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Hazardous Materials Technical Center

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INSTALLATION RESTORATION PROGRAM

PRELIMINARY ASSESSMENT

BEAR CREEK RADIO RELAY STATION, ALASKA

April 1989

Submitted to:

HQ AAC/DEPV
Elmendorf AFB, AK 99506

Submitted by:

Hazardous Materials Technical Center
The Dynamac Building
11140 Rockville Pike
Rockville, MD 20852

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EXECUTIVE SUMMARY

A. Introduction

The Hazardous Materials Technical Center (HMTC) was retained in January 1988 to conduct the Installation Restoration Program (IRP) Preliminary Assessment of Bear Creek Relay Station (RRS) Alaska, under Contract No. DLA-900-82-C-4426 with funds provided by Alaskan Air Command (AAC).

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

To implement the DoD policy, a four-phased IRP has been directed consisting of:

- Preliminary Assessment (PA) - to identify past spill or disposal sites posing a potential and/or actual hazard to public health or the environment;
- Site Investigation/Remedial Investigation/Feasibility Study (SI/RI/FS) - to acquire data via field studies, for the confirmation and quantification of environmental contamination that may have an adverse impact on public health or the environment and to select a remedial action through preparation of a feasibility study;
- Research, Development, and Demonstration (RD & D) - if needed, to develop new technology for accomplishment of remediation; and
- Remedial Design/Remedial Action (RD/RA) - to prepare designs and specifications and to implement site remedial action.

The Bear Creek RRS Preliminary Assessment included:

- an onsite visit, including interviews with six AAC personnel, conducted by HMTC personnel during 12 through 21 July, 1988;
- the acquisition and analysis of pertinent information and records on hazardous material use and hazardous waste generation and disposal at the installation; and
- the acquisition and analysis of available geological, hydrological, meteorological, and environmental data from pertinent Federal, State, and local agencies.

B. Major Findings

Past installation operations involved the use and disposal of materials and wastes that were subsequently categorized as hazardous. The major operations of the installation that used and disposed of hazardous materials/hazardous wastes (HM/HW) included automobile maintenance, storage of petroleum products, and communications. Types of hazardous wastes generated at the facility include residual fuels and oils, lead-acid storage batteries, and equipment containing polychlorinated biphenyls (PCBs). Asbestos was also used as a construction material at the facility.

C. Conclusions

Based on information obtained through interviews with Air Force personnel and installation records, small quantities of hazardous materials were used at the RRS while the facility was in operation. After the facility closed, PCB-contaminated soil and equipment were removed from the site, as were batteries and fuels. No evidence of contamination was visible at the time of the site visit. However, as it was a common practice at similar facilities to bury drums and waste liquids, these wastes may be present at the disposal site at the RRS. Liquid wastes may have also been disposed of into the floor drains of the vehicle maintenance shop; these drains may be connected to a dry well. In addition, asbestos may remain within the buildings.

D. Recommendations

The electrical equipment, batteries, fuels, and PCB-contaminated soil and equipment at Bear Creek RRS have been removed and no visible signs of contamination are evident at the facility. However, further IRP investigation is recommended for the disposal site to determine if the wastes it contains are hazardous, and if so, the wastes should be removed and the area remediated according to State and Federal regulations. The vehicle maintenance shop drains should be investigated to determine if they are connected to a dry well and if liquid hazardous wastes were disposed of in this manner. Abatement of any asbestos remaining within the buildings and removal of the residual fuel in the petroleum products storage tanks are also recommended.

I. INTRODUCTION

A. Background

The United States Air Force, due to its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, State, and local governments have developed strict regulations to require that disposers of hazardous materials/hazardous wastes (HM/HW) identify the locations and contents of disposal sites and take action to eliminate the hazards in an environmentally responsible manner. The current Department of Defense (DoD) Installation Restoration Program (IRP) policy was directed by Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5 dated 11 December 1981, and implemented by Air Force message dated 21 January 1982, as a positive action to ensure compliance of military installations with existing environmental regulations. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the IRP. DoD policy is to identify and fully evaluate suspected problems associated with past HM/HW disposal sites on DoD facilities, to control the migration of hazardous contamination, and to control hazards to health and welfare that may have resulted from these past operations. The IRP is a basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986.

To conduct the IRP Preliminary Assessment for Bear Creek Radio Relay Station (RRS), the Headquarters Alaskan Air Command/Directorate of Programs and Environmental Planning (HQ AAC/DEPV) retained the Hazardous Materials Technical Center (HMTC) (operated by Dynamac Corporation) in January 1988 under Contract No. DLA-900-82-C-4426.

