzed as a part of the PA included the history of the Base, with special emphasis on the history of the shop operations and their past hazardous materials/hazardous wastes management procedures; the local geologic, hydrologic, and meteorologic conditions that may affect migration of potential contaminants; local land use, public utilities, and zoning requirements that affect the potential for exposure to contaminants; and the ecological settings that indicate environmentally sensitive habitats or evidence of environmental stress.

## C. SCOPE

The scope of this PA is limited to the property situated within the boundaries of the Base and property which is or has been controlled by the Base and included the following:

- an on-site visit;

- the acquisition of pertinent information and records on hazardous materials use and past hazardous wastes generation and disposal practices at the Base to establish the source and characteristics of hazardous wastes or spills;

- the acquisition of available geologic, hydrologic, meteorologic, land use and zoning, critical habitat and utility data from various federal, state, and local agencies to establish potential pathways and receptors of hazardous wastes or spills;

- a review and analysis of all information obtained; and

- the preparation of a report, to include recommendations for further actions.

The on-site visit, interviews with Base personnel, and meetings with local agency personnel were conducted from August 29 through September 2, 1988. The PEER PA team consisted of the following individuals (resumes are included as Appendix A):

- Mr. Tom Webb, Senior Project Manager
- Mr. Keith Owens, Geologist
- Mr. Kevin Pack, Civil/Environmental Engineer

Individuals from the Base who assisted in the PA included Lt. Col. James E. Johnson, 130th TAG/DE; Major Robert L. Wolfe, 130th CES/DEE; and selected members of the 130th TAG. Also assisting was Mr. Greg Krisanda, Headquarters Air National Guard Support Center (ANGSC), Project Officer.

## D. METHODOLOGY

A flowchart of the PA methodology is presented in Figure I-A. This PA methodology ensures, to the greatest extent possible, a comprehensive

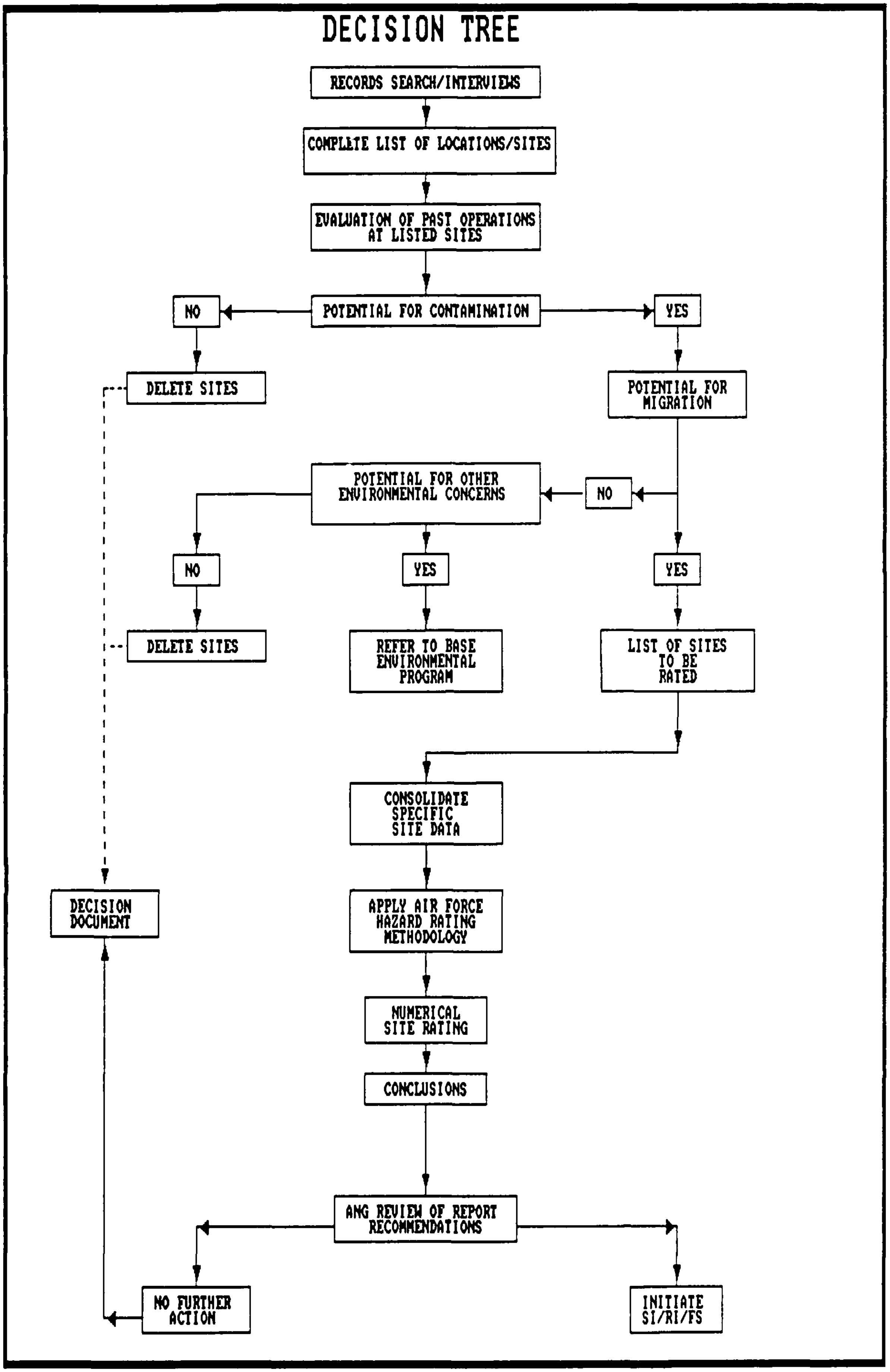



Figure I-A Preliminary Assessment Methodology Flowchart collection and review of pertinent site-specific information, and is used in the identification and assessment of potentially contaminated hazardous waste spill and disposal sites.

The PA began with a site visit to the Base to identify all shop operations or activities that may have used hazardous materials or generated hazardous wastes. Next, an evaluation of past and present hazardous materials and hazardous wastes handling procedures at the identified locations was made to determine whether environmental contamination may have occurred. The evaluation of past hazardous materials and hazardous wastes handling practices was facilitated by extensive interviews with 25 ANGB employees with an average of 22 years' experience with the various operating procedures at the Base. These interviews were also used to define the areas on the Base where any waste materials, either intentionally or inadvertently, may have been used, spilled, stored, disposed of, or released into the environment in order to establish the source and characteristics of hazardous wastes or spills.

Historical records contained in the Base files were collected and reviewed to supplement the information obtained from interviews. Using the information outlined above, a list of waste spill, disposal, and storage sites on the Base was identified for further evaluation. A general survey tour of the potential sites, the Base, and the surrounding area was conducted to determine the presence of visible contamination and to help the PEER survey team assess the potential for contaminant migration. Particular attention was given to locating nearby drainage ditches, surface water bodies, residences, and wells to establish potential pathways for migration.

Detailed geologic, hydrologic, meteorologic, developmental (land use and zoning), and environmental data for the area of study were also obtained from appropriate federal, state, and local agencies as identified in Appendix B for the purpose of establishing potential pathways and receptors of hazardous wastes or spills.

Using the process shown in Figure I-A, a decision was then made, based on all the above information, regarding the potential for hazardous materials contamination and migration to receptors. If no potential existed for contamination, migration, or reception, a decision document was implemented to delete the site from further consideration. If potential for contamination was identified, the potential for migration of the contaminant was assessed based on site-specific conditions. If there was potential for contaminant migration, the site was evaluated using the Hazard Assessment Rating Methodology (HARM). A discussion of the HARM system is presented in Appendix C. Appendix D contains the HARM rating forms for the four potentially contaminated sites.

# II. INSTALLATION DESCRIPTION

## A. LOCATION

The 130th TAG, West Virginia Air National Guard, is located at Yeager Airport (formerly Kanawha Airport) in Kanawha County, approximately 4 miles northeast of downtown Charleston, West Virginia. Yeager Airport is situated next to the Charleston corporate boundary, and portions of several residential zones lie within a 1-mile radius of the Base. The Base occupies a total of 75 acres of land. Of this total, 43 acres are occupied by most of the Base facilities next to the airport. The remaining 32 acres surround a sloping and winding road (Commando Road) which begins at the entrance of the Base property off Coonskin Park Road and ascends about 220 feet in elevation to the runway level. This area contains the liquid fuels and liquid oxygen facilities, the disaster preparedness, civil engineering, security police, vehicle maintenance, waste treatment facilities, and the traffic check station. The Base employs 229 full-time and 714 part-time military personnel. The 130th TAG is stationed at the Base. Figure II-A shows the location and boundaries of the Base.

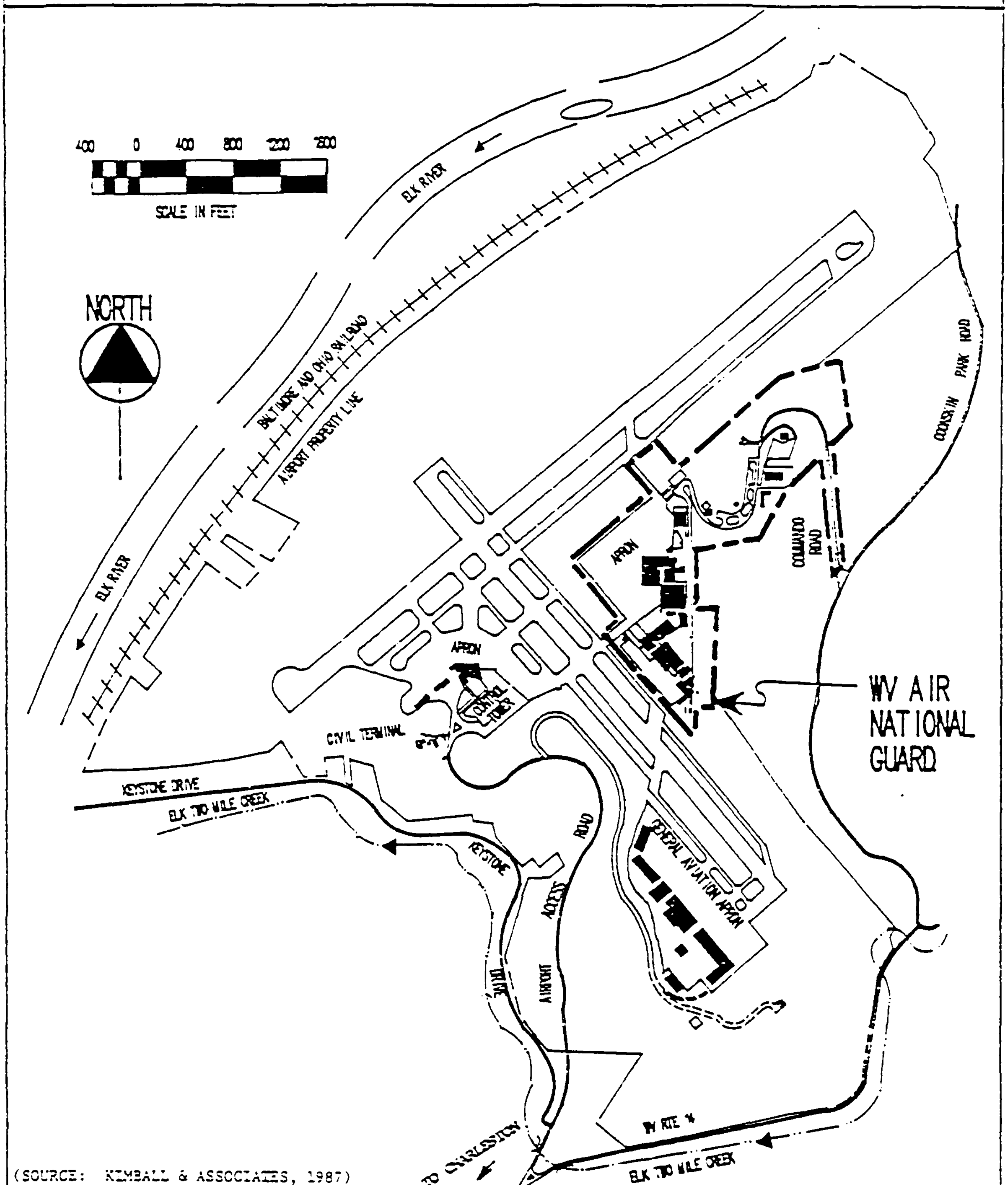
## B. ORGANIZATION AND HISTORY

The 130th TAG traces its roots back to the end of World War II with the demobilization of the 369th Fighter Squadron (Table II-A). The 369th was formed in 1943 for service with the Army Air Force in Europe. The unit was reactivated and assigned to the West Virginia Air National Guard in October 1947, with the new name of 167th Fighter Squadron. The unit shared the Kanawha Airport facilities for about 2 years, then moved to its present location. The primary aircraft was the Republic F-47 "Thunderbolt" or "Jug."

By October 1950, the 167th Fighter Squadron was flying the F-51D "Mustang" due to mobilization of the Reserve Forces during the Korean Conflict. From 1950 to 1952, the 167th performed training missions and provided personnel in Korea and also in England as part of the North Atlantic Treaty Organization (NATO) Forces. In 1952, the 167th returned to Kanawha Airport with a new name, the 167th Fighter-Bomber Squadron.

| LOCATION MAP | FIGURE II-A |
|---|---|

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA




(SOURCE: KIMBALL & ASSOCIATES, 1987)

## TABLE II-A

## SUMMARY OF ORGANIZATION STRUCTURE AND HISTORICAL EVENTS AFFECTING THE 130th TACTICAL AIRLIFT GROUP, WEST VIRGINIA AIR NATIONAL GUARD

| | |
|---|---|
| January 1947 | Base formed as 167th Fighter Squadron at Kanawha Airport, Charleston, West Virginia, with operation of the Republic F-47 "Thunderbolt" aircraft. |
| October 1950 | Aircraft changed to F-51D "Mustang." |
| July 1952 | 167th released from federal service to return to Kanawha Airport. Unit changed to the 167th Fighter-Bomber Squadron. |
| Early 1950s | Construction of several facilities completed including Base Supply, Administration-Clinic, Hangar No. 1, and Vehicle Maintenance. |
| July 1955 | 167th became a Fighter-Interceptor Squadron. |
| October 1955 | New unit formed as 130th Troop Carrier Squadron and received Curtiss-Wright C-46 aircraft. |
| December 1955 | Part of unit moved to Martinsburg, West Virginia, to receive the North American F-86 "Sabre Jet." |
| Late 1950s | Unit upgraded to Group Level as 130th Troop Carrier Group. Aircraft changed to the Grumman HU-16 "Albatross." |
| July 1963 | Unit became 130th Air Commando Group and was assigned the Fairchild C-119 "Packet" aircraft and the Helio Aircraft U-10 "Courier." |
| 1965-1975 | 130th conducted training and support for the Panama Canal Zone, participated in NATO exercises, and provided support to Army, Air Force, and federal and state governments. |
| 1975 | Assignment of the Lockheed C-130E "Hercules" aircraft. Unit became the 130th Tactical Airlift Group. |
| 1976 | Final conversion of the C-119 to C-130. Training was concentrated on flying and maintaining the new C-130s and on new airlift missions. |
| October 1985 | Kanawha Airport renamed Yeager Airport. |

In 1955, part of the 167th was moved to Martinsburg Municipal Airport in Martinsburg, West Virginia, in preparation for the receipt of the North American F-86 "Sabre Jet." Kanawha Airport could not support jet fighter aircraft due to size limitations. The unit changed to the 130th Troop Carrier Squadron employing the Curtiss-Wright C-46 aircraft.

During the late 1950s, the 130th was upgraded to Group level, and the aircraft was changed to the Grumman HU-16 "Albatross."

The unit was active during the Vietnam era, providing aerial gunships, psychological warfare, and air evacuation support. The Charleston Unit became the 130th Air Commando Group in July 1963, with the assignment of the Fairchild C-119 "Packet" or "Flying Boxcar" and the Helio Aircraft U-10 "Courier." In February 1965, the unit was flying daily training missions to the Panama Canal Zone as part of the Air Force operations.

During 1965 to 1975, Panama training missions were a normal responsibility, and the unit also participated in NATO exercises in England and West Germany. The 130th provided training support for the Army's Special Forces and paratroopers, airlift support for the Air Force, and flying relief missions whenever needed for the federal and state governments.

In 1975, the 130th was given a new primary aircraft, the Lockheed C-130E "Hercules," a combat-proven transport, and the unit became the 130th TAG. In 1976, training was concentrated on flying, maintaining, and supporting the new aircraft and new airlift missions.

The Kanawha Airport was renamed Yeager Airport, in October 1985, after Brigadier General Charles "Chuck" Yeager. There have been no significant events or change of organization between 1985 and the present time.

# III. ENVIRONMENTAL SETTING

## A. METEOROLOGY

The climate in Kanawha County is mild and humid, which is characteristic for this particular latitude (N 38° 22'). Summers are relatively mild and winters are typically short in duration. National Weather Service (NWS) personnel have maintained weather records at the NWS Building, Yeager Airport, approximately 3 miles northeast of Charleston and approximately one-quarter of a mile southwest of Yeager Air National Guard Base. Within Charleston, slightly above 600 feet mean sea level (MSL), the average annual temperature was 56.9°F from 1902 to 1987. Mean temperatures for the coldest and warmest months, January and July, average 37.9°F and 76.9°F, respectively. The average growing season is 186 days from April 30 to October 23. Table III-A provides a statistical picture of important meteorological parameters at Charleston.

Weather patterns in the Charleston area are quite dynamic, especially from midautumn through the spring. The first freeze of winter usually occurs by the end of October. Based upon the period of record from 1948 to 1987, winter snowfall can vary greatly from one year to the next at the Yeager Airport. Averaging 30 inches of snowfall per year, this area received a high of 76.6 inches of snowfall during the 1977-1978 winter and a low of 17.1 inches during the 1968-1969 season. January and February receive the majority of snowfall, averaging about 11 and 9 inches, respectively, which coincides with the lowest month mean temperatures for this time period (35.5°F for January; 37.6°F for February). The Charleston area averages 18 days per year when the maximum temperature reaches only 32°F or below. Maximum snowfall in 24 hours and maximum monthly snowfall were both noted in January 1978, during which values of 15.8 inches and 39.5 inches, respectively, were recorded. Most single snowfall events are in the 4-inch or less category.

Table III-A

Climatic Data for Charleston, West Virginia

Sources: Doll et al. (1960), Haught (1968), SCS (1981), and NOAA (19[illegible]7)

| | |
|---|---|
| Temperature (°F) | |
| Mean annual temperature | 56° |
| Average winter temperature | 36° |
| Average winter daily minimum | 27° |
| Average summer temperature | 73° |
| Average summer daily maximum | 84° |
| Coldest month - January | 37° |
| Warmest month - July | 76° |
| Absolute minimum temperature | -17° in December 1917 |
| Absolute maximum temperature | 108° in August 1918 |
| Average frost-free period | 186 days (April 30-October 23) |
| Precipitation | |
| Mean annual precipitation | 46" |
| Mean annual lake evaporation | 33" |
| Net precipitation (calculated) | 13" |
| Wettest year | 59.2" in 1890 |
| Driest year | 26.1" in 1930 |
| Wettest months | July/August > 4" |
| Driest months | September/October < 3" |
| Highest one month | 13.6" in July 1961 |
| Lowest one month | 0.09" in October 1963 |
| Highest single day | 5.6" on July 19, 1961 |
| 1 year - 24 hour event | 2.25" |
| Precipitation, 0.01 inches or more | 151 days per year |
| Mean annual relative humidity | 50% |
| Average seasonal snowfall | 30" |
| Maximum 24-hour snowfall | 15.8" in January 1978 |
| Maximum snowfall in one month | 39.5" in January 1978 |
| Snow, ice pellets, 1" or more | 10.3 days per year |

Daily maximum winter temperatures for the coldest months of January and February averaged 41.8 and 45.4°F, respectively, over the period of record from 1902 to 1987. However, from 1958 to 1987, a slight overall warming trend appeared to be evident, with average daily maximum temperatures for January and February recorded at 45.5 and 48.4°F, respectively.

Charleston summers and early autumn have more day-to-day uniformity than the winter. Daily maximum afternoon summer temperatures average 82 to 85°F for the hottest months of June through August; temperatures above 90°F average 21 days per year. Summer precipitation typically falls as brief to occasionally heavy rains. Thunderstorms average 43 per year, with most occurring during the summer. Flash flooding can occur along small drainages, but is rare on the dam-controlled Elk and Kanawha rivers.

The average annual and monthly precipitation in Charleston is 45.8 inches and 3.75 inches, respectively. Net precipitation as calculated per 40 CFR 300 Subpart I, Appendix A, 3.2, equates to about 13 inches per year, indicating a relatively low potential for leachate generation at the Base. Precipitation is usually well distributed throughout the year, with July and August usually comprising the wettest period and September and October the driest. From 1890 to 1987, annual precipitation has ranged in the years of record from a low of 26.1 inches in 1930 to a high of 59.2 inches in 1890. Available data more specific to the life of the operation of Yeager Airport indicate a range of 30.2 inches to 54.9 inches of annual precipitation from 1958 through 1987. The maximum yearly rainfall intensity average based on a 1-year frequency, 24-hour rainfall event, is 2.25 inches per 40 CFR 300 Subpart I, Appendix A, 3.2. Fifty-four percent (22 inches) of the total annual precipitation usually falls from April through September. Droughts are uncommon, but dry periods may occur during the spring or fall.

The presence of early morning fog is common from late June into October. The area averages about 104 days per year when visibility is limited to one-quarter of a mile or less. Charleston is dominated by cloudy days (189) with partly cloudy skies usually occurring on about 113 days. Average relative humidity is lowest in the midafternoons at about 50 percent and increases and peaks to 80 percent at dawn. Prevailing winds are from the southwest and average about 6 mph throughout the year. March is usually the windiest month at 9 mph (mean); peak gusts have been recorded as high as 62 mph. The average atmospheric pressure for the last 15 years (1972 - 1987) is 983.2 millibars.

## B. GEOLOGY

### 1. GEOMORPHOLOGY

The Base at Charleston, West Virginia, is situated in the Appalachian Plateaus Physiographic Province. This province is a relatively narrow northeast-southwest band extending from southern New York to southern Alabama (Figure III-A). Relief in the plateau is measured in hundreds of feet to over 1000 feet.