The Preliminary Assessment comprises the first phase of the DoD IRP and is intended to review installation records to identify possible hazardous waste-contaminated sites and to assess the potential for contaminant migration from the installation. The Site Investigation (not part of this contract) consists of follow-on field work as determined from the Preliminary Assessment. The Site Investigation includes a preliminary monitoring survey to confirm the presence or absence of contaminants. Upon confirmation of contamination, additional field work is implemented under a Remedial Investigation (not part of this contract) to determine the extent and magnitude of the contaminant migration and provide data necessary for determining appropriate remedial actions, which are evaluated during the Feasibility Study (not part of this contract). Research, Development, and Demonstration (not part of this contract) consists of a technology base development study to support the development of project plans for controlling migration or restoring the installation. Remedial Design/Remedial Action (not part of this contract) includes those activities which are required to control contaminant migration or restore the installation.

B. Authority

The identification of hazardous waste disposal sites at Air Force installations was directed by Defense Environmental Quality Program Policy Memorandum 81-5 (DEQPPM 81-5) dated 11 December 1981, and implemented by Air Force message dated 21 January 1982, as a positive action to ensure compliance of Air Force installations with existing environmental regulations.

C. Purpose of the Preliminary Assessment

DoD policy is to identify and fully evaluate suspected problems associated with past hazardous material disposal sites and spill sites on DoD facilities, control the migration of hazardous contamination from such facilities, and control hazards to health or welfare that may have resulted from these past operations. HMTC evaluated the existence and potential for migration of HM/HW contaminants at Bear Creek RRS by visiting the installation; reviewing existing installation records concerning the use, generation and disposal of HM/HW; reviewing available environmental information; and conducting interviews with present Air Force personnel who are familiar with past hazardous materials management activities at the installation.

A physical inspection was made of the various facilities at the RRS. Relevant information collected and analyzed as a part of the Preliminary Assessment included the history of the installation, with special emphasis on the history of past operations and their past HM/HW management procedures; local geological, hydrological, and meteorological conditions that may affect migration of contaminants; local land use that could affect the potential for exposure to contaminants; and the ecological settings that indicate environmentally sensitive habitats or evidence of environmental stress.

D. Scope

The Preliminary Assessment program included a pre-performance meeting, an onsite installation visit, a review and analysis of the information obtained, and preparation of this report.

The pre-performance meeting was held at HQ AAC/DEPV, Elmendorf Air Force Base (AFB), Alaska, on 12 July 1988. Attendees at this meeting included representatives of HQ AAC/DEPV and HMTC. The purpose of the pre-performance meeting was to provide detailed project instructions, clarification, and technical guidance by AAC, and to define the responsibilities of all parties participating in the Bear Creek RRS Preliminary Assessment.

The scope of this Preliminary Assessment is limited to the installation and includes:

- An onsite visit;
- The acquisition of pertinent information and records on hazardous materials use and hazardous wastes generation and disposal practices at the installation;
- The acquisition of available geological, hydrological, meteorological, land use, and critical habitat data, from various Federal, State and local agencies;
- A review and analysis of all information obtained; and
- The preparation of a report to include recommendations for further actions, if warranted.

The onsite visit, records search, and interviews with Air Force personnel were conducted during the period 12 to 21 July 1988. The Preliminary Assessment site visit was conducted by Dr. Naichia Yeh, Ph.D., Project Manager/Environmental Scientist; Ms. Janet Emry, Hydrogeologist; Ms. Kathryn Gladden, Chemical Engineer; and Mr. Mark Johnson, P.G./Program Manager (Appendix A). Other HMTC personnel who assisted in the Preliminary Assessment include Mr. Raymond G. Clark, Jr., P.E./Department Manager. Personnel from AAC who assisted in the Preliminary Assessment included Mr. James W. Hostman, Chief, Environmental Planning HQ AAC/DEPV and Mr. Jeffrey M. Ayres, the Point of Contact (POC) at HQ AAC/DEPV.

E. Methodology

A flow chart of the Preliminary Assessment Methodology is presented in Figure 1. This Preliminary Assessment methodology ensures a comprehensive collection and review of pertinent site specific information, and is used in the identification and assessment of potentially contaminated hazardous waste spill/disposal sites.