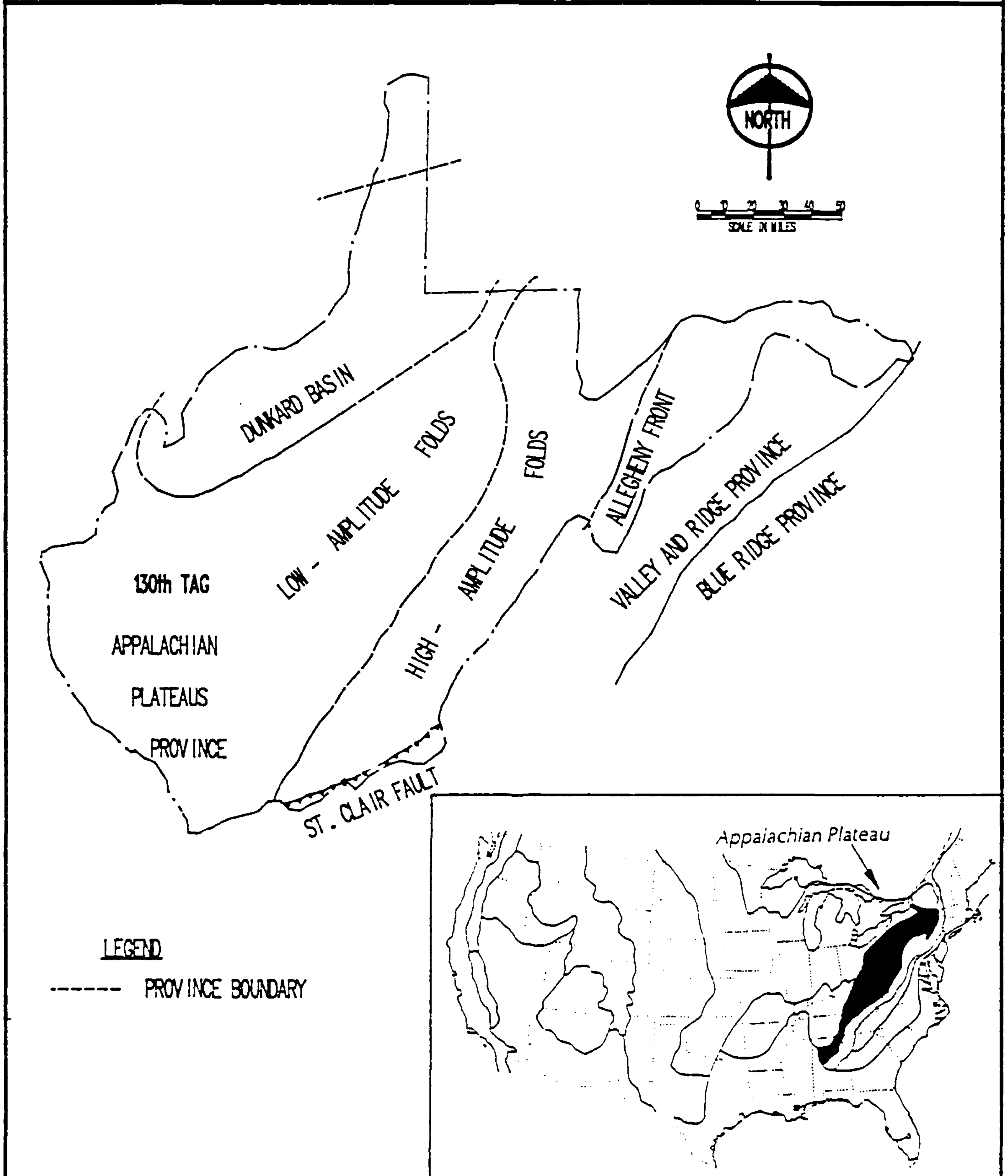
In West Virginia, the Appalachian Plateau Physiographic Province is further divided into sections based on differences in geology and topography. The Allegheny Plateau covers the western two-thirds of West Virginia and includes Kanawha County and the Base. The entire 908 square miles of Kanawha County is hilly, with the exception of about 11 square miles of nearly level alluvium along the Kanawha and Elk rivers and a few of the smaller streams. The hilly terrain in the Yeager Airport area in ascending order is dominated by upper Pottsville (Kanawha), Allegheny, and lower Conemaugh rocks, and are comprised of primarily sandstones and sandy or silty shales. Slopes are generally very steep and valleys are characteristically narrow and V-shaped with straight stream reaches. Ridgetops can be flat to gently convex and are increasingly being exploited for residential use.

The Base is situated within the typical Allegheny and Conemaugh hilly terrain of the area. Hilltops at the Base have been cut away up to a maximum of 130 vertical feet and the valleys have been filled in to provide aerially extensive flat surfaces suitable for an airport facility. Base elevation is about 945 feet MSL. Maximum elevation in the immediate area is 1058 feet MSL; relief ranges from about 300 to 400 feet from Yeager Airport to surface water drainages (Elk Creek, Elk River, Coonskin Branch System). The original topography of Yeager Airport before construction activity began on October 18, 1944, is depicted on Figure III-B.

PHYSIOGRAPHIC PROVINCES AND REGIONAL GEOLOGIC STRUCTURAL FEATURES | FIGURE III-A

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA

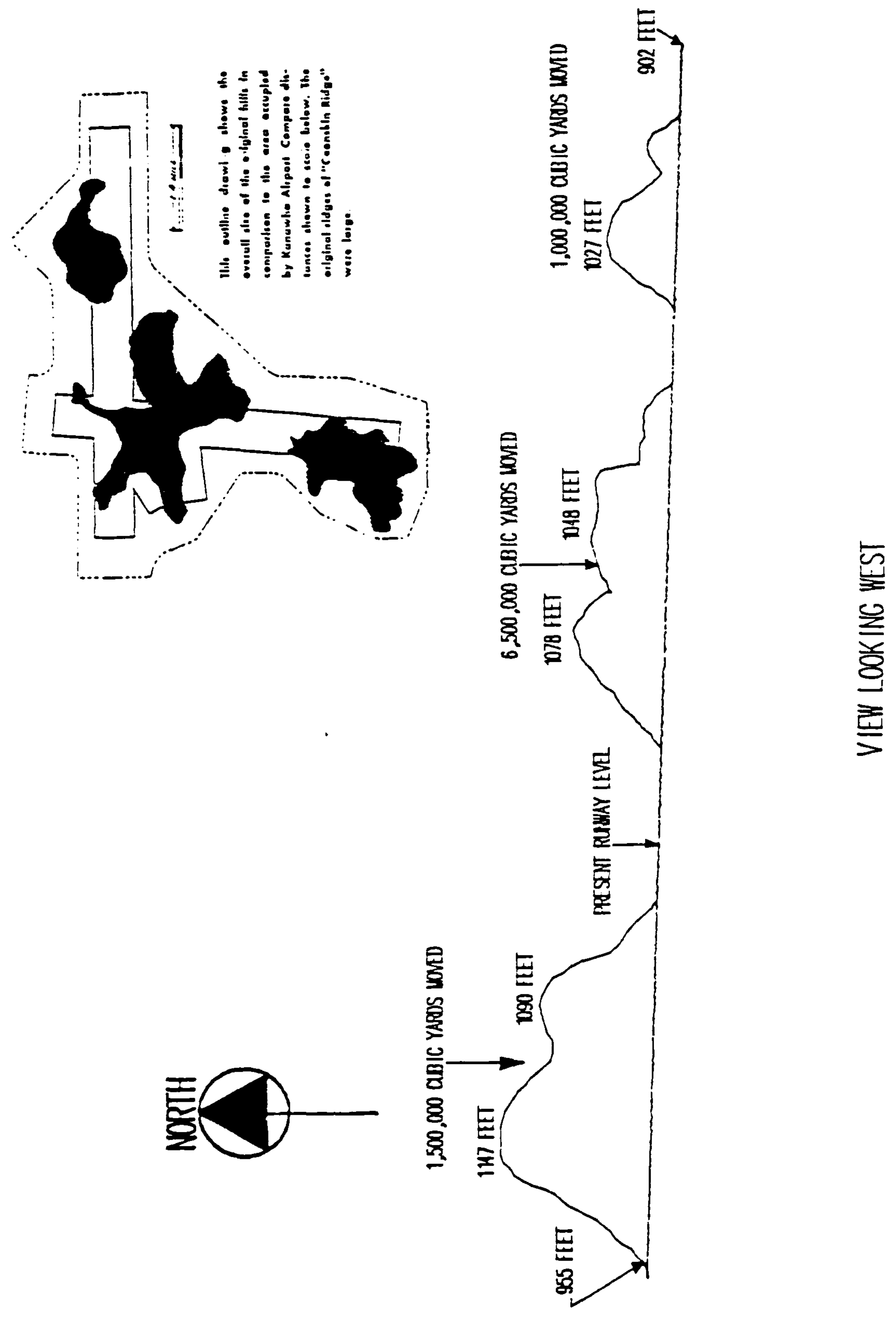
(SOURCE: SCHWIETERING, 1981)



# ORIGINAL YEAGER AIRPORT TOPOGRAPHY

FIGURE III-3

## 130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
## YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA




(SOURCE: ADVERTISING, DEC., 1950)

## 2. STRATIGRAPHY

Within Kanawha County, surface bedrock exposures belong to four divisions of the Pennsylvanian System in the Appalachian region. In descending order, the four groups consist of the Monongahela, Conemaugh, Allegheny, and Pottsville. These groups are products of almost continual sedimentation through most of the Pennsylvanian System. Their cumulative thickness ranges from about 1750 feet to well over 3500 feet. Primarily nonmarine in origin, sediments comprising these groups were deposited on lowland flood plains or in bodies of fresh water and lithified. Hence, dominant lithologies consist of sandstones, siltstones, and shales. Thin coal seams accompanied by fire clays and mudstones, and scattered thin, impure limestones are also present. Pennsylvanian through Pleistocene strata in Kanawha County are illustrated in Figure III-C.

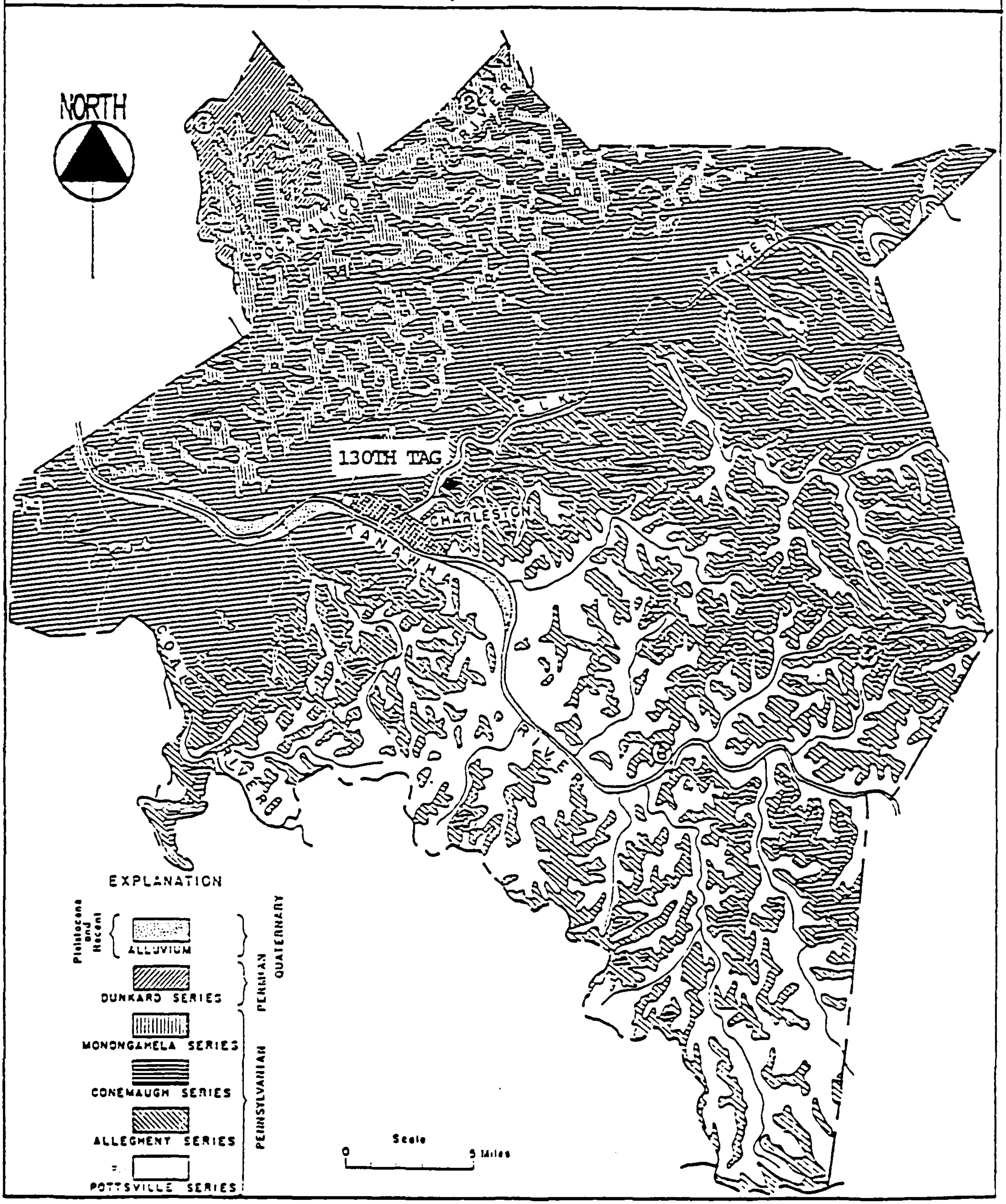
The surface geology at Yeager Airport has been mapped by the West Virginia Geological Survey as the Conemaugh Group. Relative to the Base by virtue of their stratigraphic position and groundwater control are the Conemaugh and Allegheny Groups. The 600 foot thick Conemaugh section consists of shaly-sandstone, massive sandstone, and shale in its upper 250 to 300 feet. The middle 100 feet is comprised of red and purple shales with calcareous zones, mudstones, and fine sandstone. The lower 200 feet consists of massive lenticular sandstones and siltstones with interbedded and interlensing shales. Upper Conemaugh sandstones are conspicuous on hilltops and ridges and are mostly oxidized and weathered.

The Allegheny Formation, approximately 150 to 300 feet, is separated from the Conemaugh Formation by the Upper Freeport Coal, and typically consists of two to three thick (each about 30 feet) sandstones separated by thinner layers of shales and mudstones.

The highly disturbed nature of the Base from cut and fill activities preclude the use of the shallow soil borings to establish the precise stratigraphic position of the Base or to verify regional geologic mapping by the U.S. Geological Survey (USGS). However, a geologic cross section extending

| KANAWHA COUNTY GEOLOGIC MAP | FIGURE III-C |
|---|---|

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA (SOURCE: DOLL ET AL., 1960)



from Coonskin Park, located about 1 mile NE of the Base, to the Elk River, is indicative of and applicable to Base stratigraphy (Figure III-D). This 700-foot lateral cross section, based on three test boring logs, indicates the Allegheny/Conemaugh contact at 550 to 570 feet MSL. Therefore, on Base, the Allegheny series is located about 450 to 500 feet below the surface, overlain by the majority of the Conemaugh section. Most of the sand subbase material used in the airport pavement construction was taken from a borrow pit near the administration area of the airport, which was the upper decomposed Conemaugh sandstone.

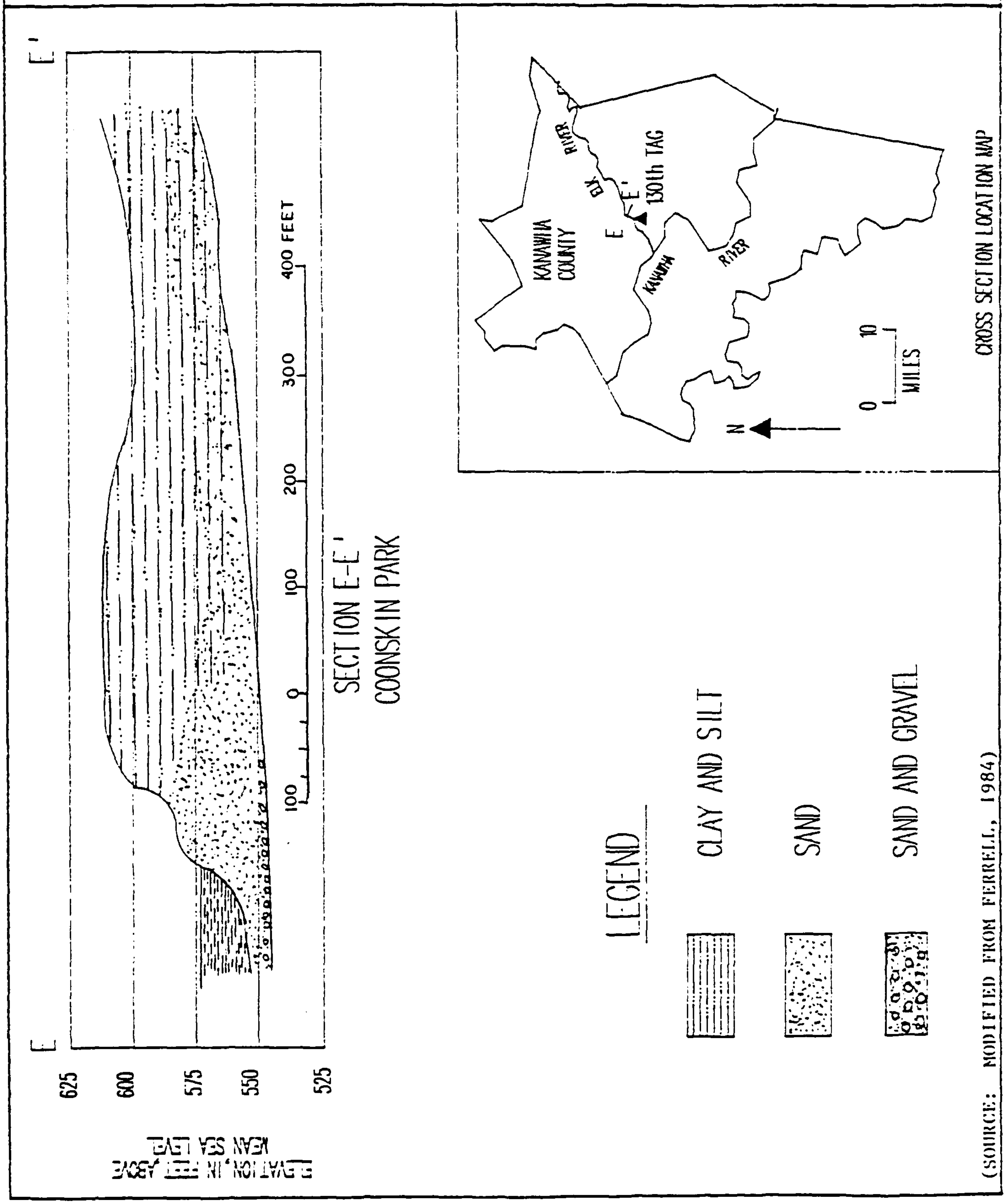
3. STRUCTURE

Figures III-A and III-E show the regional and local structural features, respectively, of West Virginia. The Base is within an area of low-amplitude folds and is situated south of the Dunkard Basin. The Dunkard Basin, which is a Permian depositional basin to the north, and the high-amplitude folds to the southeast within the Valley and Ridge physiographic province, are responsible for the regional dip to the north and northwest.

The Pennsylvanian strata in Kanawha County are gently folded into northeastward trending axes from six anticlines and eight synclines. Dips vary from 10 to 280 feet per mile. No major faults are known to occur within the county or the Base. Joints are common in all of the consolidated rocks and are best developed in sandstones. The predominant strike of the joints is to the northeast and northwest, or parallel and perpendicular, respectively, to the strike of the axes of the primary folds. Most joints dip steeply from 60 to 90°; some minor joints are encountered parallel to bedding (Doll et al. 1960).

Some evidence of vertical joints in sandstone shallowly underlying the Base was indicated from the soil borings. These joints would greatly enhance the downward percolation of groundwater.

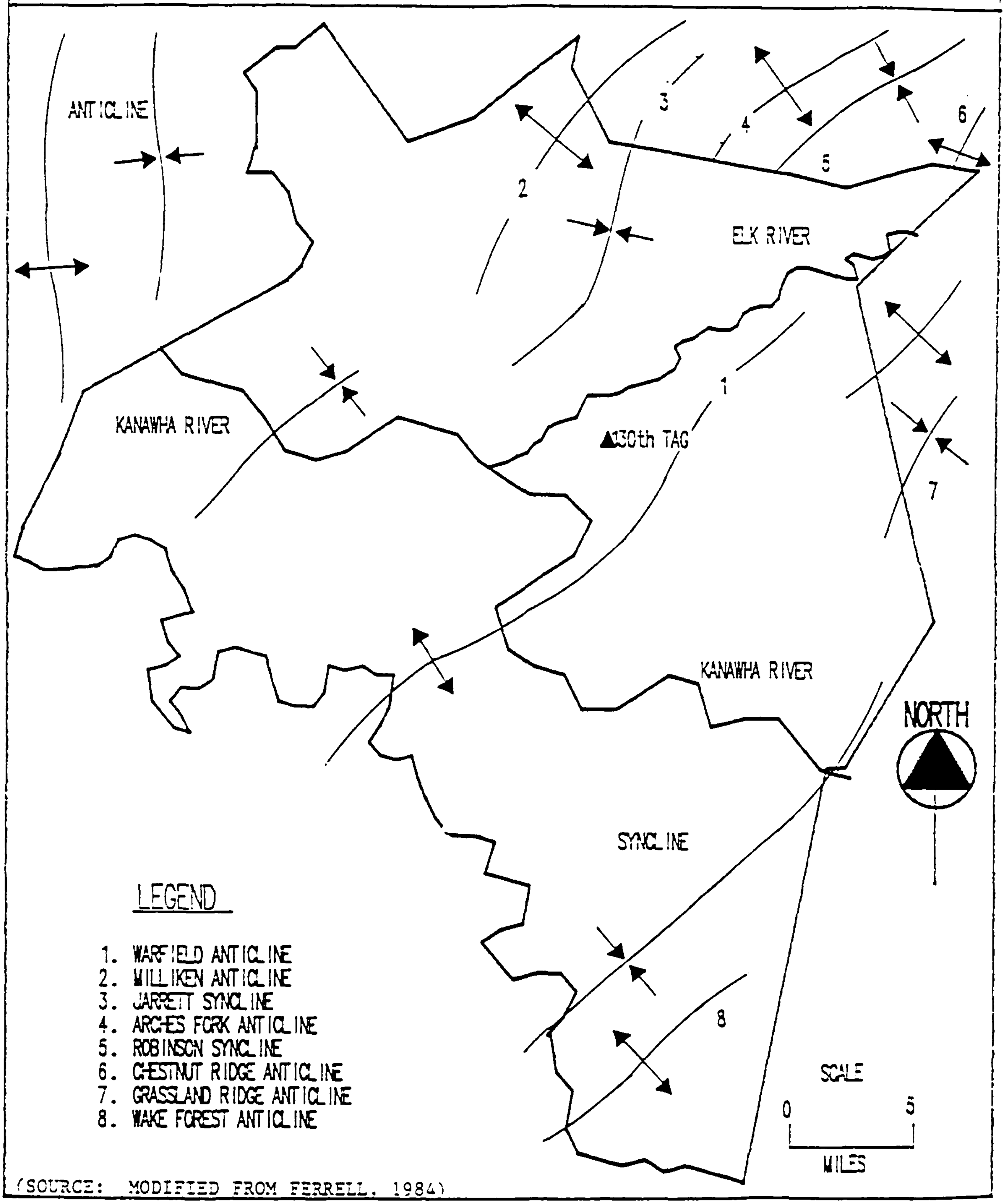
| GENERALIZED COONSKIN PARK GEOLOGIC CROSS SECTION | FIGURE III-D |
|---|---|
| 130th TAG, WEST VIRGINIA AIR NATIONAL GUARD<br>YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA | |



# GEOLOGIC STRUCTURE MAP OF KANAWHA COUNTY

FIGURE III-E

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA




LEGEND

1. WARFIELD ANTICLINE
2. MILLIKEN ANTICLINE
3. JARRETT SYNCLINE
4. ARCHES FORK ANTICLINE
5. ROBINSON SYNCLINE
6. CHESTNUT RIDGE ANTICLINE
7. GRASSLAND RIDGE ANTICLINE
8. WAKE FOREST ANTICLINE

(SOURCE: MODIFIED FROM FERRELL, 1984)

## C. SOILS

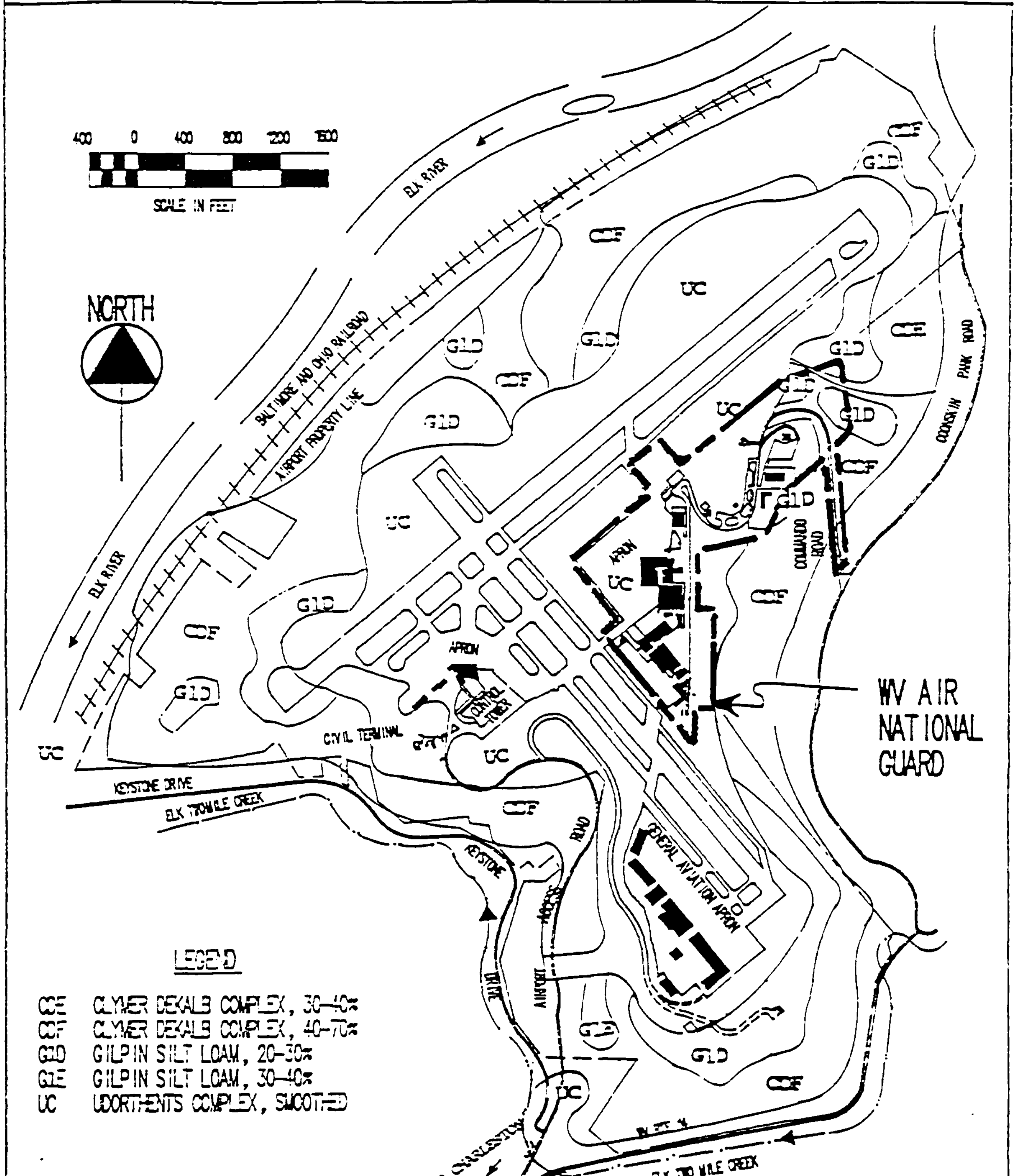
The primary soil series at the Base and throughout Yeager Airport consists of the Udorthents soil complex (UC). The northern portion of the Base also contains one soil phase (Gilpin silt loam, 20 to 30 percent slopes, GlD) and one soil complex (Clymer-Dekalb, very steep, CDF). The UC soil complex consists of nearly level to steep, variably drained Udorthents and Urban land, generally located on upland terraces and flood plains. Areal extent of this complex on Base is about 53 acres. This complex is comprised of 50 percent Udorthents, smoothed (graded), 35 percent Urban land, and 15 percent miscellaneous soils. The Urban land portion of this complex is covered by fill material, streets, parking lots, buildings, and related structures which usually obscure and prevent easy identification of the underlying soil material. However, likely soil types making up the Urban land portion of the complex probably consist primarily of Gilpin silt loams, 10 to 40 percent slopes, (GlD, GlC, GlE) since they were the original undisturbed soils at the present Base and airport locations. Figure III-F, taken from the Soil Survey of Kanawha County (SCS, 1981), maps the distribution of soil types within and adjacent to the Base/Yeager Airport vicinity.