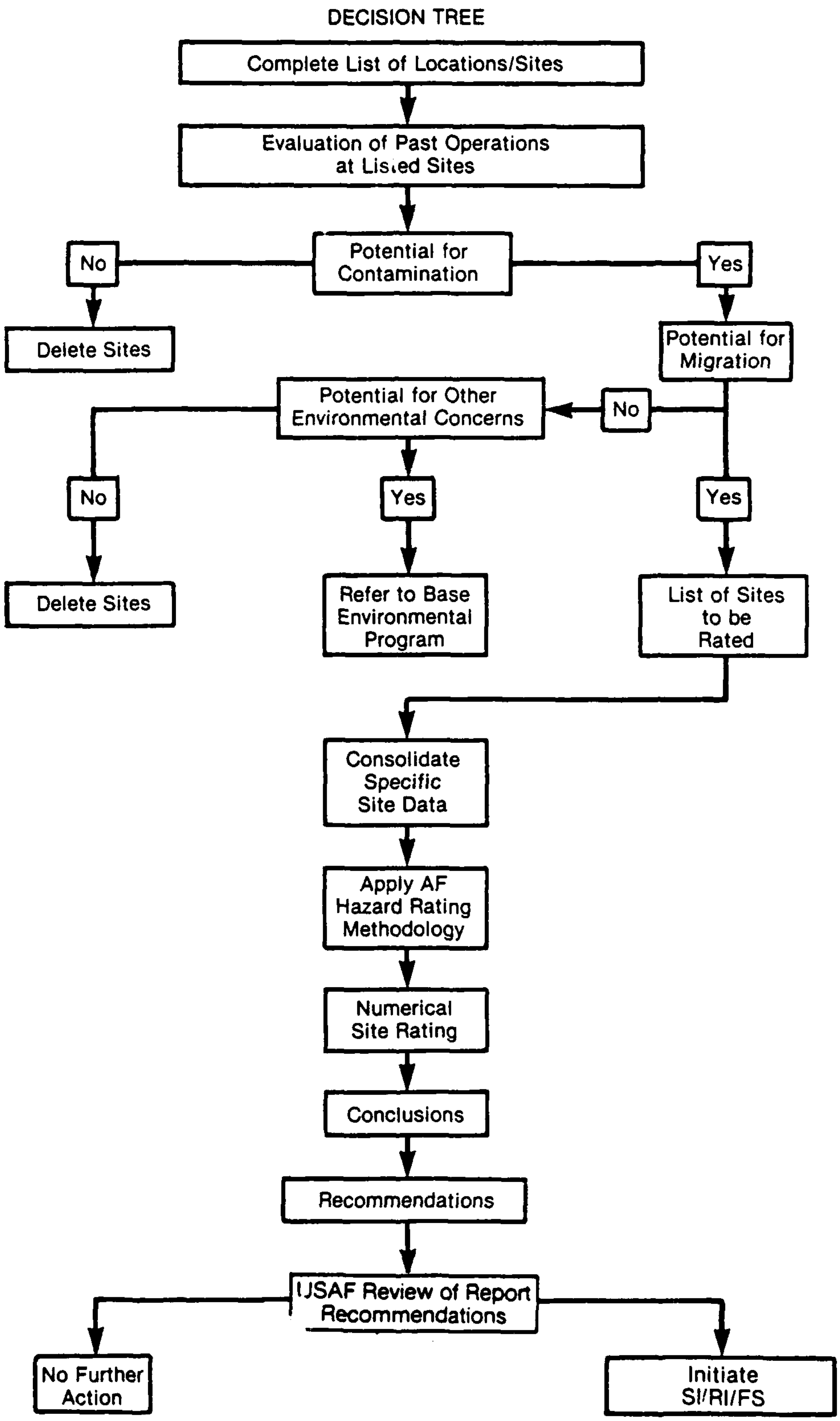
The Preliminary Assessment begins with a site visit to the installation to identify all potential areas where contamination may have resulted from the use or disposal of HM/HW. Next, an evaluation of past HM/HW handling procedures at the identified locations is made to determine whether environmental contamination may have occurred. The evaluation of past HM/HW handling practices is facilitated by extensive interviews with Air Force personnel familiar with the various past operating procedures at the installation. The interviews also define the areas on the installation where any waste materials, either intentionally or inadvertently, may have been used, spilled, stored, disposed of, or released into the environment.

Historical records are collected and reviewed to supplement the information obtained from interviews. Using the information outlined above, a list of past waste spill/disposal sites on the installation is identified for further evaluation. A general survey tour of the identified spill/disposal sites, the

HMTC PRELIMINARY ASSESSMENT INSTALLATION RESTORATION PROGRAM

Figure 1.

Preliminary Assessment Methodology Flow Chart.



installation, and the surrounding area is conducted to determine the presence of visible contamination and to help assess the potential for contaminant migration. Particular attention is given to locating nearby drainage ditches, surface water bodies, residences, and wells where they are present.

Detailed geological, hydrological, meteorological, land use, and environmental data for the area of study is also obtained from the POC and from appropriate Federal, State, and local agencies. A list of outside agencies contacted is in Appendix B. Following a detailed analysis of all the information obtained, sites are identified as suspect areas where HM/HW disposal may have occurred. Evidence at these sites suggests that they may be contaminated and that the potential for contaminant migration exists. Where sufficient information is available, sites are assigned a Hazard Assessment Score (HAS) using the U.S. Air Force Hazard Assessment Rating Methodology (HARM) and the HARM guidelines (Appendix C). However, the absence of a HAS does not necessarily negate a recommendation for further IRP investigation, but rather may indicate a lack of data.

II. INSTALLATION DESCRIPTION

A. Location

Bear Creek RRS is located approximately 9 miles northeast of Tanana, Alaska, near the confluence of the Yukon and Tanana Rivers (Figure 2). It is located in Section 10, Township 5 North, Range 21 West, Fairbanks Meridian. The RRS is located in a completely remote area at 1,887 feet elevation surrounded by forest.

The 116.2 acre installation is comprised of a 16.12-acre communications site, a water well site, a 1.6-acre petroleum, oils, and lubricants (POL) site, and a 99.1-acre access road and a water line right-of-way. The communication site consists of seven industrial buildings and 19 miscellaneous facilities, including a 13,728-square foot (SF) composite building, a 2,035-SF vehicle maintenance shop, a 1,400-SF vehicle operations heated parking, a fire water pump station, a 7,000-barrel diesel fuel storage tank, a 390-barrel motor gasoline storage tank, and a 40,000-gallon water storage tank. Figure 3 shows the original facilities at Bear Creek RRS.

B. History

Bear Creek RRS was constructed during 1956 and 1957, and officially activated on 6 January 1959. It was part of the original White Alice Communication System (WACS). Bear Creek RRS was a tropospheric scatter station linking Indian Mountain RRS, Kalakaket Creek RRS, and Pedro Dome RRS. The WACS was phased out during the 1970's as its function was replaced by satellite earth stations and commercial long distance carriers. Notice of intention to relinquish Bear Creek RRS was forwarded to the Bureau of Land Management in November 1981 (Reynolds, 1988).

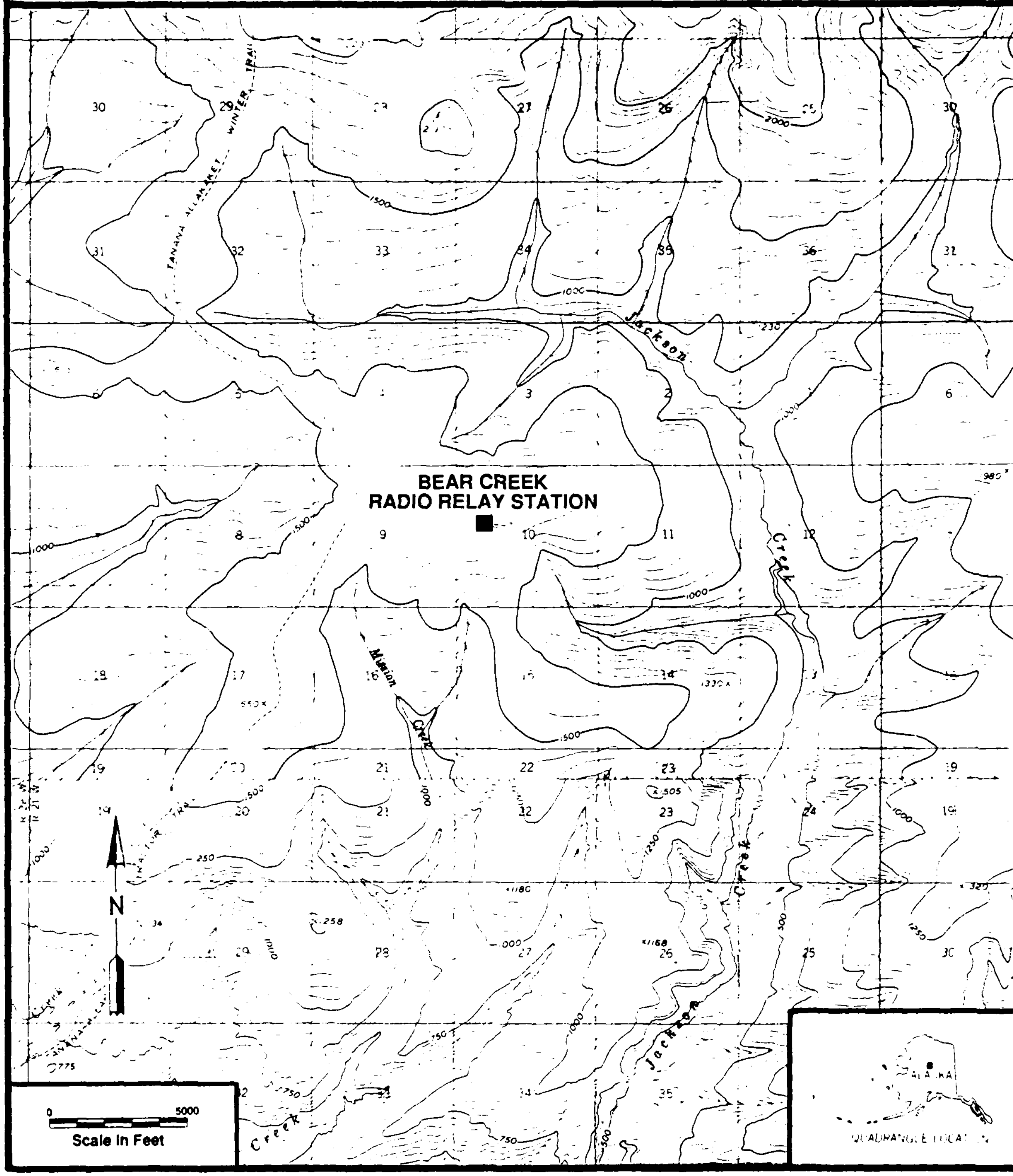
Bear Creek RRS was inspected by the Air Force during the initial cleanup of 25 U.S. Air Force WACS sites in 1981 and 1982. Hazardous and toxic materials and wastes, as well as most of the moveable equipment, were shipped back to