Udorthents consist of moderately deep to deep, well drained to excessively drained soils formed in soil material that has been disturbed by excavating, cutting, or drilling activities. Udorthents have a solum (A and B horizons) in the 5 to 10 inch range with bedrock characteristically noted at a depth of more than 2 feet. Typically medium to extremely acidic, Udorthents contain coarse fragments which make up 0 to 75 percent of the soil. The 2 to 8 inch thick A horizon, ranging from sandy loam to silty clay loam, has hue range of 5 YR to 10 YR, value of 3 to 6, and chroma values of 3 to 8. Underlying horizons of sandy loam to silty clay or their channery analogues (soils consisting of at least 15 percent by volume of thin, flat fragments of sandstone, shale, slate, limestone, or schist) have similar hue and chroma ranges.

## SOILS MAP

FIGURE III-F

## 130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
## YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA




(SOURCE: KIMBALL & ASSOCIATES, 1987)

Physical, chemical, and engineering properties of the UC complex are variable as a result of the different types, thicknesses, and compactness of the soil comprising this complex from cut and fill activities at the Base. However, approximations from available data for the Gilpin silt loams, which are the primary constituents of the Udorthents and miscellaneous portions of the UC complex, can serve as a reference characterizing UC properties.

The Gilpin silt loam, a major constituent of the UC complex, has also been mapped at the north end of the Base and is the primary soil phase that encircles the airport. This soil phase, mapped as GlD, belongs to the fine loamy, mixed, mesic Typic Hapludults soil family. A mesic regime has a mean soil temperature of 47° through 57°F with the difference between mean summer and winter temperatures more than 9°F at 50 cm of soil depth. Mesic soil regimes can furnish information relative to vapor pressures of volatile pollutants into their various forms. Hapludults refers to a composite term representing the soil under the order ult of ultisols. Ultisols are highly weathered soils characterized by having a low percentage of clay in the upper 10-inch horizon and relatively higher clay contents in the 10- to 24-inch zone. This clay distribution occurs as a result of translocation by percolating water. Ultisols are limited in their ability to filter polar contaminants from percolating water due to the difficulty of displacing the aluminum and iron ions (weathering products which accumulate on clay surfaces) from soil colloids. Also, because many of the minerals present in ultisols are resistant to weathering (e.g., silicates), there is less likelihood for deactivation of waterborne pollutants through precipitation reactions within ions or free radicals furnished by weatherable minerals.

This GlD soil phase, formed in acid material weathered from interbedded shale, siltstone, and sandstone, is a moderately steep (20 to 30 percent slopes), well-drained, moderately deep soil found on ridgetops and benches. Areal extent of this soil on the Base is about 16 acres in the vicinity of and north of Buildings 128 and 129. The surface of this soil generally is covered by a 3-inch layer of leaf litter under which 7 inches of dark grayish brown and brown to dark brown silt loam is located. The subsoil extends to a depth of 31 inches, the uppermost 5 inches of which consists of a yellowish brown, friable silty clay loam underlain by 8 inches of a strong brown, friable silty clay loam. The lowermost 7 inches is a brown, friable, channery light silty clay loam. A brown, very channery heavy silt loam 5 inches thick makes up the substratum. Within Kanawha County, bedrock is typically encountered at a depth of 20 to 40 inches. This bedrock, capable of being excavated with a single tooth-ripping attachment on a 200-HP tractor, is termed "rippable." The rippable nature of this bedrock, as opposed to the "hard" nature of the bedrock 40 to 60 inches beneath the Clymer-Dekalb complex (CDF), which has to be blasted in order to be excavated, indicates a relatively higher risk of bedrock contamination beneath GlD zones than in CDF soil zones.

Permeability in the Gilpin series ranges from 1.2 to 4 feet per day. This series can be strongly acid to very strongly acid (pH of 4.5 to 5.5). Runoff is rapid, thus the potential for erosion by water can be severe. The Gilpin series has a low shrink-swell potential, thus the risk of building and pavement cracking by clay expansion is low. Due to low clay contents within the Gilpin series, the seasonal (dry weather) opening of surface cracks within the soil, which can cause polluted water or spills to immediately accumulate deep within the soil without undergoing any filtration, is not a factor. Because the rate of water transmission through the Gilpin soils is slow, caused by the relatively fine texture of the subsoil layer, this series belongs to the Hydrologic Soil Group C (see Glossary for definition).

As previously mentioned, up to 50 percent of the Udorthents complex at the Base, generically composed of urban and miscellaneous soils, are more specifically comprised of Gilpin silt loams (GlC, GlD, and GlE). The GlC and GlE soil phases differ from their GlD counterparts by their topographic location on 10 to 20 percent slopes and 30 to 40 percent slopes, respectively. GlC and GlE soils are typically found along ridgetops and benches; GlC soils are also located on side slopes. Gilpin silt loams have been assigned a Capability Class/Subclass of VI(e) which indicates these soils have severe limitations that make them unsuitable for cultivation, primarily because of the high risk of erosion and the shallow depth to bedrock.

The Clymer-Dekalb complex, mapped as CDF, occupies about 6 acres within the vicinity of Buildings 123, 171, 127, 117, 116, and the Commando Road located in the northern portion of the Base. The CDF complex is also found in pockets surrounding the airport, separated by the topographically higher Gilpin silt loams. The CDF complex consists of very steep, well-drained, moderately deep to deep soils on ridgetops and side slopes ranging from 40 to 70 percent. This complex is composed of 40 percent Clymer channery loam, 35 percent Dekalb channery sandy loam, and 25 percent miscellaneous soils (primarily Gilpin series). In terms of soil taxonomy, Clymer soils belong to the fine-loamy, mixed, mesic Typic Hapludults, while Dekalb soils are of the loamy-skeletal, mixed, mesic Typic Dystrochrepts soil family.

The surface layer of the Clymer soil is generally about 5 inches thick and is a dark grayish brown and yellowish brown channery loam. The subsoil extends down to a depth of about 37 inches, is friable, and ranges from a yellowish brown channery to a strong brown channery loam and clay loam. The 16-inch thick substratum consists of brown/yellowish red, very channery light clay loam. Sandstone and shale bedrock are typically encountered at a depth of 54 inches within Kanawha County.

The surface layer of the Dekalb soil is generally 4 inches thick and is a black and brown channery sandy loam. The subsoil is 28 inches thick, pale brown, and varies from a firm to friable, channery to very channery sandy loam. Sandstone bedrock is generally encountered at a depth of 32 inches within Kanawha County. The permeability is moderate to moderately rapid (1.2 to 6 feet per day) in the Clymer soil and moderately rapid to rapid (4 to 40 feet per day) in the Dekalb soil. The surface layers and subsoils of both of these soils are commonly acidic (pH of 4.5 to 5.5) and both have low shrink-swell potential. Overall, the CDF complex is assigned to Hydrologic Soil Group B (see Glossary for definition), thus infiltration rates in areas of CDF soil complexes at the Base can be expected to be higher than in those areas characterized by UC complexes and GlD soil phases. The CDF complex is assigned to the Capability Class/Subclass of VI(e).

Finally, the SCS mapping of soils within the Base and airport vicinity is supported by an extensive soil coring program conducted in 1985 as part of a Base Comprehensive Land Development Plan prepared by Kimball and Associates (1987). A total of 90 cores were drilled through all the pavement areas at the airport at 500 foot intervals to determine the type, thickness, and condition of the pavement. Each corehole extended 3 to 5 feet below the pavement to determine the subsurface materials. Locations of these cores are shown in Figure III-G which delineates the 17 wet cores from the remainder of the dry cores.

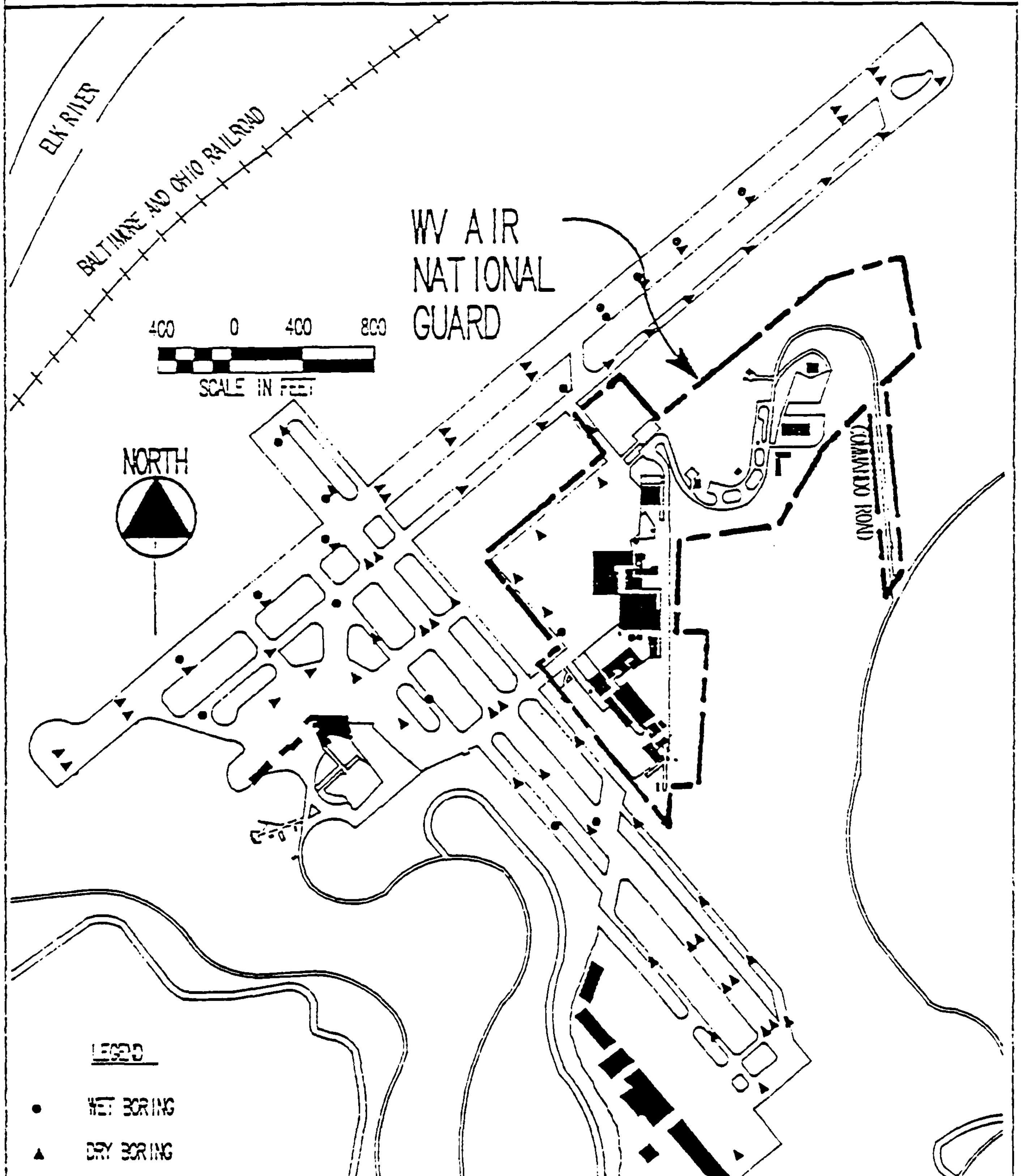
Specific to the Base were 11 cores, 5 of which were located on the ANG concrete apron (B1 through B5), 4 cores on the ANG bituminous section of the apron (B6 through B9), 1 core on the ANG taxiway D-2 A (B47), and 1 core on the ANG taxiway D-1 C (B85). Borings B1 through B5 revealed 0.6 to 0.8 feet of reinforced concrete underlain by 4.2 to 4.4 feet of gray, brown, and red clay, and gray shale. Borings B6 through B9 showed 0.4 to 0.5 feet of bituminous pavement with a one foot gravel base, underlain by about 3.5 feet of red, gray, and brown clay, and gray shale. B47 had 1.1 foot of bituminous underlain by 3.5 feet of brown clay. B85 revealed only 0.3 feet of bituminous pavement with a 1.2 foot gravel base, underlain by 3.5 feet of brown clay. All borings on Base were dry with the exception of B1, which indicated a wet gray shale layer from 0.6 to 5.0 feet below land surface (BLS).

Soil types and lithologies beneath the 1.5 foot thick concrete and bituminous pavement and gravel base of the 79 other cores drilled throughout the Airport were essentially the same as those types encountered on Base. Of these 79 cores, 16 encountered water within 5 feet of the surface. The two cores with water closest to the Base were B-67 and B-79, located about 360 feet and 600 feet WSW of the SW corner of Building 126, respectively. The other 14 cores with water are located from 750 to over 1500 feet from Base property boundaries.

A total of 17 additional borings, 10 to 15 feet deep, were drilled in early to mid-April of 1985 on Base property to geotechnically evaluate the area for construction purposes. Locations of these borings are indicated on Figure III-H. Limited water table data (no surface elevation determinations of

SOIL BORING (B) LOCATION MAP | FIGURE III-9

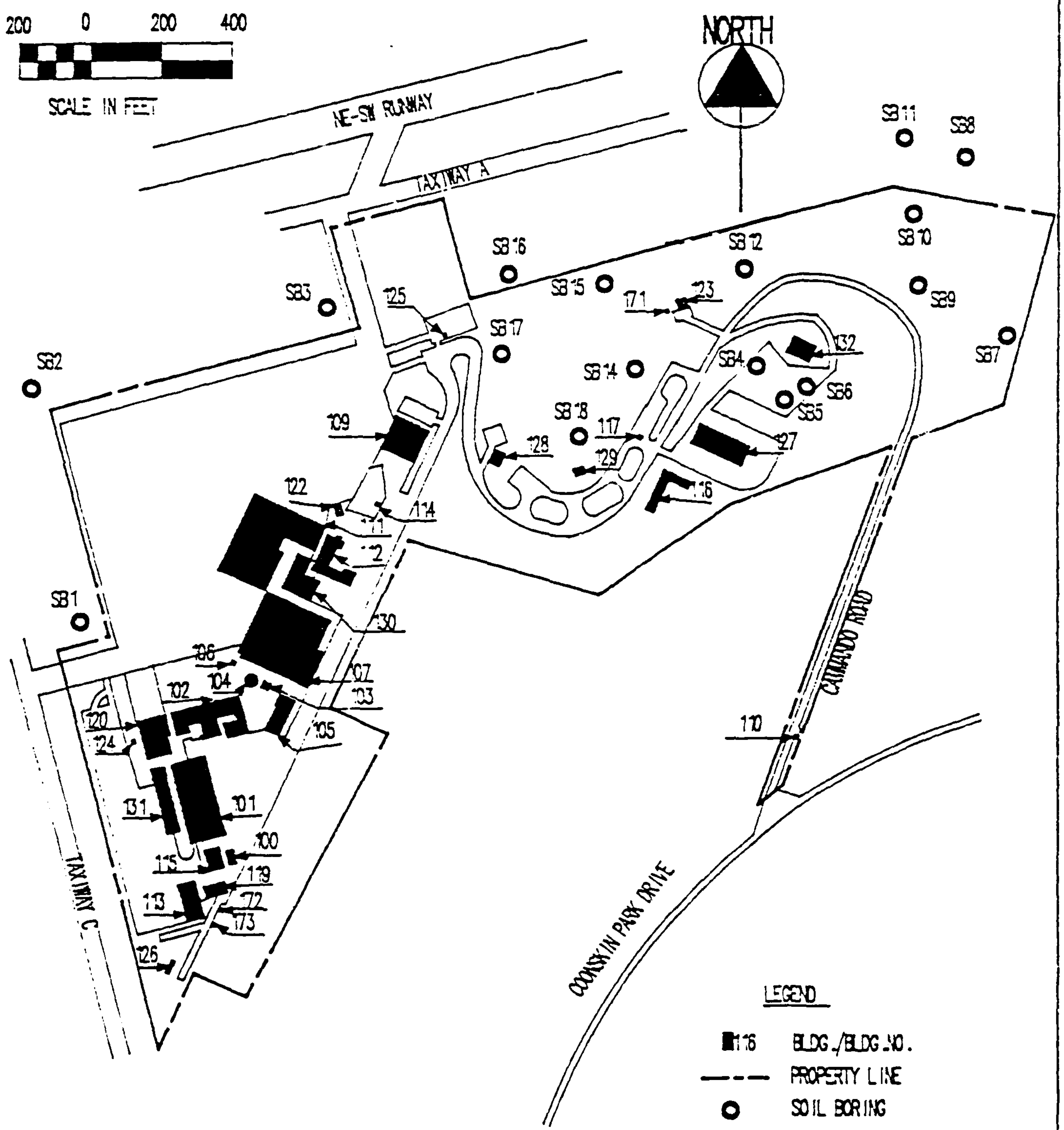
130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA (SOURCE: MODIFIED FROM SCS, 1981)



# SOIL BORING (SB) LOCATIONS MAP

FIGURE III-H

## 130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
## YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA




(SOURCE: MODIFIED FROM SCS, 1981)

the soil borings were made) are also available for these borings and are presented in Table III-B. Borings SB1 through SB, located in the grassy area west of maintenance hangars (Buildings 107 and 121), all had about one foot of topsoil. The topsoil in SB2 and SB3 was underlain by 9 feet of gray and red claystone; SB1 indicated a 9-foot hard brown and gray clay layer underlain by at least one foot of brown weathered shale.

Borings SB4 through SB6 were drilled in parking areas between the civil engineering and security buildings (Buildings 127 and 132). Each boring revealed a 1-foot thick blacktop section underlain by soft to hard brown and gray claystone.

Borings SB7, SB9, and SB12 were placed on the slopes on the north side of the Base access road (Commando Road) and indicated a 10- to 15-foot brown clay soil layer overlying a 5- to 9-feet or more soft brown sandstone strata.

Borings SB8, SB10, SB11, and SB15 were drilled near the valley bottom north of Commando Road. SB8 was logged as having 1 foot of brown sandstone, 0.9 feet of gray shale and sandstone, underlain by 4.3 feet of gray-brown claystone overlying at least 13 feet of soft brown sandstone. Borings SB10 and SB11 had 2 and 5 feet, respectively, of brown clay, underlain in SB10 by 14 feet of soft brown sandstone and at least 4 feet of hard gray sandstone. In SB11, the 5-foot brown clay layer was underlain by at least 5 feet of gray claystone. SB15, located about 160 feet WNW of Building 123, contained 15 feet of what was described as fill material (concrete, blacktop material, boulders, red-brown clay) overlying 1.8 feet of gray claystone, and at least 3.2+ feet of brown soft sandstone.

SB14 and SB18 were drilled on the slope between the waste treatment and liquid oxygen storage areas (Buildings 171 and 117). SB14 contained 15 feet of fill material similar to that in SB15, and was underlain by 1.8 feet of gray claystone and at least 4 feet of soft brown sandstone. SB18 contained 10 feet of sandy brown clay underlain by at least 10 feet of soft brown sandstone with vertical cracks.

## Table III-B

## DEPTH TO WATER FOR SOIL BORINGS

| SOIL BORING | 24 HOUR WATER LEVEL | STATIC WATER LEVEL (feet) | RISING HEAD (feet) | FALLING HEAD (feet) |
|---|---|---|---|---|
| SB1 | DRY | DRY | NA | NA |
| SB2 | NO DATA | 3.1 | NO DATA | NO DATA |
| SB3 | NO DATA | 2.5 | NO DATA | NO DATA |
| SB4 | NO DATA | 6.8 | NO DATA | NO DATA |
| SB5 | NO DATA | 5.0 | NO DATA | NO DATA |
| SB6 | NO DATA | 4.0 | NO DATA | NO DATA |
| SB7 | 5.3 | 6.0 | NA | 0.7 |
| SB8 | 18.5 | 18.0 | 0.5 | NA |
| SB9 | 8.7 | 7.0 | NA | 1.3 |
| SB10 | 7.6 | 7.2 | 0.4 | NA |
| SB11 | DRY | DRY | NA | NA |
| SB12 | 14.8 | 8.5 | 6.3 | NA |
| SB14 | 12.9 | 12.0 | 0.9 | NA |
| SB15 | 3.5 | DRY | NA | 1.6+ |
| SB16 | 12.9 | 23.4 | NA | 10.5 |
| SB17 | DRY | DRY | NA | NA |
| SB18 | 12.5 | 8.6 | 3.9 | NA |

The two remaining borings, SB16 and SB17, located about 250 feet north of and 200 feet southwest of Building 125, respectively, both contained 20 feet of brown clay with sandstone fragments underlain by 5 feet of gray claystone.

## D. WATER RESOURCES

### 1. Groundwater

The Base and northern Kanawha County are situated within the Elk River Basin, which runs roughly east to west, and is approximately 90 miles long by 20 miles wide. Forests make up the dominant land use (93.6 percent) in this 1532 square mile drainage basin with farmland comprising 4.8 percent. Urban and residential areas comprise 1.2 percent, surface mines 0.2 percent, and wetlands/water surfaces 0.2 percent of the Elk River basin. The drainage basin is located entirely within the unglaciated portion of the Appalachian Plateau physiographic province and includes parts of Braxton, Clay, Kanawha, Nicholas, Pocahontas, Randolph, Roane, and Webster counties. Topography is typically steep with narrow valleys; altitude ranges from 566 feet MSL at the mouth of the Elk River in Charleston to 4840 feet MSL on the eastern boundary of the basin near Snowshoe, West Virginia.

The drainage basin is inhabited by about 80,000 people, half of whom live in the Charleston area. Domestic water use in this basin is estimated at 3.5 million gpd, the most of which comes from surface water. The water intake for Charleston and the Base is located on Elk River about 1 1/2 mile upstream from its confluence with the Kanawha River, and about 1 1/2 miles downstream from Yeager Field. Groundwater is more important in rural areas of the basin that depend primarily upon the groundwater resource for their domestic needs.

Precipitation, which varies from about 46 inches per year in the Charleston Area to about 66 inches per year in the higher elevations in the northeastern portions of the basin, is the primary source of groundwater within the basin. Less than 50 percent of the precipitation enters the groundwater, because much is lost as overland runoff or evapotranspiration before reaching the zone of saturation. The degree with which water can be withdrawn from the saturated zone is dependent on the extent of hydraulic interconnection, which is higher in fractured rock strata than in clay or shale.

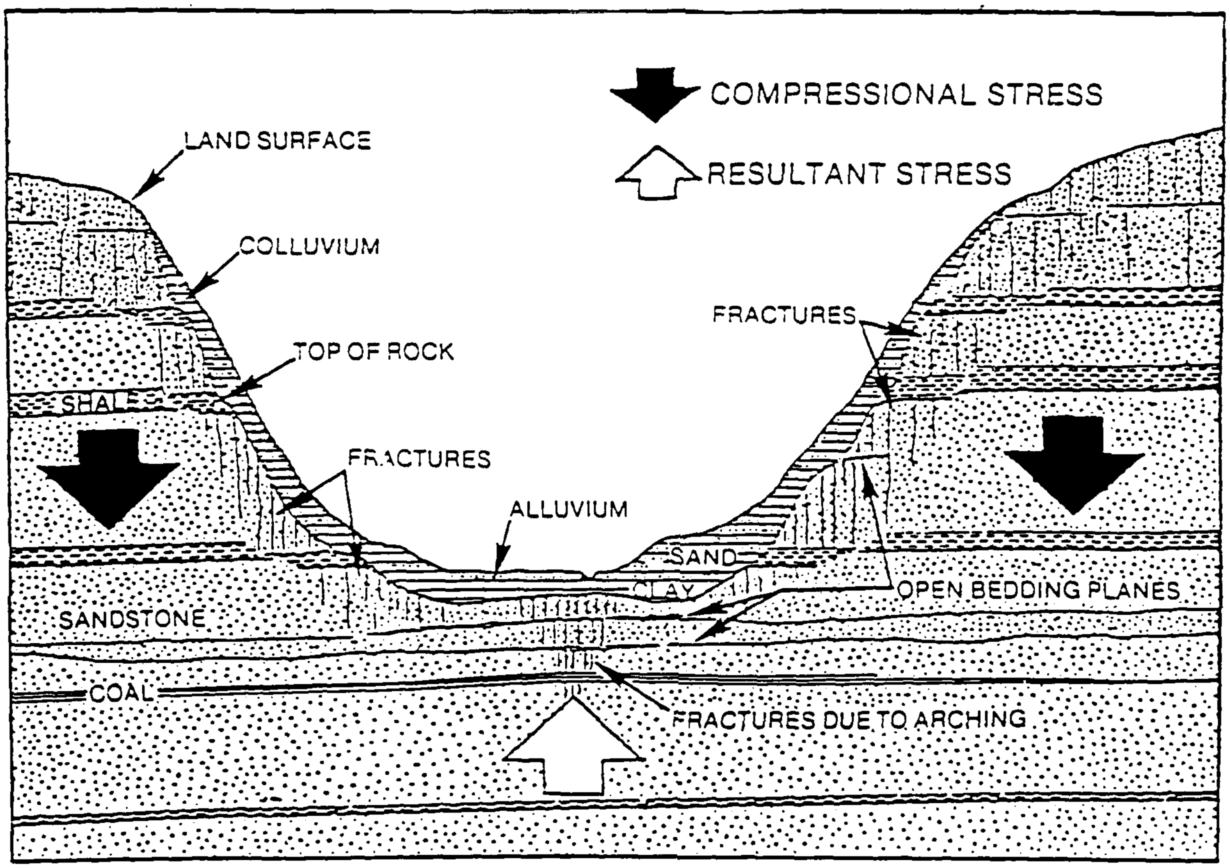
Surface rocks in the Elk River Basin range from the older Mississippian rocks that crop out on the eastern edge of the basin to the younger Pennsylvanian strata outcropping in the western and northwestern portions of the basin. Unconsolidated silts, clays, sands, and gravels of Quaternary age occur in many valleys. Rock strata are generally nearly horizontal and consist of alternating layers of sandstone, siltstone, clay, coal, and limestone, all typical of the cyclical deposition of the Carboniferous Period. Regional dip is to the north and northwest toward the Dunkard Basin, a Permian depositional basin occupying the tristate area of northern West Virginia, southwestern Pennsylvania, and eastern Ohio.

Water percolating through these basin lithologies is transmitted through faults, joints, and bedding plane separations, the velocity of which is controlled by the hydraulic gradient and the permeability of the strata. The major source of fractures in rocks of this basin is a result of stress-relief fracturing created by the erosion of valleys, which causes unequal stress distribution accompanied by numerous horizontal and vertical (stress-relief) fractures along the valley floor and walls. These fractures are interconnected and are major groundwater conduits. Figure III-I schematically illustrates the concept of stress-relief fracturing.

Fractures are best developed in the more brittle sandstones, siltstones, coals, and limestone and are less developed in the more plastic clay beds and shale. Sandstones in the basin generally have the higher well yields as a result of stress-relief fracturing, which is indicative of why higher median well yields are greater in the Lower Pennsylvanian rocks that contain more sandstone than the Upper Pennsylvanian strata. Table III-C presents the water-bearing characteristics of the Pennsylvanian section in Kanawha County (see Schweitering, 1981, for stratigraphic column).

GENERALIZED STRESS-RELIEF FRACTURING DIAGRAM | FIGURE III-1

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA (SOURCE: FERRELL, 1984)




Rocks overlain by younger deposits are subjected to compressional strength. When these younger deposits are removed through erosion processes in valleys, the compressional force is relieved. The rocks in the valley floor, however, are still subject to the compressional force of rocks forming the hills. As a consequence of these unequal forces, the valley floor rocks arch upward. Valley walls are also prone to unequal stress distribution as erosion occurs, resulting in numerous stress-relief fractures along the valley floor and walls.

TABLE III-C

GENERALIZED PENNSYLVANIAN GEOLOGIC SECTION OF KANAWHA COUNTY (DOSS ET AL. 1960)

| Geologic Series | Thickness (feet) | Lithology | Water-bearing Characteristics |
|---|---|---|---|
| Monongahela Series | 250-325 | Red and varicolcred sandy shale, gray, green, and brown sandstone, minor beds of coal, fire clay, black carbonaceous shale, and limestone. | Yields enough water to the wells for domestic use. No quantitative data available on well yields; however, probably similar to yields of wells in the Conemaugh Series. Water in places is of the sodium bicarbonate type and soft. |
| Conemaugh Series | 500-600 | Red and varicolored sandy shale, gray, green, and brown sandstone, minor beds of coal, fire clay, black carbonaceous shale, and limestone. | Yields enough water to wells for domestic use and some industrial use. Well yields range from less than 1 to 66 gpm and average about 13 gpm. Water quality is generally good and in places is excellent; soft and moderately mineralized. |
| Allegheny Series | 250-300 | Gray and brown, massive, coarse-grained sandstone locally conglomeratic; beds of shale, coal, fire clay, and limestone. | A source of large industrial supplies. Well yields range from less than 1 to 600 gpm and average about 125 gpm. Water soft to moderately hard; low to high in iron and dissolved solids. Water from deep wells in valleys may be moderately mineralized. |
| Pottsville Series | 400-2,000 | Gray and brown, massive, coarse-grained sandstone, locally conglomeratic; minor beds of shale, coal, fire clay, and limestone; lower part contains a 300 to 500 zone of the "Salt sandstones" of drillers. | A source of large industrial and municipal supplies. Well yields range from less than 1 to 522 gpm and average about 118 gpm. Water from deep wells in foot valleys is more mineralized than from wells of equal depth at higher elevations. The "salt sandstones" of drillers are encountered in wells at depths of about 550 to 1,200 ft; brine wells yields range from 5 to 60 gpm and average 32 gpm. |

Well yields taken from 170 wells within the Elk River Basin are highly variable and range from less than 1 to 1000 gpm. Since the homogeneity of geologic units in the basin with regard to lithology, structure, and permeability is low, well yields do not correlate well by geologic unit on a basin-wide basis. Generally, the highest median well yield is in valleys (17 gpm) compared to median well yields on hillsides and hilltops of 7 and 2 gpm, respectively. Median depth to water and median well depth is lowest in valleys and highest on hilltop wells because of higher recharge rates and more rock fractures in valley areas than on hilltops.

Within the Elk River and Kanawha River Basins, average well yields drilled into the Conemaugh Group are about 9 gpm and average specific well capacity is about 1.4 gallons per minute per foot of drawdown. Also, for the Conemaugh Group, the transmissitivity coefficient ranges from 19 to 2059 and averages 468 $ft^2$/day, and the coefficient of storage ranges from 0.0001 to 0.031, averaging 0.008, (Wilmoth, 1966). For the Allegheny Group of rocks, average well yield is about 75 gpm, and the specific capacity averages 3.4 gallons/minute/foot of drawdown, (Doll et al. 1960). Transmissitivity coefficients have been reported as high as 17,000 gallons per day per foot for the Allegheny series.

Chemical quality of groundwater within the basin is highly variable but is generally suitable for most domestic purposes. In the area of the Base, groundwater generally contains over 0.3 mg/L of iron which, at this concentration, can cause staining of plumbing fixtures and laundry. This high iron content area, as well as several other similar areas within the basin, correlates with heavy coal mining operations which can cause local degradation of groundwater quality. The Conemaugh Group of rocks, exposed and mapped within the Base/Yeager Airport vicinity, regionally within the Elk River Basin is generally not well suited for groundwater for industrial/municipal uses. The Allegheny Group has a slightly higher potential for industrial and municipal use regionally throughout the basin. Both of the groups are generally suitable for domestic and farm use and contain water that is soft to very hard and is of the sodium and calcium bicarbonate types.

Data supplied from the USGS, Charleston, West Virginia field office, indicate that 36 wells are located within 3 miles of the Base, 35 of which are within 1.5 miles of the Base. It is not known how many of these wells are still in use. Undoubtedly, use of many of these wells has been discontinued and the user has been connected in to the Charleston Water District. Official USGS use designation of these wells include one each for irrigation, industrial, and commercial uses, respectively, four in the unused category, with the remainder listed as domestic utilization. Depths of the wells vary from 17 to 300 feet (most are less than 100 feet deep) with water levels from 4 to 170 feet below land surface (most are less than 60 feet BLS). Discharge rates vary from 1 to 43 gpm with 11 of the wells producing from the Allegheny Group, 11 from the Kanawha Group, and 7 wells producing from the Holocene Alluvium along surface water drainages. The majority of wells are located along valley bottoms where groundwater would be expected to be present in greater amounts and were constructed before 1957 using the cable tool method of construction. Most wells were finished using open hole or open end. None of the wells are suitable for off-Base monitoring purposes due to their hydrologic inapplicability to the Base, lack of proper well development and screening, and lack of important well construction and development parameters, with perhaps the exception of the Jay Woolridge well (N38°22'50.0" by W81°35'45.01"). This 6-inch diameter well, located within 0.7 miles NW of the Base at 600 feet MSL near Elk River, was constructed on March 30, 1987, and is 68 feet deep with casing from 698.5 feet to 664.5 feet MSL. Tapping into the Allegheny Group and producing 2 gpm, this well could be used to establish baseline water quality near the Base.

No groundwater wells or seasonal monitoring data are currently available for the Base and Yeager Field. However, there is an abundance of soil boring data from field operations during April 1985 which indicate that the Base rests on top of a shallow, unconfined aquifer, generally within 5 to 10 feet of the land surface. This shallow aquifer probably occurs both as an unconsolidated aquifer zone composed of fill materials and as the weathered upper 100 to 200 feet of the upper Conemaugh sandstone. How much the water table fluctuates seasonally is not known. Historically within Kanawha County, groundwater levels are highest in late winter and early spring when recharge to the aquifers is highest. Groundwater levels decline to their lowest levels in late summer and early autumn due to 50 percent or more evapotranspiration rates. During late autumn and early winter, more water reaches the water table because evapotranspiration at this time is at a minimum so water levels begin to rise and continue to rise until late winter and early spring, when this groundwater-level fluctuation cycle begins again.

Shallow groundwater flow patterns probably still follow the general pre-Airport construction flow routes where original topography was the dominant flow factor. It appears that this shallow aquifer system recharges local surface water drainages in the Base and Airport vicinity. Where the depth of fill material is restricted by the presence of the less permeable Conemaugh sandstone "bedrock" aquifers (as opposed to the more permeable, unconsolidated fill material water zones), the water table is within 5 feet or less to the land surface. These areas discharge laterally northwest toward the Elk River in the form of springs at maximum estimated rate of 5 gpm. Depth-to-water data presented in Table III-B from the 17 soil borings drilled mainly in the vicinity of Commando Road indicates a shallow, wet season water table situated 4 to 18 feet underneath the land surface. Further hydrologic analysis of this data would be of relative value; surface elevations of these borings were not determined during drilling operations.

Groundwater quality of the shallow unconfined aquifer zone beneath the Base is unknown. Volumetrically, this shallow aquifer zone is not well suited for domestic, industrial, or commercial use. The Base receives its water supply from the Elk River from an intake about 1.5 miles downstream from the Base. The underlying Allegheny series, exposed at the surface in southern Kanawha County, apparently does not receive much interaquifer flow from the overlying Conemaugh water-bearing units. This is evidenced by the low yield of wells tapping into the Allegheny in the vicinity of the Base, which stratigraphically is situated about 50 feet below the Elk River elevation. Therefore, groundwater on Base and the immediate vicinity recharges surface water drainage features, discharges northward and northeastward as springs, and may also recharge the Elk River system.

2. Surface Water

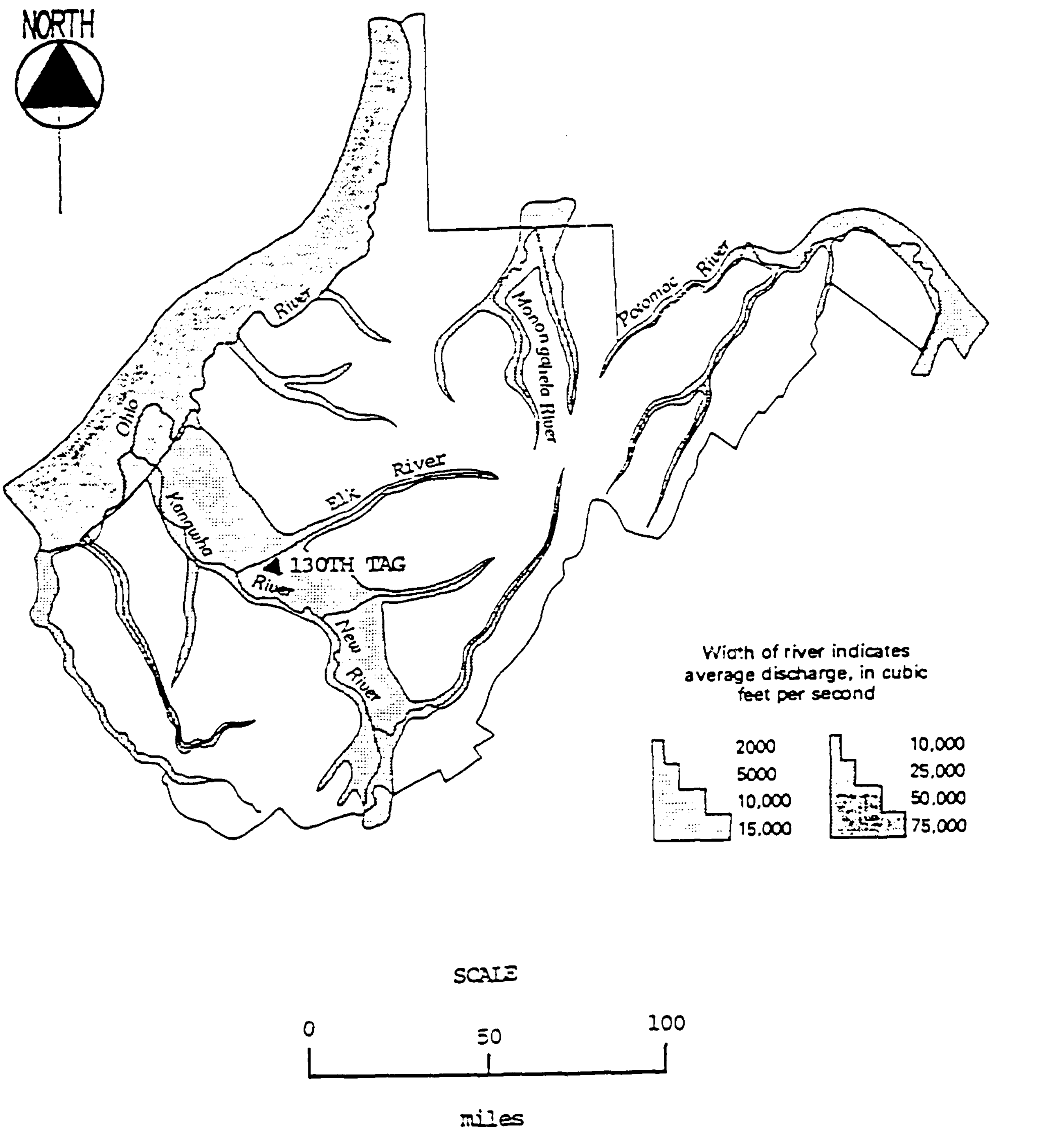
The largest stream in West Virginia and Kanawha County is the Kanawha River, a tributary to the Ohio River. The 97-mile-long Kanawha River flows in a northwesterly direction and empties into the Ohio River at Point Pleasant, West Virginia. It has an average slope of 1 foot per mile within Kanawha County where it flows a distance of 41.3 miles. This river is navigable for 91 miles and has a total drainage area of 12,243 square miles. Average flow in the Charlestor area is 14,150 cfs (9150 mgd, 1.36 cfs/square mile), normal pool stage elevation is 566 feet MSL, and the drainage area is 10,419 square miles. Maximum discharge at Charleston from 1939 to 1987 occurred on March 7, 1955, at 39.72 feet above normal pool stage elevation. Minimum discharge during this period occurred in 1953. Figure III-J illustrates the average discharge rates in cubic feet per second of the primary rivers in West Virginia.

The major tributary to Kanawha River is the Elk River, which has a drainage area of 1533 square miles. In the vicinity of Yeager Field, Elk Two Mile Creek (drainage area of 12 square miles) and Coonskin Branch (drainage area of less than 2 square miles) comprise the surface water drainageways and are shown in Figure III-K. Available data for both these perennial stream systems from the USGS are presented in Table III-D. These data, along with observations recently made by PEER Consultants, P.C., indicate no manifestations of environmental stress present in either of these streams. According to the West Virginia Department of Natural Resources, Water Resources Division, both Coonskin Branch and Elk Two Mile creeks are classified as "small non-fishable bait streams" and are not used for recreational, commercial, industrial, or agricultural purposes.

Lowest stream flows generally occur during late summer and fall. Highest stream flows occur in winter and early spring. Small tributaries are subject to minor occasional flooding caused by large, winter rainfall events, hurricane-related storms, or afternoon cloudbursts. Major tributaries to the Elk and Kanawha rivers are dam controlled, which afford flood protection for the Kanawha Valley and help reduce flood flows on the Ohio River. The risk of flooding at the Base by the Elk River is not likely; the Base is situated above

| PRIMARY RIVER DISCHARGE RATES | FIGURE III-J |
|---|---|

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA (SOURCE: USGS, 1982)



MAJOR SURFACE WATER DRAINAGES AROUND YEAGER AIRPORT | FIGURE III-K

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA

(SOURCE: USGS CHARLESTON EAST, BIG CHIMNEY TOPOGRAPHIC MAPS, 1976)

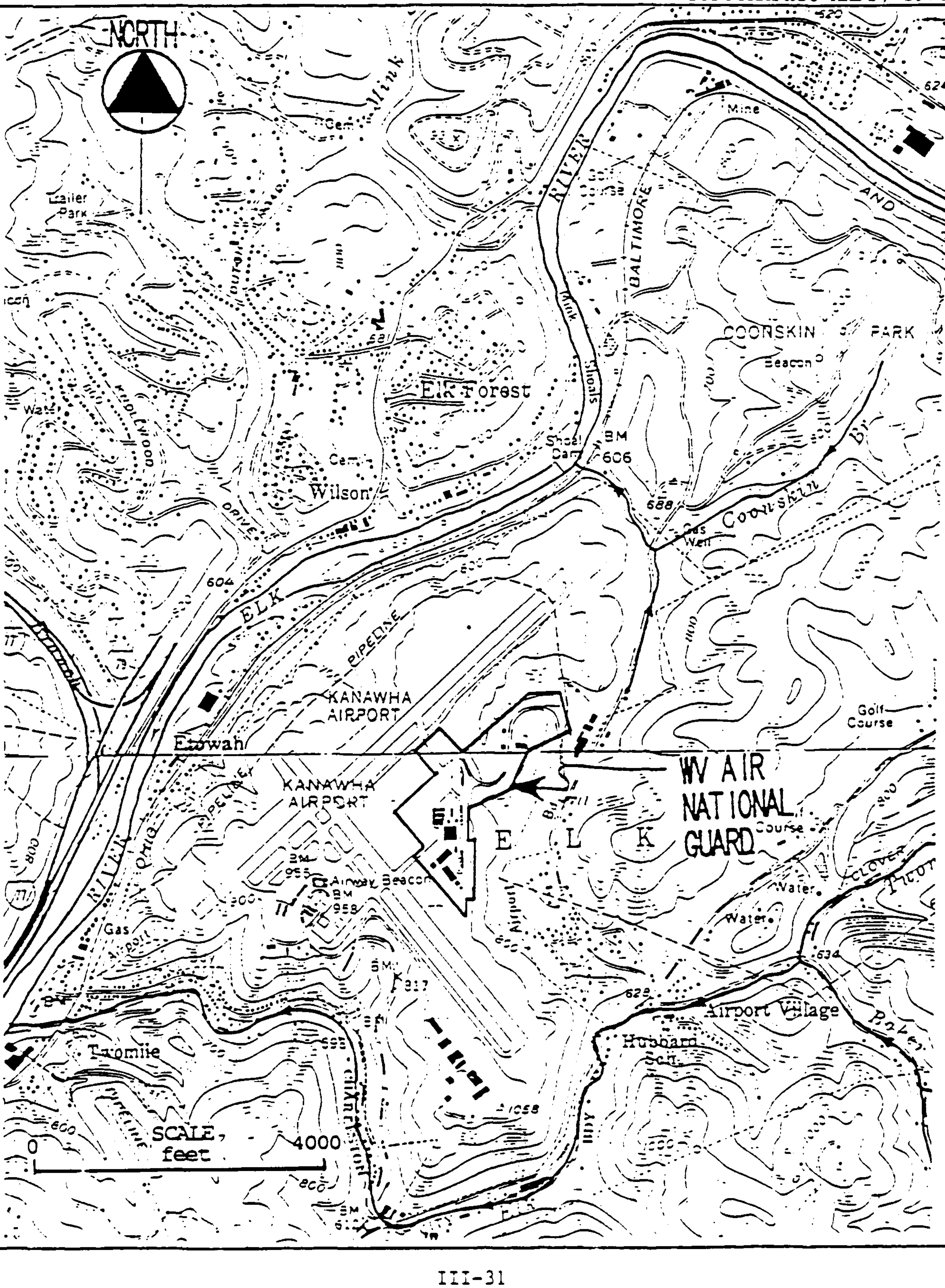


TABLE III-D

AVAILABLE SURFACE WATER DATA FROM USGS

| | Elk Two Mile Creek | Elk Two Mile Creek | Coonskin Branch |
|---|---|---|---|
| Sample date | 07/15/74 | 10/16/74 | 10/16/74 |
| Water temperature (°C) | 20 | 12 | 12 |
| Stream flow ($ft^3$/sec) | 1.20 | 0.97 | 17 |
| Specific conductance ($\mu\Omega$/cm) | 240 | 230 | 210 |
| Dissolved oxygen (mg/L) | 8 | 10.1 | 8.9 |
| pH | 7.6 | 7.5 | 6.8 |
| Hardness, as $CaCO_3$ (mg/L) | 84 | --- | 55 |
| Dissolved calcium (mg/L) | 23 | --- | 14 |
| Dissolved magnesium (mg/L) | 6.5 | --- | 4.9 |
| Dissolved chloride (mg/L) | 18 | --- | 18 |
| Dissolved sulfate (mg/L) | 36 | --- | 20 |
| Dissolved iron (mg/L) | 60 | --- | --- |
| Dissolved manganese (mg/L) | 160 | --- | --- |

the 500 year flood level and is over 300 feet higher in elevation than the Elk River.