HMTC

Source: U.S.G.S. Tanana (B-4) Quadrangle, Alaska, 7.5 Minute Series Topographic Map, 1967.

Figure 2.

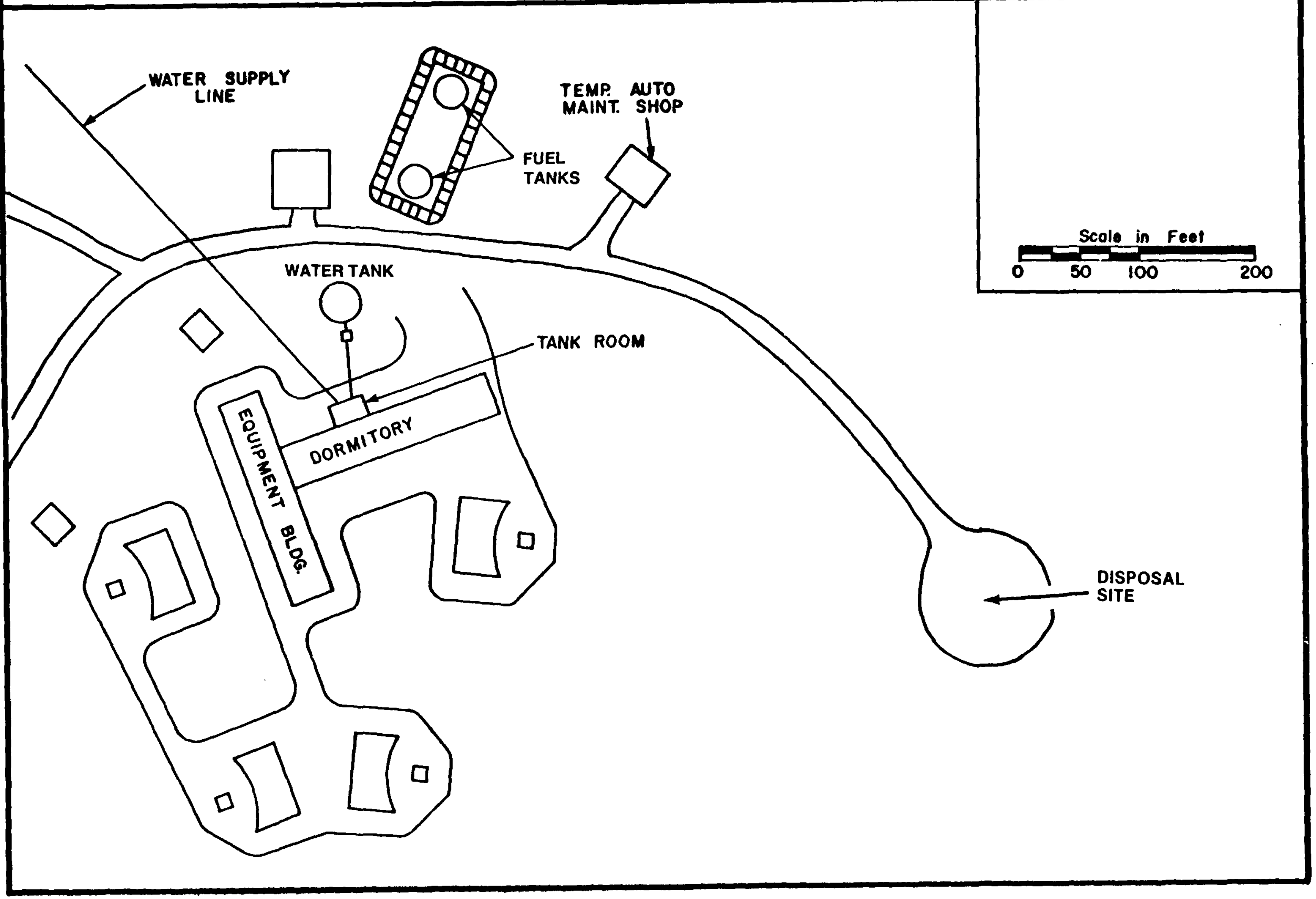
Location Map of Bear Creek Radio Relay Station, Alaska.



Source: 65 MCP Site Plan
Water Storage Tank
and Fire Pump, Undated

Figure 3.