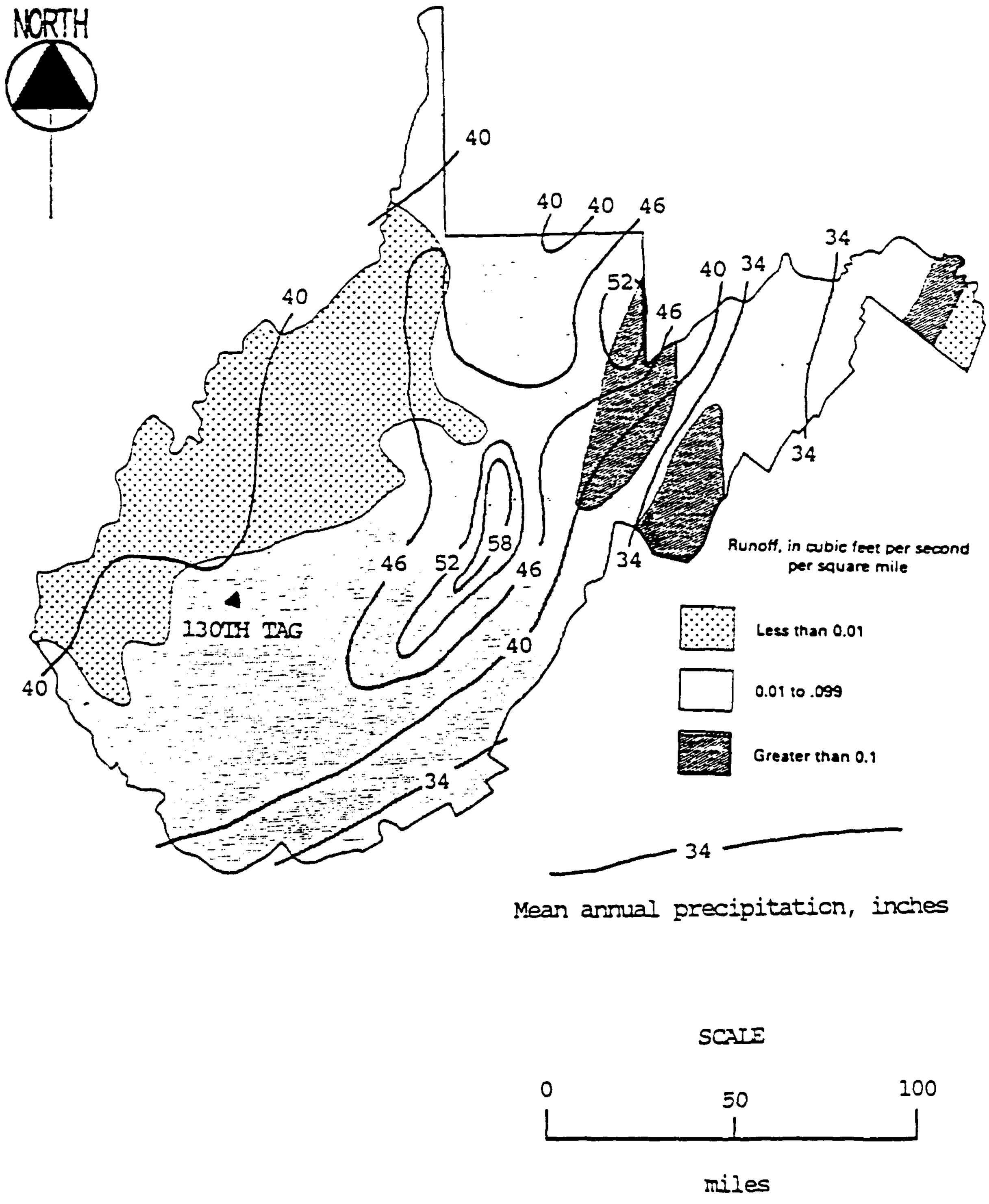
With the exception of Site No. 3 (FTA) located at the southern extremity of the Base, all surface drainage on Base is directed via interconnecting storm sewers and ditches, or by overland runoff, to the two major topographic draws east of the Base. These two groundwater recharged draws, containing flow throughout most of the year, empty into the northward flowing unnamed tributary of Coonskin Branch. This drainage then flows less than 3000 feet to the confluence with Coonskin Branch, which is about 1100 feet away from its confluence with Elk River. Thus, drainage from the Base serves as an important recharge source for Coonskin Branch, which courses through Coonskin Park, a county recreational area.

The amount of surface water runoff depends upon slope conditions (topography), soil types, and precipitation quantities. Figure III-L illustrates surface water runoff (in $cfs/mi^2$) and average yearly precipitation amounts for different regions in West Virginia. The Base is located within a regional area where runoff values range from 0.01 to 0.099 $cfs/mi^2$ and mean yearly precipitation is between 40 and 46 inches. The correlation of precipitation amounts to runoff values in the vicinity of Yeager Airport appear to be low, indicating soil types and slope conditions in this area are more important runoff factors. Because soil types at the Base are fairly permeable, slope conditions (topography) is the single most dominant factor affecting runoff. Hence, at the Base, potential contaminant migration via overland surface water runoff could be a contaminant transport pathway only in those areas where steep slopes are present.

Surface drainage from Site No. 3 could possibly enter Elk Two Mile Creek via overland runoff of about 2000 feet. From this point on Elk Two Mile Creek, drainage flows about 13,000 feet before reaching Elk River. Figure III-M illustrates surface water drainage patterns at the Base and all perennial streams/rivers in the immediate airport vicinity.

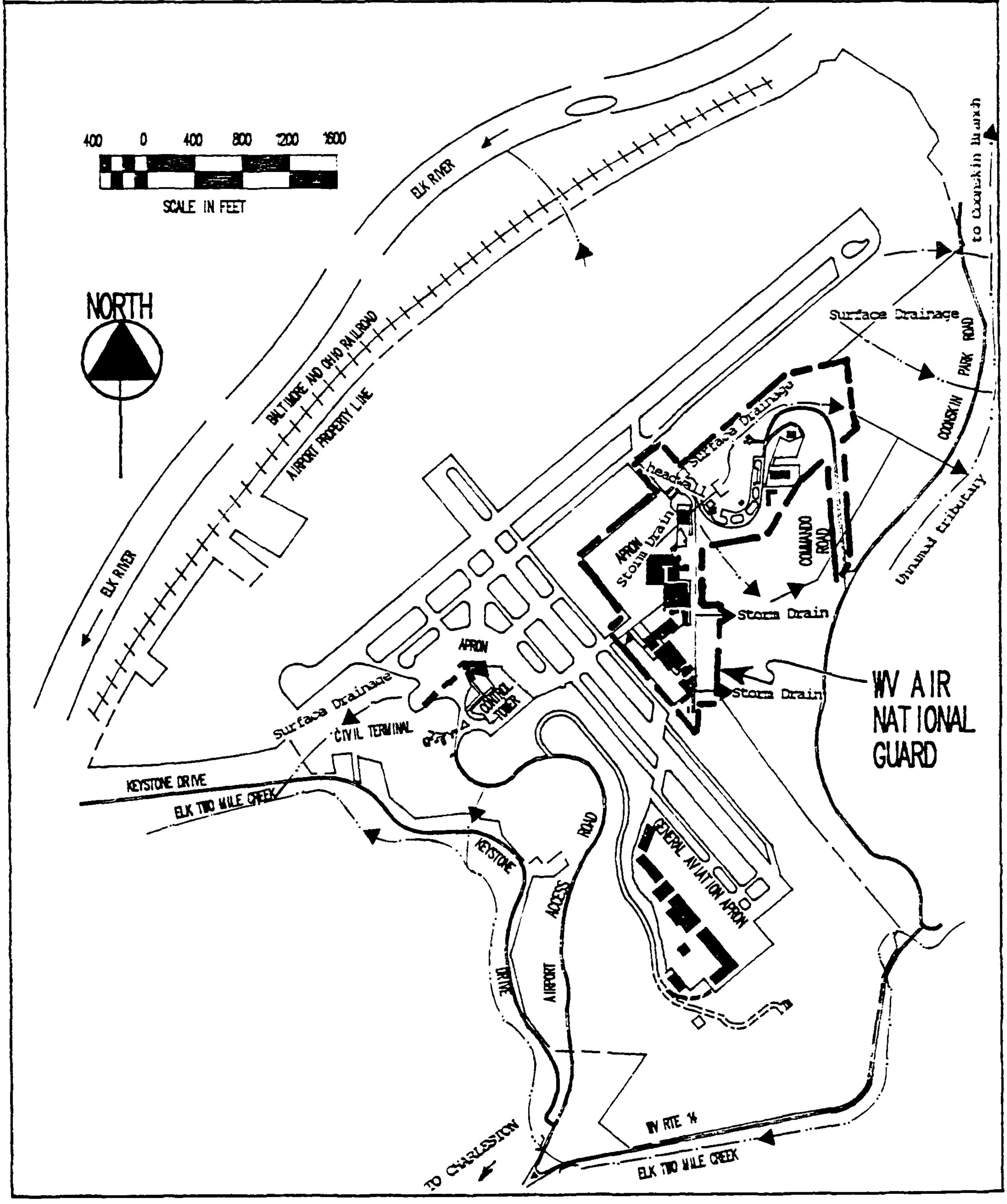
| REGIONAL SURFACE WATER RUNOFF MAP | FIGURE III-2 |
|---|---|

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA (SOURCE: USGS, 1982)



| SURFACE DRAINAGE MAP | FIGURE III-M |
|---|---|

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA (SOURCE: KIMBALL & ASSOCIATES, 1987)



There is no surface water quality monitoring program conducted at the Base. Effluent from the Base wastewater treatment facility is monitored in accordance with a state permit (see Section IV-C, Other Pertinent Facts).

## E. CRITICAL HABITATS/ENDANGERED OR THREATENED SPECIES

The uncultivated flora within a 1-mile radius of the Base is dominantly hardwood forest less than 50 years old. No wetlands habitat exist within 1 mile of the Base. Portions of these areas are urbanized or are used for agriculture.

Wildlife species expected to inhabit the area include deer, fox, squirrel, rabbit, duck, hawk, and a variety of forest and grassland (agricultural areas) birds. According to the Office of the Director of the Division of Conservation at Elkins, West Virginia, there are no critical habitats or endangered or threatened species in the vicinity of the Base.

# IV. SITE EVALUATION

## A. ACTIVITY REVIEW

A review of Base records and interviews with Base employees resulted in the identification of specific operations within each activity in which most industrial chemicals are handled and hazardous wastes are generated. Table IV-A 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 present disposal practices for the wastes. If an operation is not listed in Table IV-A, then that operation has been determined on a best-estimate basis to produce negligible (less than 5 gallons per year) quantities of wastes requiring ultimate disposal. For example, an activity may use small volumes of methyl ethyl ketone. Such quantities commonly evaporate during use and therefore do not present a disposal problem. Conversely, if a particular volatile compound is listed, then the quantity shown represents an estimate of the amount actually disposed of according to the method shown. Table IV-B contains building names and numbers.

## B. DISPOSAL/SPILL SITE IDENTIFICATION, EVALUATION, AND HAZARD ASSESSMENT

Interviews with 25 past and present Base personnel and subsequent site inspections resulted in the identification of four disposal and spill sites. It was determined that these four identified sites are potentially contaminated with hazardous materials/hazardous wastes with a potential for migration; therefore, they should be further evaluated. These sites were scored using HARM (see Appendices C, D, and E). Figure IV-A illustrates the locations of the scored sites. Table IV-C summarizes the HARM Score for each of the scored sites.

Table IV-A. Hazardous Material/Hazardous Waste Disposal Summary:
130th Tactical Airlift Group
West Virginia Air National Guard
Yeager Airport
Charleston, West Virginia

| Shop | Building No. (Past & Present) | Hazardous Materials/ Hazardous Wastes | Estimated Quantities (Gal/Year) | Method of Treatment/Storage/Disposal 1950 '60 '70 '80 '88 |
|---|---|---|---|---|
| Pneudraulic (Hangar No. 2) | 121 | PD-680 | 100 | --------Unknown--------->Bowser/FTA----->DRMO----------> |
| | | Strippers (MEK,MIK) | 55 | ---------------------NEUTR SAN---------->DRMO----------> |
| | | Synthetic Turbine Oil | 75 | --------Unknown---------->REC---------->DRMO----------> |
| | | JP-4 Jet Fuel | 500 | --------Unknown---------->REC---------->DRMO----------> |
| | | Hydraulic Oil | 100 | --------Unknown--------->Bowser/FTA----->DRMO----------> |
| Aerospace Ground Equipment Maintenance (AGE) (Hangar No. 2) | 111 | Engine Oil | 200 | --------Unknown--------->Waste Tank----->DRMO----------> |
| | | Hydraulic Oil | 30 | --------Unknown--------->Waste Tank----->DRMO----------> |
| | | Paint Strippers/Thinners | 20 | --------Unknown--------->Waste Tank----->DRMO----------> |
| | | JP-4 Jet Fuel | 25 | --------Unknown--------->Bowser/FTA----->DRMO----------> |
| | | Battery Acid | 12 | --------Unknown----------NEUTRA SAN----->DRMO----------> |
| | | Aircraft Cleaning | 24 | ----Unknown------OWS/SAN-----------------------------> |
| | | Mopping Compound | 50 | *-----------------------------------------------------> |
| Vehicle Maintenance (Motor Pool) | 112 | Engine Oil | 240 | --------Unknown--------->OWS----------->DRMO----------> |
| | | PD-680 | 20 | --------Unknown--------->OWS----------->DRMO----------> |
| | | Strippers (MEK) (Paint Booth) | 60 | -------------Unknown------------------->DRMO----------> |
| | | Stripper Residue | 60 | --------Unknown---------->OWS/SAN------->DRMO----------> |
| | | Sulfuric Acid | 12 | --------Unknown------>NEUTR SAN---------->DRMO----------> |
| | | Spray Booth Wastewater | 800 | --------Unknown-------------->OWS/SAN-----------------> |
| | | JP-4 Jet Fuel | 110 | ----------FTA-------------------------->DRMO----------> |
| | | Hydraulic Oil | 120 | --------Unknown--------->OWS----------->DRMO----------> |
| | | Transmission Fluid | 120 | --------Unknown--------->OWS----------->DRMO----------> |
| | | Paint Thinner | 30 | --------Unknown--------->SAN----------->DRMO----------> |
| | | Brake Fluid | 5 | --------Unknown--------->OWS/SAN----------------------> |
| Liquid Fuels | 128 | JP-4 Jet Fuel | 110 | --------Unknown--------->FTA----------->DRMO----------> |
| | | Sulfuric Acid | 8 | --------Unknown--------->NEUTR SAN--------------------> |
| | | AVGAS | Unknown | --------ARMY------------>FTA--------------------------> |

Table IV-A. Hazardous Material/Hazardous Waste Disposal Summary (Continued):
130th Tactical Airlift Group
West Virginia Air National Guard
Yeager Airport
Charleston, West Virginia

| Shop | Building No. (Past & Present) | Hazardous Materials/ Hazardous Wastes | Estimated Quantities (Gal/Year) | Method of Treatment/Storage/Disposal 1950 '60 '70 '80 '88 |
|---|---|---|---|---|
| Non-Destructive Inspection (NDI) (Hangar No. 1) | | Penetrant | 35 | -----Unknown------------------------------>DRMO-----------> |
| | | Emulsifier | 35 | -----Unknown------------------------------>DRMO-----------> |
| | | Developer | 25 | -----Unknown---->SAN---------------------->DRMO-----------> |
| | | Fixer | 20 | ---------Unknown-------------------------->DRMO-----------> |
| | | TCE | 7 | -----------------------NOT USED----------------->DRMO---> |
| | | PD-680 | Unknown | -----Unknown-------------->Bowser/FTA------------NOT USED> |
| | | Trichlorotrifloroethane | 15 | ---------------NOT USED------------------------->DRMO---> |
| | | Acetic Acid (Stop Bath) | 15 | -----Unknown-------------->SAN---------------------------> |
| Corrosion Control (Hanger No. 2) | 121 | Solvents/PD-680 | 360 | -----Unknown-------------->OWS/SAN-------->DRMO-----------> |
| | | Thinners | 24 | -----Unknown-------------->OWS/SAN-------->DRMO-----------> |
| | | Paint Strippers | 12 | -----Unknown-------------->OWS/SAN-------->DRMO-----------> |
| | | Lacquer | 15 | -----Unknown------------------------------>DRMO-----------> |
| | | Soap (Calla 505) | 1320 | -----Unknown-------------->OWS/SAN------------------------> |
| | | Cleaner (Klean Strip) | 12 | -----Unknown-------------->OWS/SAN------------------------> |
| Power Production (Civil Engineering Building) | 127 | Cooling Water and Cooling Tower Treatment (Antifreeze) | 15 | -----Unknown-------------->SAN----------------------------> |
| | | Sulfuric Acid | 10 | -----Unknown-------------->NEUTRA SAN----->DRMO-----------> |
| | | Lube Oil | 30 | ---------Unknown-------------------------->DRMO-----------> |
| | | Cleaning Compound (type unknown) | 30 | ---------Unknown-------------------------->DRMO-----------> |
| Machine (Hanger No. 2) | 121 | Metal Cutting Oils | Unknown | ---------------------REC BY DRMO-------------------------> |
| Battery Shop (Hanger No. 1) | 107 | Used Batteries | 24/yr | ---------Unknown------->SALVAGED--------------------------> |
| | | Battery Acid | 24 | ---------Unknown------->NEUTR SAN------->DRMO-------------> |
| Photo Lab (Flight Operations) | 130 | Developer | 10 | -----Unknown--->SAN---------------------------------------> |
| | | Fixer | Unknown | --------------->SILVER RECOVERY---------------------------> |
| | | Kodak (TM) Color Process Waste (E-6) | 120 | -----Unknown---------------->Diluted/SAN-----------------> |
| | | Kodak (TM) Color Process Waste (R-1000) | 5 | -----Unknown---------------->Diluted/SAN-----------------> |

Table IV-A. Ha ardous Material/Hazardous Waste Disposal Summary (Continued):
130th Tactical Airlift Group
West Virginia Air National Guard
Yeager Airport
Charleston, West Virginia

| Shop | Building No. (Past & Present) | Hazardous Materials/ Hazardous Wastes | Estimated Quantities (Gal/Year) | Method of Treatment/Storage/Disposal 1950 '60 '70 '80 '88 |
|---|---|---|---|---|
| Aircraft Engine Inspection and Repair | 109 | PD-680 | 250 | -----Unknown----------->BOWSER------------>DRMO-----------> |
| | | Carbon Cleaner | 70 | -----Unknown----------->Not Used-------------------------> |
| | | Strippers | 400 | |
| | | Hydraulic Oil | 12 | -----Unknown----------->REC--------------->DRMO-----------> |
| | | Synthetic Engine Oil | 650 | -----Unknown----------->REC--------------->DRMO-----------> |
| | | Fire Retardant Hydraulic Fluid | 125 | -----Unknown------------------>REC--------->DRMO-----------> |
| | | Gas Bath Cleaner (type unknown) | 250 | -----Unknown----------------->OWS/SAN----->DRMO-----------> |

Legend

FTA - Burned at Fire Training Area
REC - Recycled
SAN - Disposed of in Drains Leading to Sanitary Sewer
DRMO - Disposed of by Defense Reutilization and Marketing Office - (Before 1985, disposal was by the Defense Property Disposal Office - DPDO)
NEUTRA SAN - Neutralized and Disposed of in Sanitary Sewer
OWS - Oil/Water Separator
BOWSER - Above ground storage tank
SALVAGED - Defined to indicate recycled through AF supply channels to be disposed of at Wright-Patterson AFB and/or Rickenbacker AFB, Ohio.
UNKNOWN - Method of treatment was unknown, but in the case of flammable materials, it was common practice to burn them at the fire training area, or transport the materials to Site No. 2.
MOPPING COMPOUND - 70 percent Stoddard Solvent, 5 percent TCE, 25 percent Dichloroethane.
* - Evaporates during use

**TABLE IV-B**

**LIST OF BUILDING NAMES AND NUMBERS**

**130th TAG, WEST VIRGINIA AIR NATIONAL GUARD**

**YEAGER AIRPORT**

**CHARLESTON, WEST VIRGINIA**

| BUILDING NUMBER | DESCRIPTION |
|---|---|
| 100 | PAINT STORAGE |
| 101 | BASE SUPPLY |
| 102 | ADMINISTRATION-CLINIC |
| 103 | WATER PLANT |
| 104 | WATER STORAGE TANK |
| 105 | COMMUNICATIONS |
| 106 | CABOT GAS CORP. |
| 107 | MAINTENANCE HANGAR #1 |
| 109 | AIRCRAFT ENGINE INSPECTION AND REPAIR SHOP |
| 110 | TRAFFIC CHECK HOUSE |
| 111 | AEROSPACE GROUND EQUIPMENT STORAGE |
| 112 | VEHICLE MAINTENANCE SHOP |
| 113 | MOBILITY STORAGE |
| 114 | MOGAS ISSUE |
| 115 | AERIAL PORT STORAGE |
| 116 | DISEASE PREPAREDNESS & WEATHER FLIGHT |
| 117 | LIQUID OXYGEN STORAGE |
| 119 | CIVIL ENGINEERING STORAGE |
| 120 | FIRE STATION |
| 121 | MAINTENANCE HANGAR #2 |
| 122 | CORROSION CONTROL |
| 123 | WASTE TREATMENT |
| 125 | INSPECTION AND REPAIR TEST SHELTER |
| 126 | MUNITIONS STORAGE |
| 127 | CIVIL ENGINEERING |
| 128 | LIQUID FUELS |
| 129 | LIQUID FUELS PUMP HOUSE |
| 130 | FLIGHT OPERATIONS |
| 131 | AERIAL PORT |
| 132 | SECURITY POLICE |
| 166 | RESERVE FORCES OPERATIONS & TRAINING |
| 171 | WASTE TREATMENT STORAGE |
| 172 | HAZARDOUS STORAGE |
| 173 | HAZARDOUS STORAGE |

LOCATION OF HARM SCORED SITES

FIGURE IV-A

130th TAG, WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA (SOURCE: KIMBALL & ASSOCIATES, 1987)

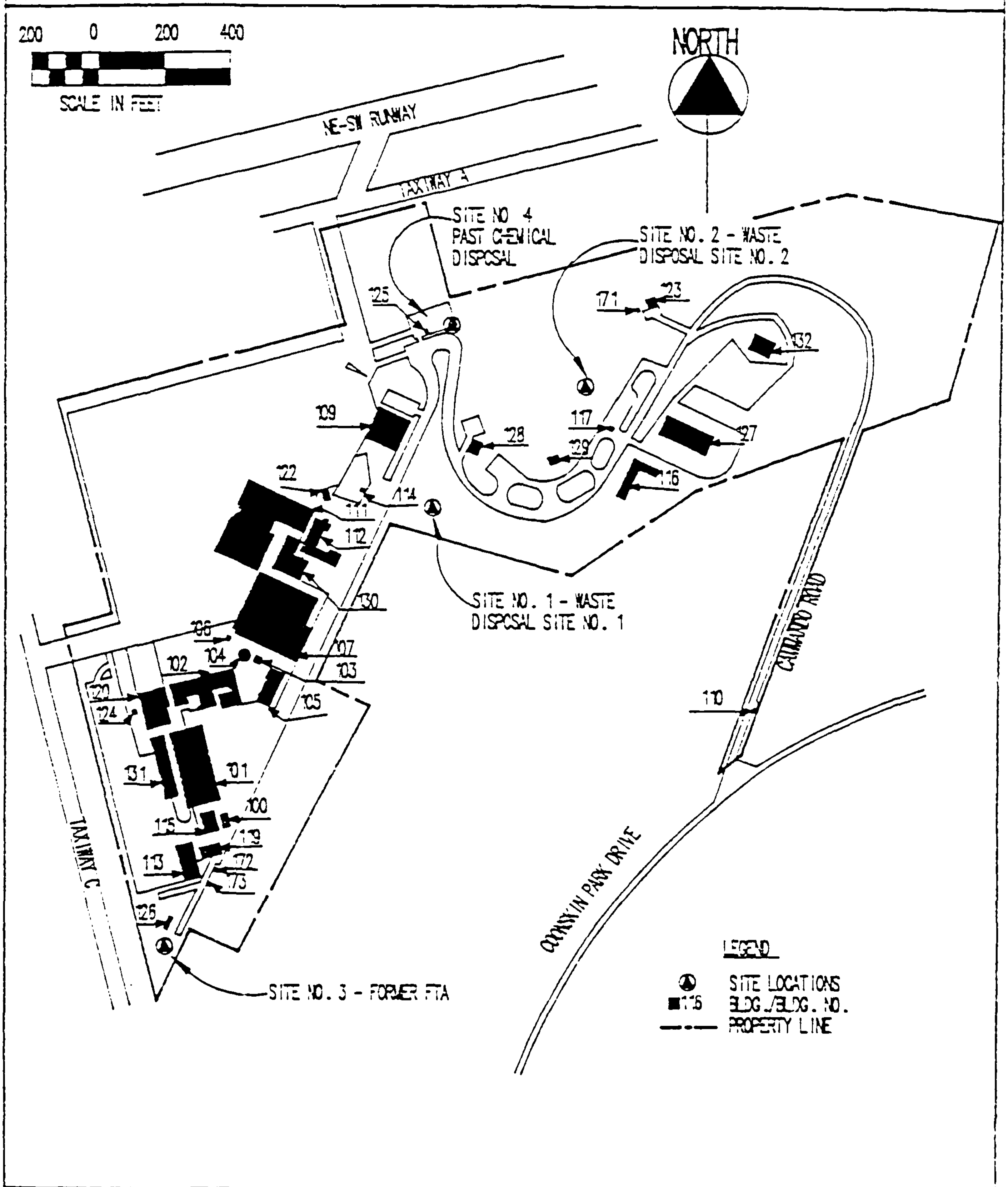


Table IV-C

**SITE HAZARD ASSESSMENT SCORES (AS DERIVED FROM HARM):**

**130th Tactical Airlift Group**
**West Virginia Air National Guard**
**Yeager Airport**
**Charleston, West Virginia**

| Site No. | Site Description | Receptors | Waste Characteristics | Pathway | Waste Management Practices | Overall Score |
|---|---|---|---|---|---|---|
| 1 | Waste Disposal Site No. 1 | 49 | 30 | 61 | 1.0 | 47 |
| 2 | Waste Disposal Site No. 2 | 47 | 80 | 76 | 1.0 | 68 |
| 3 | Former FTA | 47 | 40 | 54 | 1.0 | 47 |
| 4 | Past Chemical Disposal at Engine Test Stand | 47 | 50 | 69 | 1.0 | 55 |

Site No. 1 - Waste Disposal Site No. 1

Waste disposal Site No. 1 is approximately 120 feet south of Building 128, the Liquid Fuels Building, off Commando Road. The site was used mainly as a garbage dump for wastes generated at the Base from about 1957 to 1970. The types of waste included paper, food waste, metal and plastic containers, and general refuse from all Base operations. Liquid fuels, solvents, and waste fuels were either used for fire training or transported off Base. Some of the containers likely contained small amounts of solvents, oils, paint, etc. Paint thinner waste was reportedly stored in some containers. Approximately one pick-up truck load of waste was collected and disposed of each day (5 days/week). Some gasoline was used to ignite the waste (approximately 5 gallons/week). The waste was dumped at the edge of the road shoulder and has formed into an embankment approximately 50 feet wide at the top and 50 feet high, with a slope of approximately 50 percent.

Approximately 10 percent of the garbage, consisting of metal cans, glass, etc., remained after each burn. The remaining waste was occasionally pushed and/or sprayed with high pressure water down the embankment to expand the dumping area. Also, cover material (soil) was occasionally placed on the waste. During the site visit by PEER, glass containers and fragments, metal containers and fragments, and general refuse items were evident on the surface of the sloped embankment, with a general cover of leaves, humus, and some vegetation.

Runoff from Site No. 1 immediately flows off-Base and enters an intermittent stream channel. The stream channel follows a wooded and moderately sloping ravine. A storm drain intercepts the stream approximately 600 feet downstream of Site No. 1 and diverts it toward an unnamed tributary of Coonskin Branch (Note: This tributary also receives runoff from Site No. 2). During heavy rains, part of the runoff possibly passes this storm drain, but eventually flows along Coonskin Park Road to the tributary of Coonskin Branch. Coonskin Branch and its tributary are both within a nearby public recreation area (Coonskin Park).

Site No. 2 - Waste Disposal Site No. 2

Waste disposal Site No. 2 is next to Building 117, Liquid Oxygen Storage, off Commando Road. The site was used primarily as a construction debris dump that included soil a d asphalt and concrete rubble from construction of the Base and the airport. However, disposal of fuels, waste oils, solvents, and possibly other liquid wastes was reported. The disposal of wastes at Site No. 2 began in the early 1950s. Approximately three 55-gallon drums of fuels, waste oils, and solvents were disposed of each year. Approximately 600 gallons of sewage sludge (dried) from the waste treatment plant have been disposed of at the site since the plant has been in operation, from 1971 to the present. Disposal of the liquid wastes ended around 1980. The site is currently being used to dispose of construction debris only.

Waste disposal Site No. 2 is situated on top of the slope of a ravine. Accumulation of mainly soil, rock, and concrete and asphalt rubble has formed an embankment that extends down to a stream channel. The embankment is approximately 50 feet downstream of a storm drain discharge pipe which serves most of the Base's storm drain system. The embankment is approximately 200 feet long and from 10 to 40 feet high, with the toe of the embankment forming part of the stream channel. At the time of the site visit by PEER, the site was being used to dump earthen material from nearby construction activity. Approximately five 55-gallon drums were seen partially buried within the dump area. Three of the drums were full of concrete, and two were empty.

The adjacent stream channel, which receives runoff from Site No. 2 and most of the runoff from the Base property (runway level), follows a wooded ravine and forms the headwater of an unnamed tributary that feeds into Coonskin Branch and eventually Elk River.

Site No. 3 - Former Fire Training Area

The former FTA is located approximately 100 feet south of Building 126, Munitions Storage. The site consisted of a round pit, approximately 50 feet in diameter, up to 1-foot deep, with a dike around the perimeter of the pit. The bottom of the pit was lined with crushed stone/gravel and contained a drain pipe which served to drain liquid from the pit. The pit did not contain standing water and was usually dry. The former FTA was activated around 1970 due to the abandonment of the previous FTA located outside the Base property at the existing General Aviation Apron (see Section IV.C, Other Pertinent Facts).

The exercises at Site No. 3 usually consisted of adding water to the pit (to "float" the fuel), applying the fuel, and igniting and extinguishing the fire with water and/or foam (Type AFFF). The exercises were conducted about four times a year. Mostly, gasoline (AVGAS) and jet fuel (JP-4) were used to fuel the fire; however, other flammable liquids were used, including motor oil and solvents. Roughly 3000 gallons per year of flammable liquids were applied to the pit between 1970 and 1979. Based upon the assumption that 20 percent remained in the pit after each burn, roughly 5400 gallons of liquid may have entered the ground. The former FTA was abandoned around 1979 due to the addition of Taxiway "C." After 1979, fire training exercises have been conducted at a new FTA located outside of Base property (see Section IV.C). At the time of the site visit by PEER, there was no evidence of the pit or fuel/oil residual. The site showed some environmental stress due to a poor cover of grass, likely due to grading and filling operations from nearby Taxiway "C."

Runoff from Site No. 3 flows overland toward Elk Two Mile Creek (see Section III.D.2, Surface Water).

Site No. 4 - Past Chemical Disposal at Engine Test Stand

Disposal of approximately 100 gallons of a water diluted solvent (percentage unknown) occurred in 1981, approximately 50 feet northeast of the Inspection and Repair (Engine) Test Shelter, Building 125. The solvent was dumped from two 55-gallon drums directly onto the ground, onto a grassy area between Commando Road and the paved area at Building 125. Reportedly all of the solvent soaked into the ground.

According to Base files, there have been at least four types of solvents used at the Base. The liquid solvent dumped at Site No. 4 may have been one of the following solutions: (1) Stoddard solvent; (2) 70% Stoddard solvent, 25% dichloroethane, 5% tetrachloroethylene; (3) 30% perchloroethylene, 19% methylene chloride, 51% aliphatic petroleum distillate; and (4) paraffins and chlorinated hydrocarbons.

Runoff from the Site No. 4 area drops suddenly down into a steep ravine, to a stream channel that receives most of the runoff from the Base. The ravine has a slope of about 35 percent and was partly formed by fill material from airport construction, including soil, gravel, and concrete and asphalt rubble.

## C. OTHER PERTINENT FACTS

- The gravel parking area at the Aircraft Engine Inspection and Repair Shop (Building 109) was subjected to approximately 100 gallons per year of liquid waste disposal (gasoline, oil, etc.) from the mid-1950s up to about 1974. In 1983, two areas, 15 ft x 30 ft x 12 ft deep and 50 ft x 100 ft x 3 ft deep, were excavated from this area, and the material was disposed of at Site No. 2. The excavations were restored with new fill material. A geotechnical investigation was performed for the Base in February 1981. Four borings were drilled. The log did not note any abnormalities that would indicate contamination was present.

- An old FTA was located outside of Base property, at what is now the General Aviation Facilities, Yeager Airport. The old FTA was in operation from around 1954 to the late 1960s when the General Aviation Facilities were constructed, then relocated to the south corner of the Base property (see Site No. 3, Section IV). The old

FTA was not under exclusive control by the Base while it was in operation.

- The most recent FTA is located outside of Base property, near the northeast runway of Yeager Airport. This FTA has been in operation from around 1979 to present, since the abandonment of a former FTA located on the south corner of the Base property (see Site No. 3, Section IV-B). This FTA has not been under exclusive control by the Base during its operation.

- A wastewater treatment plant that is located on Base property has served the Base from 1971 to present. The plant is permitted by a National Pollutant Discharge Elimination System (NPDES) Water Pollution Control Permit through the West Virginia Department of Natural Resources (WVDNR).

- There have never been any active water wells on the Base and the airport.

- There have never been any known leaks of PCB-contaminated material from the use of electrical transformers.

- Pesticide use has been limited to roughly 1 gallon/year for control of spiders and 2 pounds/year for control of ants. There are no reported leaks or spills from the use and storage of pesticides.

- Herbicides have been used on the Base since the late 1970s to control weeds. Approximately 30 gallons of herbicide are used each year and is sprayed along fence lines and other areas on the Base.

- There have never been any radioactive waste burial sites on or near the Base.

- There are 12 USTs located on the Base (see Appendix F). Three 25,000 gallon MOGAS USTs located near Building 114 were abandoned in 1976.

Two 2,000 gallon USTs located near Building 122 were abandoned in 1981. One tank contained solvents and the other contained soap used for aircraft washing. The five abandoned tanks are programmed for removal. Seven USTs are presently active with no reports of leaks or spills.

- The following is a list of oil/water separators (with associated buildings) located on the Base:

| Bldg Name/Bldg No. | Quantity | Service Period | Associated UST |
|---|---|---|---|
| Hangar No. 1/107 | 1 | late 1970s - present | Yes |
| Vehicle Maint./112 | 1 | early 1970s - present | Yes |
| Vehicle Maint./112 | 1 | late 1970s - present | Yes |
| Engine Shop/109 | 1 | 1983 - present | Yes |
| Flight Operations/130 | 1 | early 1970s - present | No |
| Civil Engineering/127 | 1 | 1976 - present | No |
| Aircraft Wash Rack | 1 | 1971 - present | Yes |
| Engine Test Cell/125 | 1 | late 1970s - present | Yes |

Effluent from each of the oil/water separators is discharged into the sanitary sewer. Wash water from the aircraft wash rack is manually controlled to enter the oil/water separator during washing operations; thereafter, the wash rack is manually controlled to discharge into the Base storm sewer. The USTs associated with the oil/water separators are listed in Appendix F.

# V. CONCLUSIONS

Information obtained through interviews with Base personnel, review of Base records, field observations, and communication with outside agencies have resulted in the identification of four potentially contaminated sites.

# VI. RECOMMENDATIONS

Based on the investigation documented in this PA and the HARM scores for the identified sites, it is recommended that further investigation be implemented.

# GLOSSARY OF TERMS

AIRCRAFT CLEANING COMPOUND - A nonhazardous cleaning compound composed of nonionic detergent (monyl phenol ethylene oxide condensate), sodium dodecyl benzene sulphonate, and water. Not a priority pollutant.

ALLUVIUM - A general term for all detrital deposits resulting from the operations of modern rivers; thus including the sediments laid down in river beds, flood plains, lakes, fans at the foot of mountain slopes, and estuaries.

ANTICLINE - A fold in rock strata that is convex upward or had such an attitude at some stage of development.

AQUIFER - A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield economical quantities of water to wells and springs.

BEDROCK - A general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material.

COEFFICIENT OF STORAGE - The volume of water in an aquifer released from storage in a vertical column of 1.0 square feet when the water table declines 1.0 feet. In an unconfined aquifer, it is approximately equal to the specific yield.

COLLUVIUM - A general term applied to loose and incoherent deposits, usually at the foot of a slope or cliff and brought there chiefly by gravity.

CONTAMINANT - As defined by Section 101(f)(33) of Superfund Amendments and Reauthorization Act of 1986 (SARA) shall include, but not be limited to any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction), or physical deformation in such organisms or their offspring; except that the term "contaminant" shall not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under:

1. any substance designated pursuant to Section 311(b)(2)(A) of the Federal Water Pollution Control Act,

2. any element, compound, mixture, solution, or substance designated pursuant to Section 102 of this Act,

3. any hazardous waste having the characteristics identified under or listed pursuant to Section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress),

4. any toxic pollutant listed under Section 307(a) of the Federal Water Pollution Control Act,

5. any hazardous air pollutant listed under Section 112 of the Clean Air Act, and

6. any imminently hazardous chemical substance or mixture with respect to which the administrator has taken action pursuant to Section 7 of the Toxic Substance Control Act;

and shall not include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas).

CRETACEOUS - A geological time period lasting from 136 to 65 million years ago.

CRITICAL HABITAT - The native environment of an animal or plant which, due either to the uniqueness of the organism or the sensitivity of the environment, is susceptible to adverse reactions in response to environmental changes such as may be induced by chemical contaminants.

DENDRITIC DRAINAGE PATTERN - Characterized by irregular branching in all directions with the tributaries joining the main stream at all angles.

DETRITAL - Said of minerals occurring in sedimentary rocks which were derived from pre-existing rocks.

DIESEL FUEL - A hazardous fuel oil composed of aliphatic, olefinic, and aromatic hydrocarbons. Fuel oils are combustible or flammable. They are moderately persistent and mobile in surface soils and even more so in deep soils and groundwater. Ingestion or inhalation of fuel oil is harmful. Diesel fuels are not priority pollutants. The DOT has designated fuel oil as a hazardous material.

DIP - In geology, the angle at which a stratum or any planer feature is inclined from the horizontal.

DOWNGRADIENT - A direction that is hydraulically downslope, i.e., the direction in which groundwater flows.

DRAWDOWN - The lowering of the water table in a well as a result of withdrawal.

ENDANGERED SPECIES - Wildlife species that are designated as endangered by the U.S. Fish and Wildlife Service.

EOCENE - A geological time epoch, lasting from 54 to 38 million years ago.

EVAPOTRANSPIRATION - A term embracing that portion of the precipitation returned to the air through direct evaporation or by transpiration of vegetation.

FAULT - A fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture.

FIRECLAY - A siliceous clay rich in hydrous aluminum silicates useful in the manufacture of refractory ceramic products. A term formerly, but inaccurately, used for underclay. Although many fireclays occur as underclays, not all fireclays carry a roof of coal.

FLORA - Plants or plant life, especially of a period or region.

FOLD - An undulation in the land surface, either a low-rounded hill or a shallow depression.

GASOLINE - A fuel for internal combustion engines consisting essentially of volatile flammable liquid hydrocarbons derived from crude petroleum. Gasoline is relatively mobile and moderately persistent in most soil systems. Persistence in deep soils and groundwater may be higher. Downward migration of gasoline represents a potential threat to underlying groundwater. Inhalation and ingestion exposures are capable of causing death. Gasoline is not a priority pollutant. The DOT has designated gasoline as a hazardous material.

GEOMORPHOLOGY - That branch of both physiography and geology which deals with the form of the earth, the general configuration of its surface, and the changes that take place in the evolution of land forms.

GEOSYNCLINE - A large, generally linear trough that subsided deeply throughout a long period of time in which a thick succession of stratified sediments and possibly extrusive volcanic rocks commonly accumulated.

GROUNDWATER - refers to the subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated.

HARM - Hazard Assessment Rating Methodology - A system adopted and used by the U. S. Air Force to develop and maintain a priority listing of potentially contaminated sites on installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts. (Reference: DEQPPM 81-5, 11 December 1981).

HAZARDOUS MATERIAL - Any substance or mixture of substances having properties capable of producing adverse effects on the health and safety of the human being. Specific regulatory definitions also found in OSHA and DOT rules.

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

1. cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or

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

HYDRAULIC CONDUCTIVITY - The rate of flow of water in gallons per day through a cross section of one square foot under a unit hydraulic gradient, at the prevailing temperature ($gpd/ft^2$). In the SI system, the units are $m^3/day/m^2$ or m/day.

HYDRAULIC FLUID - A low-viscosity fluid used in operating a hydraulic mechanism. Most hydraulic fluids consist primarily of a blend of various hydrocarbons. Most are highly immobile and persistent in the soil/groundwater system due to volatilization and aerobic biodegradation. Ingestion of hydraulic fluid presents a gastrointestinal health hazard. Hydraulic fluid is not a priority pollutant. Several federal agencies have classified hydraulic fluid as a hazardous material/hazardous waste.

HYDRAULIC GRADIENT - The rate of change in total head per unit of distance of flow in a given direction.

HYDROLOGIC SOIL GROUPS - The method of soil classification according to runoff-producing characteristics. Soils are assigned to four different groups consisting of groups A, B, C, and D. Group A consists of soils having a high infiltration rate when thoroughly wet, thereby having a low runoff and erosion potential. Group A soils are predominantly deep, well drained, and sandy or gravelly. At the other extreme, group D soils have a very slow infiltration rate and thus a high runoff potential. Group D soils have a clay layer near the surface, have a permanent water table, or are shallow over bedrock.

Group B - moderate infiltration rate (0.6 to 6 inches/hour), moderately deep, well drained, moderately fine to moderately coarse texture.

Group C - slower infiltration rate (0.6 to 2 inches/hour) than groups A or B, moderately deep, generally well drained, moderately fine to moderately course texture.

JOINT - A fracture or parting in a rock, without displacement; the joint is usually a plane and often occurs with parallel joints to form part of a joint set.

JP-4 (JET FUEL) - Jet engine test fuel made up of 35% light petroleum distillates and 65% gasoline distillates. JP-4 hydrocarbons are relatively mobile and nonpersistent in most soil systems. Persistence in deeper soils and groundwater may be higher. Aspiration of the liquid into the lungs is a severe short-term health hazard. Long-term effects on other organs is noted. JP-4 is not a priority pollutant. The DOT has designated all aviation fuel as a hazardous material.

LITHOLOGY - The physical composition of a rock.

LOAM - A rich, permeable soil composed of a friable mixture of relatively equal proportions of clay, silt, and sand particles, and usually containing organic matter.

MEK (METHYL ETHYL KETONE) - A water-soluble, colorless liquid that is miscible in oil; used as a solvent in vinyl films and nitrocellulose coatings, also a a metal cleaner and degreaser. MEK migrates in the soil/groundwater system with very little retardation. Short-term exposure may include central nervous system disorders. MEK is not a priority pollutant; however, several federal programs list MEK as a toxic pollutant, toxic hazardous waste, hazardous substance or hazardous material.

METHYLENE CHLORIDE - A colorless liquid, practically nonflammable and nonexplosive; used as a refrigerant in centrifugal compressors, a solvent for organic materials, and a component in nonflammable paint remover mixtures. Methylene chloride is highly mobile in the soil/groundwater system. Little or no retardation is expected in deep or sandy soils. In the near surface volatilization is an important removal process. Migration to groundwater is common. Short-term exposure produces a narcotic effect. Death has been reported at high concentrations. There is evidence of mutagenicity in long-term exposure. Methylene chloride is not a priority pollutant.

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

MOTOR OIL AND GREASE (LUBRICANTS) - A material used to diminish friction between the moving surfaces of machine parts. Highly immobile in the soil/groundwater system due to low water solubilities and high soil sorption. Volatilization and aerobic biodegradation rates are slow; therefore, oils and grease are persistent in the subsurface. Motor oil and grease are not priority pollutants. The EPA has classified used oil as a hazardous waste.

PD-680 (STODDARD SOLVENT) - A petroleum naphtha product with a comparatively narrow boiling range; used mostly for degreasing and as a general cleaning solvent. Stoddard solvent hydrocarbons are relatively mobile and moderately persistent in most soil systems. Persistence in deep soils and groundwater may be higher. Short-term exposure causes irritation of eyes, nose, and throat. Kidney damage results from long-term exposure. Stoddard solvent is not a priority pollutant. The DOT has designated petroleum naphtha as a hazardous material.

PENNSYLVANIAN - A period of the Paleozoic era thought to have covered the span of time between 320 and 280 million years ago; also the corresponding system of rocks.

PERCHED WATER TABLE - Water table above an impermeable bed underlain by unsaturated rocks of sufficient permeability to allow movement of groundwater.

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.

PLEISTOCENE - A geological time epoch lasting from 2.5 to .005 million years ago.

POROSITY - The percentage of the bulk volume of a rock or soil that is occupied by interstices, whether isolated or connected.

POTENTIOMETRIC SURFACE - Surface to which water in an aquifer would rise by hydrostatic pressure.

PRECIPITATION - Water that falls to the surface from the atmosphere as rain, snow, hail, or sleet. Measured as a liquid-water equivalent, regardless of the form in which it fell.

QUATERNARY - A geological time period lasting from 2.5 million years ago to present.

RECENT - A geological time epoch lasting from 0.005 million years ago to present.

RELIEF - The vertical difference in elevation between the hilltops or mountain summits and the lowlands or valleys of a given region.

SOIL COMPLEX - A mapping unit used in soil surveys where two or more soils are so intermixed geographically that they cannot be separated at the scale being used.

SOIL PHASE - A subdivision of the soil series.

SOIL SERIES - The lowest category in soil classification, more specific than a soil family; a group of soils having genetic horizons of similar characteristics and arrangement in the soil profile, except for texture of the surface soil, and developed from a particular type of parent material.

SPECIFIC YIELD - The ratio of the volume of water that a given mass of saturated rock or soil will yield by gravity to the volume of that mass. This ratio is stated as a percentage.

STRATIGRAPHY - A branch of geology concerned with the form, arrangement, geographic distribution, classification, and mutual relationships of rock strata, especially sedimentary.

STRIKE - The course or bearing of the outcrop of an inclined bed or structure on a level surface. It is perpendicular to the direction of the dip.

SUBCROP - Area within which a formation occurs directly beneath an unconformity.

SULFURIC ACID - A toxic, corrosive, strongly acid, colorless, odorless liquid that is miscible with water and dissolves most metals. Widely used as a battery acid and as a laboratory reagent. Sulfuric acid is not a priority pollutant.