Site Map of Bear Creek
Radio Relay Station, Alaska.



Elmendorf AFB. A follow-up inspection of Bear Creek RRS in July 1984, found that several areas had high levels of polychlorinated biphenyls (PCBs) in the soil. Cleanup activities at Bear Creek RRS began on 23 May 1985 and continued through 26 June 1985. During this operation, suspected PCB-contaminated soil was tested and excavated from several locations at the RRS. Additional samples were collected from these areas and analyzed in the laboratory for quality control purposes. The analyses confirmed that concentrations were reduced to nearly 10 parts per million (ppm).

According to records of the 5099th Civil Engineering Operations Squadron (CEOS), the materials removed from the RRS included:

- 53 55-gallon drums of PCB-contaminated soil;
- 2 55-gallon drums of PCB-contaminated lumber;
- 1 55-gallon drum of PCB-contaminated clothes/rags;
- 2 55-gallon drums of capacitors (35) containing PCB-contaminated oil;
- 4 boxes of klystron tubes; and
- 2 55-gallon drums of used oil.

Timbers, piping, the wave guide, a burn barrel, non-liquid electronic hardware and debris, and other trash and garbage were buried in a pit excavated near the existing disposal area located approximately 0.25 miles east of the RRS. PCB-contaminated soil (8.2 ppm to 14.5 ppm) excavated from near the garage was also buried in this new disposal pit (5099th CEOS, 1985).

Additionally in 1985, Bear Creek RRS was inspected for asbestos and other hazardous wastes. Designs and specifications for asbestos abatement and demolition of the RRS were developed (HMTC, 1985). At that time, excavation and removal of the PCB-contaminated soil was under way.

III. ENVIRONMENTAL SETTING

A. Meteorology

Bear Creek RRS has a continental climate typical of the interior of Alaska. This climate is characterized by extreme seasonal variations in temperature and by low total precipitation.

At Tanana, Alaska, located approximately 9 miles southwest of Bear Creek RRS, temperature extremes range from 94°F in summer to 71°F below zero in winter. Annual precipitation averages 13 inches, with approximately half of the total annual rainfall occurring in June, July and August (Leslie, 1986). Maximum rainfall intensity, based on a 10-year, 24-hour rainfall, is 2.9 inches (Miller, 1963). Total annual snowfall averages about 50 inches, with snow generally occurring from October through March (Leslie, 1986). Net precipitation is calculated by subtracting the mean annual lake evaporation from the average annual precipitation (47 FR 31227). Since the mean annual lake evaporation rate is not available for this part of Alaska, the annual potential evapotranspiration rate was used (NOAA, personal communication, 1988). The potential evapo-anspiration rate for Tanana is 17.52 inches per year (Patric and Black, 1986); therefore the net precipitation is negative 4.52 inches per year.

B. Geology and Soils

Bear Creek is located within the unglaciated Yukon-Tanana Upland physiographic province. Bedrock beneath the RRS is primarily composed of an early Paleozoic and Precambrian metamorphic complex of quartz-mica schist, quartzite, phyllite and slate beds. This unit is designated PzpCsq in Figure 4. The quartz-mica schist is commonly light to medium gray and silvery gray in color. The quartzite is predominantly light to medium gray, very fine grained, micaceous and schistose or chert-like in parts. The slate and phyllite beds range in color from light to dark gray, silvery, greenish-gray, red, green and occasionally mottled red and green and are interbedded with quartzite. Other