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

SYNCLINE - A fold in rocks in which the strata dip inward from both sides toward the axis.

TERRACE - Relatively flat, horizontal, or gently inclined surface, sometimes long and narrow, which is bounded by a steeper descending slope on the opposite side. When typically developed, a terrace is steplike in character.

TERTIARY - A geological period lasting from 65 to 2.5 million years ago.

THREATENED SPECIES - Wildlife species who are designated as "threatened" by the U.S. Fish and Wildlife Service.

TOLUENE - A colorless, aromatic liquid derived from coal tar or from the catalytic reforming of petroleum naphthas. It is insoluble in water. Toluene is used as a paint thinner, metal cleaner, and paint equipment cleaner. It is relatively mobile in soil-water systems, including transport of vapor through air-filled pores as well as transport in solution. It may persist in the subsurface for months or years if biodegradation is not possible. Short-term exposure results in central nervous system depression. No adverse effects are noted in long-term exposure. Toluene is not a priority pollutant. Numerous federal regulations designate toluene as a hazardous substance or material.

TOPOGRAPHY - The general conformation of a land surface, including its relief and the position of its natural and manmade features.

TRANSMISSITIVITY - The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit hydraulic gradient.

UNCONFINED AQUIFER - Groundwater that has a free water table, i.e., water not confined under pressure beneath relatively impermeable rocks.

UNCONFORMITY - A surface of erosion or nondeposition that separates younger strata from older rocks.

WATER TABLE - The upper surface of a zone of saturation.

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

WILDERNESS AREA - An area unaffected by anthropogenic activities and deemed worthy of special attention to maintain its natural condition.

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# APPENDIX A

# RESUMES OF SEARCH TEAM MEMBERS

**THOMAS S. WEBB**

**EDUCATION** B.S. Civil Engineering, University of Wyoming, 1966
B.A. History, Biology, University of Wyoming, 1964

**CERTIFICATIONS** Certified Safety Executive - 1987
Certified Safety Manager - 1987
Certified Safety Specialist (Industrial Hygiene) - 1987
Certified Industrial Hygiene, Comprehensive Practice (Not Current) - 1975

**PROFESSIONAL EXPERIENCE**

1/1988-Present PEER CONSULTANTS, P. C.
Oak Ridge, TN
**Oak Ridge Regional Manager**

Oak Ridge Regional Manager for all PEER activities and program manager of all PEER tasks performed under contracts with DOE and Bechtel National, Inc. Currently providing technical assistance and support to Hazardous Waste Remedial Action programs at both DOE and DoD facilities, DOE Nuclear and Chemical Waste Programs, and Permanent Waste Storage Programs. The above work includes:

Support of regulatory and policy analysis;
Program research and scientific analysis;
Legislative and regulatory tracking;
Quality assurance and control (QA/QC);
Hydrogeological monitoring support;
Review of recently proposed federal regulations regarding hazardous waste management and groundwater protection;
Environmental analyses, health and safety analyses, community relations planning and other tasks related to remedial action planning.

1987-1/1988 **Project Manager**

Senior Project Manager for the following tasks: the New Boston AFS RI/FS and Robins AFB and Newark AFB Spill Prevention and Response Plans. Technical review and engineering support to DOE on Tinker AFB storm drainage system evaluation and Dover AFB, cadmium reduction in the industrial waste stream. Preliminary assessments for 13 Air National Guard Bases.

1966-1987 U. S. AIR FORCE

1984-1987 Directed the activities of the Occupational & Environmental Health Laboratory in providing consultation, technical guidance, and on-site assistance in industrial hygiene, air and water pollution, entomology, health physics, and bioenvironmental engineering at all Air Force bases in the Pacific area including Hawaii, Japan, Korea, Guam, and the Philippines. As director, developed the plans for establishing an asbestos identification and counting capability to support Air Force bases in the Pacific. Had responsibility for managing the administration and budgeting of operating funds for the organization, procurement of equipment and supplies, day-to-day supervision of laboratory personnel, and conducting selected field studies. Personnel directly supervised included chemists, engineers, medical entomologist, and specialized technicians in each functional area.

1979-1984 As Chief, Bioenvironmental Engineer, Headquarters US Air Force, directed the Bioenvironmental Engineering/Occupational Health programs for all Air National Guard facilities in the United States and its territories. Established policy and guidance by writing and revising Air National Guard regulations and by supplementing Air Force publications. From 1981 to 1984 conducted initial hazardous waste site investigations at Volk Field Wisconsin ANG field training site, Suffolk County ANGB, N.Y., Burlington ANGB, NH, and Lincoln ANGB, NE. Supervised all field activities in drilling, placement, and development of monitoring wells used to determine the extent of the plume and quantity of the contaminants under investigation. Personally determined the number of wells required, their location, and both the soil and ground water sampling strategy including analytes. Collected soil and ground water samples, packaged, and shipped them to OEHL for analysis, and interpreted results. Investigations at the above sites resulted in the placement of over seventy-five monitoring wells and the collection of hundreds of soil and ground water samples. Budgeted for and technically directed the Phase IIA Installation Restoration Program at five other ANG bases including Otis ANGB, MA, Buckley ANGB, CO and McEntire ANGB, SC. Was the only full time certified industrial hygienist in the command and personally conducted IH surveys including asbestos identification and evaluation; also assisted in developing plans and specifications for managing or removing asbestos in Air National Guard facilities. Represented the National Guard Bureau (NGB) Surgeon on the Agency Environmental Protection Committee and the NGBs on the DoD Safety and

Occupational Health Policy Council. Served on DoD subcommittees and provided testimony to Congressional committees in area of expertise.

Directed the Bioenvironmental Engineering/Environmental Health program for Clark AB, John Hay AB, and Wallace AS. Evaluated community and work environments and recommended controls to keep occupational and environmental stresses within acceptable limits. Established and conducted the environmental monitoring program for Clark AB.

As the Command Bioenvironmental Engineer, Headquarters AF Reserve, developed occupational health and environmental protection plans, policy, and programs for all AF reserve bases. Also developed and taught a two week training course for all AF Reserve bioenvironmental engineering technicians.

As Chief, Bioenvironmental Engineering, Robins AFB, Georgia, conducted an industrial hygiene program for 18,000 civilian and 5,000 military workers. Performed industrial hygiene evaluations of aircraft operations, paint stripping, industrial radiography, microwave radiation, laser and other industrial facilities.

Has also served as Chief, Bioenvironmental Engineering, Hill AFB, Utah; DaNang AB, Vietnam; and Wright-Patterson AFB, Ohio.

As the bioenvironmental engineer at the above bases, conducted numerous noise surveys for determining noise levels to which base personnel were exposed. Is also thoroughly familiar with land use planning with respect to aircraft noise having conducted such evaluations for both Hill and Robins AFB. These latter evaluations generated Ldn contours for then current aircraft operations, as well as projected contours for future aircraft conversions and modifications.

As the Bioenvironmental Engineer at five Air Force bases over a period of twelve years, collected, prepared, and interpreted results from base water samples submitted for bacteriological and chemical content analysis. As Commander of Operating Location AD USAF Occupational and Environmental Health Laboratory, directly supervised analytical personnel who performed analysis of lead and other metals in water and was directly responsible for appropriate analytical procedures and accuracy of data. In addition, provided consultative services concerning health and environmental effects to bases experiencing abnormally high levels of metals in drinking water. At Wright-Patterson AFB, assisted in all environmental protection evaluations and conducted stack gas monitoring of all coal-fired heating plants on base. At Hill AFB, was one of the principal authors of the Air Force's first Environmental Impact Statements (1970-71).

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"For a Breath of Clean Air", AF Aerospace Safety Magazine, March 1975

"Baseline Industrial Shop Surveys," AF Medical Service Digest, April 1973

"Knee Problems Observed in Weapons Loading Personnel," AF Medical Service Digest, March 1970

"Lasers - A New Problem for Bioenvironmental Engineers," AF Medical Service Digest, March 1969

"Use of Iodine as a Swimming Pool Disinfectant," AF Medical Service Digest, July 1967

## KEVIN WAYNE PACK

**EDUCATION** B.S. Civil Engineering, West Virginia University, 1981
Currently enrolled in the graduate Environmental Engineering Program at the University of Tennessee, Knoxville

**CERTIFICATIONS** Engineer-In-Training, 1987

**PROFESSIONAL EXPERIENCE**

1987-Present PEER CONSULTANTS, P.C.
Oak Ridge, TN
**Civil Engineer**

Prepared Preliminary Assessments for three Air National Guard Bases under the U.S. Air Force Installation Restoration Program, which included identifying past spills/disposal practices posing a potential hazard to public health and environment. Prepared Decision Documents and assisted in a Remedial Investigation/Feasibility Study for New Boston Air Force Station, Amherst, New Hampshire. Provided technical assistance on a RCRA Feasibility Investigation for East Fork Poplar Creek in Oak Ridge, Tennessee.

1984-1987 BARGE WAGGONER SUMNER AND CANNON
Knoxville, TN
**Civil Engineer**

Involved in planning, design, and construction phases of water distribution systems, sanitary and storm sewers, and site development. Responsible for developing the conceptual design and cost estimates for one, four, and ten MGD wastewater treatment facilities. Wrote the operation and control manuals for the one and four MGD facilities which included descriptions, flow diagrams, major components, control procedures for common operating problems, and laboratory tests of each unit process. Reviewed manufacturer's equipment drawings and literature for compliance with design drawings.

1982-1984 TOMPKINS BECKWITH, INC.
Waterford III Steam Electric Station
Taft, LA
**Engineer**

Responsibilities included resolving construction restraints for installation of structural steel pipe support systems, implementing design modifications, and acting as liaison between construction contractors, design engineers, and quality control personnel on a fast-paced production schedule.

1982 DANIEL CONSTRUCTION COMPANY
Calloway Nuclear Power Plant
Fulton, MO
**Engineer**

Responsibilities included inspecting pipe support systems, maintaining production schedules, and acting as liaison between construction contractors and design engineers.

1974-1982 Summers — Technician, H. C. Nutting Gectechnical Engineers, Charleston, WV; Engineering Aide, WV Department of Natural Resources, Charleston, WV; Laborer, E. E. Moore Construction Company, South Charleston, WV.

## KEITH E. OWENS

**EDUCATION** B.S., Geology, Austin Peay State University, 1986

**MEMBERSHIP** Association of Groundwater Scientists and Engineers
East Tennessee Geological Society

**PROFESSIONAL EXPERIENCE**

5/1988-Present PEER CONSULTANTS, P.C.
Oak Ridge, TN
**Geologist**

Prepare preliminary assessment reports for the Air National Guard under the U. S. Air Force Installation Restoration Program (IRP) which involves identifying past spill or disposal sites posing a potential and/or actual hazard to public health and environment. Reviewed proposed Remedial Investigation/Feasibility Study (RI/FS) investigative program for an IRP site at Bangor ANGB, Maine. Prepared project procedurals for the Department of Energy (DOE) Oak Ridge National Laboratory (ORNL) RI/FS program. Assisted in the preparation of RCRA Part B applications. Conducted on-site inspections of Yeager ANGB, West Virginia; St. Louis ANGB, Missouri; and Youngstown Test Annex, New York.

1987-1988 ATEC ASSOCIATES, INC.
Nashville, TN
**Senior Technician**

Monitor well installation at service stations in Memphis, TN. Duties included logging, purging, and sampling wells for hydrocarbons. Core logging and environmental site assessments for various projects. Conducted compaction tests for Aviation Fuel Storage Facility for the Metro Nashville Airport Expansion project. Conducted environmental site assessments for Radnor Homes (Developer). Conducted caisson inspections for Tennessee Technological University's new library. Supervised field technicians and laboratory tests. Interfaced with clients on a daily basis. Assisted Construction Materials Division Manager with weekly reports.

1986-1987 MID-TENN EXPLOSIVES
Nashville, TN
**Explosives Handler**

Assisted in shot preparation and loading at Vulcan Materials (Quarry). Delivered explosives to selected clients.

**JONI S. OLIVER**

**EDUCATION** B.S. Civil Engineering, University of Tennessee, 1985

**MEMBERSHIP** American Society of Civil Engineers

**CERTIFICATION** Certified as an Asbestos Abatement Supervisor, 1988

**PROFESSIONAL EXPERIENCE**

3/1988-Present

PEER CONSULTANTS, P.C.
Oak Ridge, TN
**Civil Engineer**

Prepared preliminary assessment reports for the Air National Guard under the U.S. Air Force Installation Restoration Program (IRP) which involves identifying past spill or disposal sites posing a potential and/or actual hazard to public health and environment. Conducted field surveys to assess what impact past hazardous waste disposal practices have had on the environment. Review and assist in preparation of the Asbestos Management and Operation Plans for Keesler AFB, Mississippi, and Tinker AFB, Oklahoma. Surveyed local schools for potential asbestos-containing building materials. Reviewed proposed RI/FS investigative program for an IRP site at Kelly AFB, Texas. For the Department of Energy, reviews Notices of Intent (NOI) to remove asbestos for regulatory compliance, writes letters to the regulators as needed to forward the NOI to the appropriate state regulator. Determines control measures and prepares cost estimates for asbestos abatement activities. Prepared RCRA Part B permit applications for Oak Ridge National Laboratory covering a wide variety of materials being treated. The materials included organics, inorganics, and compressed gasses. Reviewed the Final Safety Analysis Report (FSAR) for the E-Wing Chip Processing Facility at the Y-12 Plant. The review of the report included site location and structural components. The structural components reviewed were principal design criteria, structural and mechanical safety criteria, wind loadings, flood design, seismic design, and structural specifications.

1987-1988

EBASCO SERVICES INCORPORATED
Watts Bar Nuclear Plant Site
Spring City, TN
**Associate Engineer**

Involved in the support design group for the Tennessee Valley Authority's Watts Bar Unit 1 Reanalysis Project. Experience in Civil Engineering Branch performing extensive calculations (static, dynamic, and thermal). Resolved design discrepancies of conduit and instrumentation systems. Worked on Conditions Adverse to Quality Reports (CAQR). Responsible for the logging in-out of civil tasks. Sent out transmittals for civil outputs. Responsible for weekly progress reports. Oversaw corrective actions during construction at plant site. Interfaced with client on regular basis.

1986-1987

IMPELL CORPORATION
Knoxville, TN
**Civil Engineer**

Involved in the support design group for the Tennessee Valley Authority's Watts Bar Unit 1 Reanalysis Project. Qualified nuclear safety related pipe supports which comply with TVA design criteria AISC and ASME Section III code requirements. Familiar with both computer and hand analysis in the design of support structures. Computer analysis programs used included; GTSTRUDL, CDC's BASEPLATE II, and TVA's CONAN and DDLUG. Familiar with phases of structural design including sizing preengineered components, structural steel and connection design. Evaluated baseplate and concrete anchorage design. Qualified existing designs at Sequoyah Nuclear Station.

1984-1985

LAMAR DUNN & ASSOCIATES
Knoxville, TN
**Engineering Aide** (part-time)

Assisted in the planning, design, and construction phases of the water distribution system for the City of Jonesborough, TN.

**RICHARD P. RAIONE**

**EDUCATION**
M.S., Geology, University of Kentucky (honors), 1983
B.S., Biology and Geology, East Tennessee State University (honors), 1981
Completion of the Basic and Advanced Geodetic Surveying courses taught by the U.S. Department of Defense, Defense Mapping School, Ft. Belvoir, VA 1985, 1986
Completed the Magnavox MX-1502-DS and the TI-4100 Satellite Surveyor Geoceiver Training Courses taught by the Satellite Geophysics Division, Defense Mapping Agency, Washington, D.C. 1985, 1986
Completed the 40 hour OSHA 29 CFR 1910.120 Health and Safety Training course and 8 hours of radioactive waste handling training, Oak Ridge, TN October, 1988

**CERTIFICATIONS**
Certified Professional Geologist, American Institute of Professional Geologists
Certified Professional Geologist, Tennessee

**SECURITY CLEARANCE**
"L", "Q" Clearance (in progress), U.S. Department of Energy
Top Secret Security Clearance (U.S. Department of Defense)

**MEMBERSHIPS**
Tennessee Water Well Association
East Tennnessee Geological Society
Association of Ground Water Scientists and Engineers
Sigma Gamma Epsilon, Geology Honorary

**PROFESSIONAL EXPERIENCE**

8/1988-Present
PEER CONSULTANTS, P. C.
Oak Ridge, TN
**Geohydrologist**

Provide technical support on performing and designing remedial investigations/feasibility studies for the U.S. Departments of Defense and Energy (DoD, DOE) as part of their Installation/Environmental Restoration Programs (IRP). Determine Hazard Assessment Rating Methodology (HARM) scores and prepare preliminary assessment reports for DoD installations used to identify and evaluate previous hazardous waste spill/disposal sites which may pose potential hazards to the public health and the environment. Review work plan documents and hydrogeologic/chemical analytical data; audit field work for compliance with project objectives and RCRA, CERCLA/SARA regulations; and prepare statements of work. Also review RCRA Facility Investigation Plans for RCRA 3004(u) regulatory compliance and technical adequacy of the sampling and safety plans for U.S. DOE plants under DOE contract DE-AC05-87OR21731 (specific to Oak Ridge Operations: K-720 Ash Pile, K-1070-G Burial Ground, K-1413 WAG, K-770 Scrap Metal Yard, K-1401 Acid Line, K-725 Building, K-1232 Treatment Facility, K-1070-F Old Contractor's Burial Ground, 2104-u (S-212) Tank). Prepare preliminary assessment reports for DoD and DOE installations used to identify and evaluate previous hazardous waste spill/disposal sites which may pose potential hazards to the public health and the environment. Provide technical and programmatic support to the hydrologic aspects of RCRA, CERCLA RI/FS, DOE Order, and solid waste compliance, underground storage tank corrective actions, and underground injection control to DOE plants.

1/88-8/88
URS CORPORATION, INC.
Oak Ridge, TN
**Senior Hydrologist**

Used a multidisciplinary approach to deal with hazardous waste control and management. Duties were technical, supervisory, contract administrative, and marketing in nature. As part of the Dod IRP effort, evaluated/conducted geohydrologic site investigations involving subsurface analysis, monitoring well installation and sampling, surface and subsurface water/sediment sampling, soil boring sampling, soil organic vapor and magnetometer surveys, ground penetrating radar surveys, and groundwater flow/contaminant migration analysis. Prepared field sampling and QA/QC plans and determined HARM ratings at IRP sites. Served on the URS National Water Resources Committee which dealt primarily with water resources management problems.

1986-1988
U.S. DEPARTMENT OF THE INTERIOR
Knoxville, TN
**Hydrologist**

Supervised and conducted hydrologic and geologic field sampling and analysis. Managed computer data base and modeling systems.

Ascertained prevailing surface and groundwater quality and quantity to predict impacts to the hydrologic balance as a result of coal mining operations and topographic disturbances using hydrology and other multidisciplinary approaches (geology, geochemistry, biology, civil-environmental engineering, and computer modeling). Analyzed for local and regional flooding potential, sediment loading, runoff/flow patterns, aquifer restoration feasibility, and for alternate domestic water supplies.

Produced cumulative hydrologic impact assessment reports, National Environmental Policy Act (NEPA) environmental assessments, summary of findings documents, and hydrologic and geologic reports related to the "Lands Unsuitable for Mining" (LUM) petitions and Environmental Impact Statements.

Served as the hydrology expert to government lawyers in a case involving reclamation problems of the reputed "most toxic coal mine" site in Tennessee.

Analyzed mine discharges and their effect on public safety and the environment using National Pollutant Discharge Elimination System (NPDES), U.S. Environmental Protection Agency (EPA), and Department of the Interior regulations. Evaluated toxic materials handling, storage, and disposal plans, in addition to techniques used for the physical, chemical, and biological treatment of wastewater.

Coordinated mine site visits, and reviewed the geologic and hydrologic permit items for Tennessee, Kentucky, and North Carolina, in addition to participating in Federal Lands permitting procedures.

Attended the EPA Region IV Program Manager's course on the uses of the STORET Water Quality Computer Data System. Used the U.S. Geological Survey WATSTORE System.

Received cash awards for end of year performance appraisal (1986) and for field safety procedures suggestions incorporated into standard operating procedure (1987).

1984-1986 U.S. DEPARTMENT OF DEFENSE
Washington, D.C., and Worldwide
**Geodesist**

Conducted field testing and evaluation of the TI-4100 satellite geoceiver to be used exclusively in satellite geodetic missions relating to the Global Positioning System (GPS). Point-positioning stations were established and evaluated around several locations in the Washington, D.C., area.

Planned, coordinated, and executed geodetic data acquisition surveys worldwide using electronic and optical satellite positioning equipment as well as conventional geodetic surveying instruments. Performed preliminary surveying operations to make precise geodetic ties from existing local control to satellite survey station sites. Used first - third order triangulation, electronic traverse, and leveling methods. Made astronomic observations and completed and checked all field computations and reports.

Managed operations and maintenance of the TRANET satellite tracking station and the MX-1502-DS satellite geoceiver monitoring station. Served as instructor for geodetic surveying and satellite tracking equipment training courses. Authored computer user manual for narrative data system.

1982-1984 KENTUCKY CENTER FOR ENERGY RESEARCH LABORATORY
Lexington, KY
**Research Geologist**

Planned coal research in eastern Kentucky using field and laboratory methods, geophysics, chemistry, paleontology, and statistics in order to determine coal depositional environments, paleontology, and petrographic relationships of the area, in addition to assessing the coal's optimum technological uses. Secondary studies included coal hydrology, acid mine drainage, and environmental analysis. Funding for this research was competitively awarded by the US Department of Energy.

**PUBLICATIONS**

1986-1987, Authored over 100 technical reports (Cumulative Hydrologic Impact Assessments) used as legal documents by the U.S. Department of the Interior which dealt with hydrological, geological, biological, and civil engineering data analysis used to determine potential mining-related impacts to the environment. Also authored numerous environmental assessment reports which analyzed current environmental conditions (geology, hydrology, topography, vegetation/forestry, soils, terrestrial and aquatic wildlife, threatened and endangered species, cultural and historic resources, socioeconomics, land use, aesthetics, noise and air quality analysis) and cumulative impacts as a result of mining in Tennessee, Kentucky, and North Carolina. Contributed to geohydrological sections of Environmental Impact Statements issued by the Department of the Interior.

Raione, Richard, and James Hower, 1984, Petrographic Characterization of Kentucky Coal: Final Report: Part III: Petrographic Characterization of the Upper Elkhorn No. 2 Coal Zone of Eastern Kentucky: Report No. DOE/PC/30223-11. (U.S. Department of Energy)

Hower, J., Raione, R., and others, 1983, Petrographic Characterization of Kentucky Coals: Quarterly Progress Report: DOE/PC/30223-7

_____, 1982, Petrographic Characterization of Kentucky Coals: Quarterly Progress Report: DOE/PC/30223-6.

_____, 1982, Petrographic Characterization of Kentucky Coals: Quarterly Progress Report: DOE/PC/30223-5.

_____, 1982, Petrographic Characterization of Kentucky Coals: Quarterly Progress Report: DOE/PC/30223-4.

# APPENDIX B

# OUTSIDE AGENCY CONTACT LIST

# OUTSIDE AGENCY CONTACT LIST

1. West Virginia Department of Natural Resources
   Division of Water Resources
   1800 Washington Street East
   Charleston, West Virginia 25305

2. West Virginia Department of Natural Resources
   Division of Water Resources
   1201 Greenbrier Street
   Charleston, West Virginia 25311

3. West Virginia Department of Natural Resources
   Division of Waste Management
   1260 Greenbrier Street
   Charleston, West Virginia 25311

4. Central West Virginia Regional Airport Authority
   Yeager Airport
   Charleston, West Virginia 25311

5. United States Department of the Interior
   United States Geological Survey
   Water Resources Division
   603 Morris Street
   Charleston, West Virginia 25301

6. Municipal Planning Commission
   P.O. Box 2749
   Charleston, West Virginia 25330

7. Heritage Data Base
   Box 67
   Ward Road
   Elkins, West Virginia 26241

8. Regional Intergovernmental Council
   1223 Leone Lane
   Dunbar, West Virginia 25064

9. United States Department of Agriculture
   Soil Conversation Service
   Westmoreland Place
   400 Allen Drive
   Charleston, West Virginia 25302

10. National Oceanic and Atmospheric Administration
    National Environmental Satellite, Data and Information Service
    National Climatic Data Center
    Asheville, North Carolina 28801

# APPENDIX C

# U.S. AIR FORCE HAZARD ASSESSMENT RATING METHODOLOGY - HARM GUIDELINES

## APPENDIX C

## U.S. AIR FORCE 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 facilities. One of the actions required under this program is to:

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

Accordingly, the U.S. Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Preliminary Assessment (PA) phase of its Installation Restoration Program (IRP).

### 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 National Guard in setting priorities for follow-on site investigations.

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 USAF'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 PA portion of the IRP. Scoring judgment 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. 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 flowchart (see Figure I-A of this report). The site rating form and the rating factor guideline are in Appendices D and E.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: (1) possible receptors of the contamination, (2) the waste and its characteristics, (3) the potential pathways for contamination migration, and (4) any efforts that were made to contain the wastes resulting from a spill.

The receptors category rating is based on four rating factors: (1) the potential for human exposure to the site, (2) the potential for human ingestion of contaminants should underlying aquifers be polluted, (3) the current and anticipated uses of the surrounding area, and (4) the potential for adverse effects upon important biological resources and fragile natural settings. The potential for human exposure is evaluated on the basis of the total population within 1000 feet of the site and the distance between the site and the Base boundary. The potential for human ingestion of contaminants is based on the distance between the site and the nearest well, the groundwater use of the uppermost aquifer, and the population served by the groundwater supply within 3 miles of the site. The uses of the surrounding area are determined by the zoning within a 1-mile radius. Determination of whether or not critical environments exist within a 1-mile radius of the site predicts the potential for adverse effects from the site upon important biological resources and fragile natural settings. Each rating factor is numerically evaluated (from 0 to 3) and increased by a multiplier. The maximum possible score is also computed.

The factor score and maximum possible scores are totaled, and the receptors subscore computed as follows: receptors subscore = (100 x factor score subtotal/maximum score subtotal).

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 that 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, and scores for sludges and solids are reduced.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways: surface-water migration, flooding, and groundwater migration. 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 the three possible routes is used. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The scores for each of the three categories are added and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Scores for sites with no contaminant 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.

I. RECEPTORS CATEGORY

| | Rating Factors | Rating Scale Levels 0 | 1 | 2 | 3 | Multiplier |
|---|---|---|---|---|---|---|
| A. | Population within 1000 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 | 3001 feet to 1 mile | 0 to 3000 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 | 1001 feet to 1 mile | 0 to 1000 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. | Groundwater 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 | 51-1000 | Greater than 1000 | 6 |
| I. | Population served by aquifer supplies within 3 miles of site | 0 | 1-50 | 51-1000 | Greater than 1000 | 6 |

## II. WASTE CHARACTERISTICS

### A-1 Hazardous Waste Quantity

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

### A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

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

S = Suspected confidence level

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

### A-3 Hazard Rating

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

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

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

II. WASTE CHARACTERISTICS--Continued

Waste Characteristics Matrix

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

## 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, groundwater, or air. Evidence should confirm that the source of contamination is the site being evaluated.

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

### B-1 Potential for Surface Water Contamination

| Rating Factors | 0 | 1 | 2 | 3 | Multiplier |
|---|---|---|---|---|---|
| Distance to nearest surface water (includes drainage ditches and storm sewers) | Greater than 1 mile | 2001 feet to a mile | 501 feet to 2,000 feet | 0 to 500 feet | 8 |
| Net precipitation | Less than -10 inches | -10 to +5 inches | +5 to +20 inches | Greater than +20 inches | 6 |
| Surface erosion | None | Slight | Moderate | Severe | 8 |
| Surface permeability | 0 to 15% clay ($>10^{-2}$ cm/sec) | 15 to 30% clay ($10^{-2}$ to $10^{-4}$ cm/sec) | 30 to 50% clay ($10^{-4}$ to $10^{-6}$ cm/sec) | Greater than 50% clay ($>10^{-6}$ cm/sec) | 6 |
| Rainfall intensity based on 1-year, 24-hour rainfall (thunderstorms) | <1.0 inch | 1.0 to 2.0 inches | 2.1 to 3.0 inches | >3.0 inches | 8 |

### B-2 Potential for Flooding

| 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 Groundwater Contamination

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

## IV. WASTE MANAGEMENT PRACTICES CATEGORY

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

B. Waste Management Practices Factor

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

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

Guidelines for fully contained:

Landfills:

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

Surface Impoundments:

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

Spills:

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

Fire Protection Training Areas:

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

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

# APPENDIX D

# SITE HAZARDOUS ASSESSMENT RATING FORMS

HAZARD ASSESSMENT RATING FORM

NAME OF SITE Site No. 1 - Waste Disposal Site No. 1

LOCATION 130th TAG, WEST VIRGINIA AIR NATIONAL GUARD, CHARLESTON, WV

DATE OF OPERATION OR OCCURRENCE

OWNER/OPERATOR West Virginia Air National Guard

COMMENTS/DESCRIPTION

SITE RATED BY K. Owens

I. RECEPTORS

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| A. Population within 1000 ft. of site | 3 | 4 | 12 | 12 |
| B. Distance to nearest well | 2 | 10 | 20 | 30 |
| C. Land use/zoning within 1-mile radius | 3 | 3 | 9 | 9 |
| D. Distance to installation boundary | 3 | 6 | 18 | 18 |
| E. Critical environments within 1-mile radius of site | 0 | 10 | 0 | 30 |
| F. Water quality of nearest surface water body | 0 | 6 | 0 | 18 |
| G. Groundwater use of uppermost aquifer | 0 | 9 | 0 | 27 |
| H. Population served by surface water supply within 3 miles downstream of site | 3 | 6 | 18 | 18 |
| I. Population served by groundwater supply within 3 miles of site | 2 | 6 | 12 | 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) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) L

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

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

30 x 1.0 = 30

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

30 x 1.0 = 30

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 groundwater migration. Select the highest rating, and proceed to C.

1. Surface water migration

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Distance to nearest surface water | 3 | 8 | 24 | 24 |
| Net precipitation | 2 | 6 | 12 | 18 |
| Surface erosion | 1 | 8 | 8 | 24 |
| Surface permeability | 1 | 6 | 6 | 18 |
| Rainfall intensity | 2 | 8 | 16 | 24 |
| | | Subtotals | 66 | 108 |

Subscore (100 x factor score subtotal/maximum score subtotal) 61

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. Groundwater migration

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Depth to groundwater | 2 | 8 | 16 | 24 |
| Net precipitation | 2 | 6 | 12 | 18 |
| Soil permeability | 2 | 8 | 16 | 24 |
| Subsurface flows | 0 | 8 | 0 | 24 |
| Direct access to groundwater | 0 | 8 | 0 | 24 |
| | | Subtotals | 44 | 114 |

Subscore (100 x factor score subtotal/maximum score subtotal) 39

C. Highest pathway subscore

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

Pathways Subscore 61

IV. WASTE MANAGEMENT PRACTICES

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

| | |
|---|---|
| Receptors | 49 |
| Waste Characteristics | 30 |
| Pathways | 61 |

Total 140 divided by 3 = 47
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

47 x 1.0 = 47

HAZARD ASSESSMENT RATING FORM

NAME OF SITE Site No. 2 - Waste Disposal Site No. 2

LOCATION 130th TAG, WEST VIRGINIA AIR NATIONAL GUARD, CHARLESTON, WV

DATE OF OPERATION OR OCCURRENCE

OWNER/OPERATOR West Virginia Air National Guard

COMMENTS/DESCRIPTION

SITE RATED BY K. Owens

I. RECEPTORS

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| A. Population within 1,000 ft. of site | 2 | 4 | 8 | 12 |
| B. Distance to nearest well | 2 | 10 | 20 | 30 |
| C. Land use/zoning within 1 mile radius | 3 | 3 | 9 | 9 |
| D. Distance to installation boundary | 3 | 6 | 18 | 18 |
| E. Critical environments within 1 mile radius of site | 0 | 10 | 0 | 30 |
| F. Water quality of nearest surface water body | 0 | 6 | 0 | 18 |
| G. Groundwater use of uppermost aquifer | 0 | 9 | 0 | 27 |
| H. Population served by surface water supply within 3 miles downstream of site | 3 | 6 | 18 | 18 |
| I. Population served by groundwater supply within 3 miles of site | 2 | 6 | 12 | 18 |
| | | Subtotals | 85 | 180 |

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 47

II. WASTE CHARACTERISTICS

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

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

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

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

80 x 1.0 = 80

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.0 = 80

## III. PATHWAYS

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

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

Subscore 0

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

1. Surface water migration

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Distance to nearest surface water | 3 | 8 | 24 | 24 |
| Net precipitation | 2 | 6 | 12 | 18 |
| Surface erosion | 3 | 8 | 24 | 24 |
| Surface permeability | 1 | 6 | 6 | 18 |
| Rainfall intensity | 2 | 8 | 16 | 24 |
| | | Subtotals | 82 | 108 |

Subscore (100 x factor score subtotal/maximum score subtotal) 76

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. Groundwater migration

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Depth to groundwater | 3 | 8 | 24 | 24 |
| Net precipitation | 2 | 6 | 12 | 18 |
| Soil permeability | 2 | 8 | 16 | 24 |
| Subsurface flows | 0 | 8 | 0 | 24 |
| Direct access to groundwater | 0 | 8 | 0 | 24 |
| | | Subtotals | 52 | 114 |

Subscore (100 x factor score subtotal/maximum score subtotal) 46

C. Highest pathway subscore

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

Pathways Subscore 76

## IV. WASTE MANAGEMENT PRACTICES

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

| | |
|---|---|
| Receptors | 47 |
| Waste Characteristics | 80 |
| Pathways | 76 |

Total 203 divided by 3 = 68 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

68 x 1.0 = 68

HAZARD ASSESSMENT RATING FORM

NAME OF SITE Site No. 3 - Former Fire Training Area (FTA)

LOCATION 130th TAG, WEST VIRGINIA AIR NATIONAL GUARD, CHARLESTON, WV

DATE OF OPERATION OR OCCURRENCE

OWNER/OPERATOR West Virginia Air National Guard

COMMENTS/DESCRIPTION

SITE RATED BY K. Owens

I. RECEPTORS

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| A. Population within 1,000 ft. of site | 2 | 4 | 8 | 12 |
| B. Distance to nearest well | 2 | 10 | 20 | 30 |
| C. Land use/zoning within 1 mile radius | 3 | 3 | 9 | 9 |
| D. Distance to installation boundary | 3 | 6 | 18 | 18 |
| E. Critical environments within 1 mile radius of site | 0 | 10 | 0 | 30 |
| F. Water quality of nearest surface water body | 0 | 6 | 0 | 18 |
| G. Groundwater use of uppermost aquifer | 0 | 6 | 0 | 27 |
| H. Population served by surface water supply within 3 miles downstream of site | 3 | 6 | 18 | 18 |
| I. Population served by groundwater supply within 3 miles of site | 2 | 6 | 12 | 18 |

Subtotals 85 180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 47

II. WASTE CHARACTERISTICS

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

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

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

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

40 x 1.0 = 40

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 1.0 = 40

## III. PATHWAYS

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

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

Subscore 0

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

1. Surface water migration

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Distance to nearest surface water | 2 | 8 | 16 | 24 |
| Net precipitation | 2 | 6 | 12 | 18 |
| Surface erosion | 1 | 8 | 8 | 24 |
| Surface permeability | 1 | 6 | 6 | 18 |
| Rainfall intensity | 2 | 8 | 16 | 24 |
| Subtotals | | | 58 | 108 |

Subscore (100 x factor score subtotal/maximum score subtotal) 54

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. Groundwater migration

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Depth to groundwater | 3 | 8 | 24 | 24 |
| Net precipitation | 2 | 6 | 12 | 18 |
| Soil permeability | 2 | 8 | 16 | 24 |
| Subsurface flows | 0 | 8 | 0 | 24 |
| Direct access to groundwater | 0 | 8 | 0 | 24 |
| Subtotals | | | 52 | 114 |

Subscore (100 x factor score subtotal/maximum score subtotal) 46

C. Highest pathway subscore

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

Pathways Subscore 54

## IV. WASTE MANAGEMENT PRACTICES

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

| | |
|---|---|
| Receptors | 47 |
| Waste Characteristics | 40 |
| Pathways | 54 |

Total 141 divided by 3 = 47 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

47 x 1.0 = 47

HAZARD ASSESSMENT RATING FORM

NAME OF SITE Site No. 4 - Past Chemical Disposal at Engine Test Stand

LOCATION 130th TAG, WEST VIRGINIA AIR NATIONAL GUARD, CHARLESTON, WV

DATE OF OPERATION OR OCCURRENCE

OWNER/OPERATOR West Virginia Air National Guard

COMMENTS/DESCRIPTION

SITE RATED BY K. Pack

I. RECEPTORS

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| A. Population within 1,000 ft. of site | 2 | 4 | 8 | 12 |
| B. Distance to nearest well | 2 | 10 | 20 | 30 |
| C. Land use/zoning within 1 mile radius | 3 | 3 | 9 | 9 |
| D. Distance to installation boundary | 3 | 6 | 18 | 18 |
| E. Critical environments within 1 mile radius of site | 0 | 10 | 0 | 30 |
| F. Water quality of nearest surface water body | 0 | 6 | 0 | 18 |
| G. Groundwater use of uppermost aquifer | 0 | 9 | 0 | 27 |
| H. Population served by surface water supply within 3 miles downstream of site | 3 | 6 | 18 | 18 |
| I. Population served by groundwater supply within 3 miles of site | 2 | 6 | 12 | 18 |

Subtotals 85 180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 47

II. WASTE CHARACTERISTICS

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

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

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

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

50 x 1.0 = 50

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

50 x 1.0 = 50

## III. PATHWAYS

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

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

Subscore 0

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

1. Surface water migration

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Distance to nearest surface water | 2 | 8 | 16 | 24 |
| Net precipitation | 2 | 6 | 12 | 18 |
| Surface erosion | 3 | 8 | 24 | 24 |
| Surface permeability | 1 | 6 | 6 | 18 |
| Rainfall intensity | 2 | 8 | 16 | 24 |
| | | Subtotals | 74 | 108 |

Subscore (100 x factor score subtotal/maximum score subtotal) 69

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. Groundwater migration

| Rating Factor | Factor Rating (0-3) | Multiplier | Factor Score | Maximum Possible Score |
|---|---|---|---|---|
| Depth to groundwater | 3 | 8 | 24 | 24 |
| Net precipitation | 2 | 6 | 12 | 18 |
| Soil permeability | 2 | 8 | 16 | 24 |
| Subsurface flows | 0 | 8 | 0 | 24 |
| Direct access to groundwater | 0 | 8 | 0 | 24 |
| | | Subtotals | 52 | 114 |

Subscore (100 x factor score subtotal/maximum score subtotal) 46

C. Highest pathway subscore

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

Pathways Subscore 69

## IV. WASTE MANAGEMENT PRACTICES

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

| | |
|---|---|
| Receptors | 47 |
| Waste Characteristics | 50 |
| Pathways | 69 |
| Total 166 divided by 3 = | 55 Gross Total Score |

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

55 x 1.0 = 55

# APPENDIX E

# U.S. AIR FORCE HAZARD ASSESSMENT

# RATING METHODOLOGY - FACTOR RATING CRITERIA

130th TAG
WEST VIRGINIA AIR NATIONAL GUARD
YEAGER AIRPORT
CHARLESTON, WEST VIRGINIA

USAF HAZARD ASSESSMENT RATING METHODOLOGY
FACTOR RATING CRITERIA

1. **RECEPTORS CATEGORY**

Population within 1000 feet of site:

| | |
|---|---|
| Site 1 | Greater than 100 |
| Site 2 | 26 to 100 |
| Site 3 | 26 to 100 |
| Site 4 | 26 to 100 |

Distance to nearest well:

| | |
|---|---|
| Site No. 1 | 3001 feet to 1 mile |
| Site No. 2 | 3001 feet to 1 mile |
| Site No. 3 | 3001 feet to 1 mile |
| Site No. 4 | 3001 feet to 1 mile |

Land use/zoning within 1-mile radius

| | |
|---|---|
| Sites 1 through 4 | Residential |

Distance to Base Boundary

| | |
|---|---|
| Site No. 1 | 0 to 1000 feet |
| Site No. 2 | 0 to 1000 feet |
| Site No. 3 | 0 to 1000 feet |
| Site No. 4 | 0 to 1000 feet |

Critical Environments within 1 mile

| | |
|---|---|
| Sites 1 through 4 | Not a critical environment |

Water quality of nearest surface water body

| | |
|---|---|
| Sites 1 through 4 | Agricultural or industrial |

Groundwater use of uppermost aquifer

| | |
|---|---|
| Sites 1 through 4 | Not used, other sources readily available. |

USAF HAZARD ASSESSMENT RATING METHODOLOGY
FACTOR RATING CRITERIA

Population served by surface water supply within 3 miles downstream of site

| | |
|---|---|
| Sites 1 through 4 | Greater than 1000 |

Population served by groundwater supply within 3 miles of site

| | |
|---|---|
| Sites 1 through 4 | 51 to 1000 |

2. WASTE CHARACTERISTICS

Quantity:

| | |
|---|---|
| Site No. 1 | Less than 20 drums |
| Site No. 2 | 20 tons or 85 drums of liquid |
| Site No. 3 | 85 drums of liquid |
| Site No. 4 | Less than 20 drums |

Confidence Level:

| | |
|---|---|
| Site No. 1 | Confirmed Confidence Level |
| Site No. 2 | Confirmed Confidence Level |
| Site No. 3 | Suspected Confidence Level |
| Site No. 4 | Confirmed Confidence Level |

Toxicity:

| | |
|---|---|
| Site No. 1 | SAX Level 0 |
| Site No. 2 | SAX Level 3 |
| Site No. 3 | SAX Level 1 |
| Site No. 4 | SAX Level 2 |

Ignitability:

| | |
|---|---|
| Site No. 1 | Flash Point at 140 to 200°F |
| Site No. 2 | Flash Point at 140 to 200°F |
| Site No. 3 | Flash Point at 140 to 200°F |
| Site No. 4 | Flash Point at 140 to 200°F |

USAF HAZARD ASSESSMENT RATING METHODOLOGY
FACTOR RATING CRITERIA

Radioactivity:

| | |
|---|---|
| Site No. 1 | At or Below Background Levels |
| Site No. 2 | At or Below Background Levels |
| Site No. 3 | At or Below Background Levels |
| Site No. 4 | At or Below Background Levels |

Persistence Multiplier:

| | |
|---|---|
| Site No. 1 | 1.0 |
| Site No. 2 | 1.0 |
| Site No. 3 | 1.0 |
| Site No. 4 | 1.0 |

Physical State Multiplier:

| | |
|---|---|
| Site No. 1 | 1.0 |
| Site No. 2 | 1.0 |
| Site No. 3 | 1.0 |
| Site No. 4 | 1.0 |

## 3. PATHWAYS CATEGORY

Surface Water Migration:

Distance to Nearest Surface Water:

| | |
|---|---|
| Site No. 1 | 0 to 500 feet |
| Site No. 2 | 0 to 500 feet |
| Site No. 3 | 501 to 2000 feet |
| Site No. 4 | 501 to 2000 feet |

Net Precipitation:

| | |
|---|---|
| Sites 1 through 4 | +5 to +20 inches |

Surface Erosion:

| | |
|---|---|
| Site No. 1 | Slight |
| Site No. 2 | Severe |
| Site No. 3 | Slight |
| Site No. 4 | Severe |

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FACTOR RATING CRITERIA

Surface Permeability:

| | |
|---|---|
| Sites 1 through 4 | $10^{-2}$ to $10^{-4}$ cm/sec |

Rainfall Intensity:

| | |
|---|---|
| Sites 1 through 4 | 2.1 to 3.0 inches |

Flooding:

| | |
|---|---|
| Sites 1 through 4 | Beyond 100-year floodplain |

Groundwater Migration

Depth to Groundwater

| | |
|---|---|
| Site No. 1 | 11 to 50 feet |
| Site No. 2 | 0 to 10 feet |
| Site No. 3 | 0 to 10 feet |
| Site No. 4 | 0 to 10 feet |

Net Precipitation

| | |
|---|---|
| Sites 1 through 4 | +5 to +20 inches |

Soil Permeability:

| | |
|---|---|
| Sites 1 through 4 | $10^{-2}$ to $10^{-4}$ cm/sec |

Subsurface Flow:

| | |
|---|---|
| Sites 1 through 4 | Bottom of site greater than 5 feet above high groundwater level |

Direct Access to Groundwater:

| | |
|---|---|
| Sites 1 through 4 | No evidence of risk |

## 4. WASTE MANAGEMENT PRACTICES CATEGORY

Practice:

| | |
|---|---|
| Sites 1 through 4 | No containment |

# APPENDIX F

# LIST OF UNDERGROUND STORAGE TANKS

LIST OF UNDERGROUND STORAGE TANKS,
130th TAG, WEST VIRGINIA AIR NATIONAL GUARD,
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA

| | Tank ID./ Associated Bldg | Status | Date Installed | Date Abandoned | Capacity Gallons | Tank Construction | Contents* | Protection |
|---|---|---|---|---|---|---|---|---|
| 1. | Fuel Storage/ Building 129 | Active | 1974 | Not Applicable | 50,000 | Steel | JP-4 Jet Fuel | Cathodic/ Weatherproof |
| 2. | Fuel Storage/ Building 129 | Active | 1974 | Not Applicable | 50,000 | Steel | JP-4 Jet Fuel | Cathodic/ Weatherproof |
| 3. | Fuel Storage/ Building 129 | Active | 1974 | Not Applicable | 2,000 | Steel | Water Contaminated JP-4 Jet Fuel | Cathodic/ Weatherproof |
| 4. | Fuel Storage/ | Abandoned | 1948 | 1976 | 25,000 | Steel | Water (AVGAS) | Unknown |
| 5. | Fuel Storage/ | Abandoned | 1948 | 1976 | 25,000 | Steel | Water (AVGAS) | Unknown |
| 6. | Fuel Storage/ | Abandoned | 1948 | 1976 | 25,000 | Steel | Water (AVGAS) | Unknown |
| 7. | Fuel Storage/ Building 114 | Active | 1948 | Not Applicable | 2,000 | Steel | JP-4 Jet Fuel | Unknown |
| 8. | Fuel Storage/ Building 114 | Active | 1983 | Not Applicable | 6,000 | Steel | Empty (Regular Gasoline) | Cathodic/ Weatherproof |
| 9. | Fuel Storage/ Building 114 | Active | 1983 | Not Applicable | 6,000 | Steel | Empty (Unleaded Gasoline) | Cathodic/ Weatherproof |
| 10. | Fuel Storage/ Building 114 | Active | 1983 | Not Applicable | 6,000 | Steel | Empty (Diesel Gasoline) | Cathodic/ Weatherproof |
| 11. | Solvent Storage Building 122 | Abandoned | 1970 | 1981 | 2,000 | Steel | Empty (Solvent) | Cathodic/ Weatherproof |
| 12. | Solvent Storage Building 122 | Abandoned | 1970 | 1981 | 2,000 | Steel | Empty (Solvent) | Cathodic/ Weatherproof |

LIST OF UNDERGROUND STORAGE TANKS,
130th TAG, WEST VIRGINIA AIR NATIONAL GUARD,
YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA (Continued)

| Tank ID./ Associated Bldg | Status | Date Installed | Date Abandoned | Capacity Gallons | Tank Construction | Contents* | Protection |
|---|---|---|---|---|---|---|---|
| 13. **OWS/Building 112 | Active | Late 1970s | N/A | 1000 | Unknown | Oil Skimmings | None |
| 14. OWS/Building 109 (see notes) | Active | 1983 | N/A | 500 | Unknown | Oil Skimmings | None |
| 15. OWS/Building 125 | Active | Late 1970s | N/A | 500 | Steel | Oil Skimmings | None |
| 16. OWS/Aircraft Washrack | Active | 1971 | N/A | 5000 | Unknown | Oil Skimmings | None |

* Parentheses indicate original contents
** UST connected to oil/water separator

NOTES: 1. Effluent from all OWS flows to the sanitary sewer
2. There are two OWSs in Building 109 that are served by one UST