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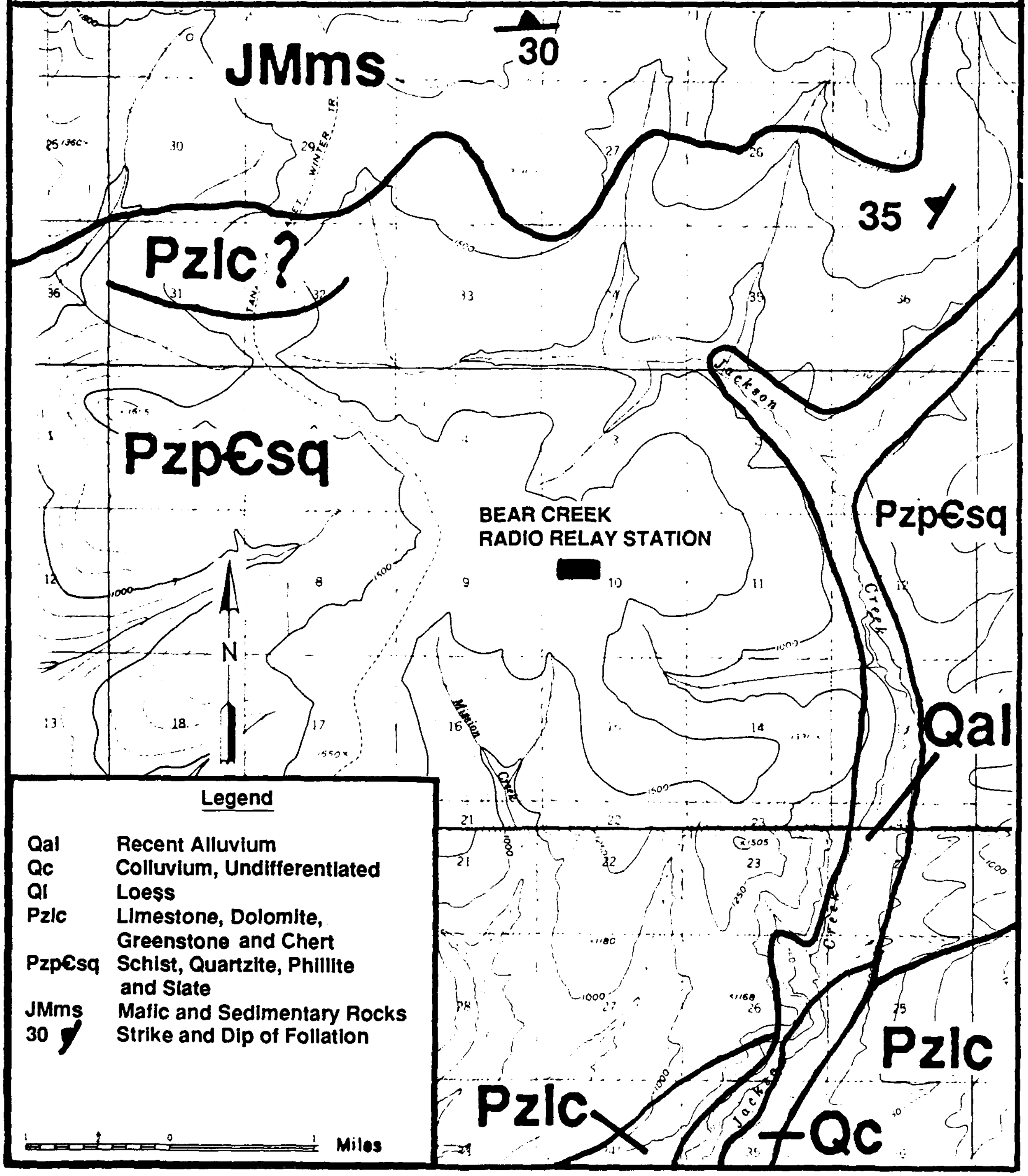
Source: U.S.G.S. Reconaissance Geological Map of the Tanana Quadrangle, Alaska, 1982.

Figure 4.

Geologic Map of Bear Creek Radio Relay Station, Alaska and Vicinity.



materials associated with this unit include minor amounts of gray schist; medium- to dark gray shaly limestone; tufaceous siltstone; fine-grained and conglomeratic graywacke sandstone with stretched or sheared pebbles and slate fragments; and white quartz pods, lenses, and irregular veinlets. These beds range from thick to thin. This unit is structurally complex and some unrecognized younger rocks may also be included. Within the region, this unit underlies a limestone, dolomite, greenstone and chert unit (Pzc); however, the contact between these units is not clearly defined (Chapman, 1982).

According to the U.S. Soil Conservation Service, the soils at Bear Creek RRS belong to the Typic Cryachrepts, very gravelly, hilly to steep - Histic Pergelic Cryaquepts, loamy, nearly to rolling association. This association is extensive on hilly uplands in the central and eastern parts of interior Alaska.

Typic Cryachrepts, very gravelly, hilly to steep, compose 30 percent of this association. These soils are well drained soils without permafrost on southfacing slopes under forests of white spruce, paper birch, and quaking aspen. These soils formed in very gravelly and stony material derived from local bedrock. In some locations, the gravelly material is capped with a thin layer of silt loam. Typically, the soils have brown silt loam or gravelly silt loam upper layers over olive brown very gravelly and stony silt loam or sandy loam. On steep slopes, these soils are only 20 to 40 inches deep over bedrock.

Histic Pergelic Cryaquepts, loamy, nearly level to rolling, make up 25 percent of this association. These soils are poorly drained soils with a shallow permafrost table on long foot slopes and valley bottoms. The vegetation is mainly sedge tussocks, mosses, low shrubs, and scattered stands of stunted black spruce. These soils typically have a peaty surface mat 8 to 16 inches thick over mottled, dark gray, frost-churned silt loam that contains black streaks of buried organic material. The permafrost table is usually 10 to 20 inches below the peaty surface.

Histic Pergelic Cryaquepts, very gravelly, hilly to steep, compose 10 percent of this association. These soils are poorly drained soils with a shallow permafrost table on steep north-facing slopes under a cover of mosses, sedges, low shrubs, and stunted black spruce. These soils typically have a thick peaty surface mat over mottled, dark gray, very gravelly and stony micaceous silt loam. The permafrost table is usually less than 10 inches below the surface mat. On the upper slopes of steep hillsides, the soils are commonly only 20 to 40 inches thick over bedrock.

Aquic Cryorthents, very gravelly, hilly to steep, make up 10 percent of this association. These soils are moderately well drained to somewhat poorly drained soils on hills and ridges near the tree line. The vegetation is mainly tall shrubs and stunted black spruce. Beneath a thin mat of peaty organic material, the soils consist of mottled dark grayish-brown and olive brown very gravelly silt loam or silt loam. In places, bedrock is 20 to 40 inches below the surface.

The remaining soils, which make up 25 percent of this association, are generally very gravelly, hilly to steep well drained soils with permafrost. These soils generally occur under arctic tundra, shrubs, mosses, lichens, or grasses.

C. Hydrology

Surface Water

Bear Creek RRS is located approximately 6 miles north of the Yukon River. Most of the surface runoff from the RRS flows off the site approximately 3,500 feet toward the north or approximately 10,000 feet east into Jackson Creek. Runoff on the western portion of the facility flows approximately 10,000 feet west off the site into Bear Creek. Both Jackson Creek and Bear Creek are tributaries of the Yukon River. Due to the remoteness of these creeks, they serve as habitats for fish and wildlife and do not serve as a drinking water source. Due to its elevation, Bear Creek RRS is outside any flood plains.

Groundwater

Specific groundwater data for the Bear Creek RRS area is not available; however, some general assumptions can be made based on the nature of the soils and geology of the region. Shallow groundwater at the RRS occurs within the soil and weathered metamorphic bedrock. As Bear Creek RRS is situated on a topographically high area, shallow groundwater flows from this high toward lower elevations, mimicking surface water flow.

Groundwater may also be found in joints, fractures, and shear zones within the bedrock. Joints generally occur within the uppermost 300 feet of bedrock; fractures associated with faulting can occur at any depth. Yield from wells within this type of rock decreases rapidly with depth (Fetter, 1980).

D. Critical Habitats/Endangered or Threatened Species

According to the U.S. Fish and Wildlife Service, Alaska Division, there are no endangered or threatened species within a 1-mile radius of Bear Creek RRS. No federally- or state-designated critical habitats or wilderness areas are located within 1 mile of the RRS. According to the National Wetland Inventory (1985), no wetlands are located within a 1-mile radius of the RRS.

IV. FINDINGS

A. Activity Review

A review of AAC records and interviews with Air Force personnel resulted in the identification of specific operations at the Bear Creek RRS in which the majority of HM/HW were handled or generated. These operations included:

- Vehicle maintenance, including management of motor gasoline, oils, and antifreeze;
- Management of diesel fuel used to power the generators;
- Management of electrical equipment containing PCBs;
- Management of lead-acid batteries used to store electricity; and
- Use of asbestos as a construction material.

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

Interviews with Air Force personnel and subsequent site inspections resulted in the identification of no potentially contaminated sites at Bear Creek RRS. Although no sites were identified or assigned a HAS according to HARM, the methodology and guidelines are included as Appendix C . The objective of this assessment is to identify and provide a relative ranking of sites suspected of contamination from hazardous substances. The final rating score would reflect specific components of the hazard posed by a specific site: possible receptors of the contamination (e.g., population within a specified distance of the site and/or critical environments within a one-mile radius of the site); the waste and its characteristics; and the potential pathways for contaminant migration (e.g., surface water, groundwater, flooding).

C. Other Pertinent Information

At the time of the site visit to Bear Creek RRS on 14 July 1988, the following observations were made:

- The auto maintenance shop was generally clean and free of debris. Although no visible signs of contamination were evident, drain inlets were observed in the floor of the shop (see Photos 1 and 2, Appendix D). These drains may be connected to a dry well;

- Most of the contents of the radio relay building had been previously removed, except for electrical equipment, including four generators (surrounded by a concrete berm, for spill control), two empty fuel tanks, rows of power control panels, fuse boxes, and switch/circuit control boards (see Photos 3 and 4, Appendix2 D). The generators were rusted and had leaked oil around their bases, however, the leaks were confined to the concrete floor as there are no floor drains in this area (see Photo 5, Appendix D). There were also three generators, a large empty fuel tank, and a boiler in the tank room by the dormitory. No lead-acid storage batteries were found. Paint was found scaling off the walls and ceilings within the building (See Photo 6, Appendix D). Some of the rooms in the dormitory contained standing water from precipitation. In addition, asbestos may remain within the building;

- A small amount of residual fuel was found in both petroleum products storage tanks (see Photo 7, Appendix D). At the time of the site visit, openings on top of the tanks released a strong odor of fuel. However, the residual fuel was fully confined and floating on standing water. The pipelines from these tanks were buried. The surrounding area was overgrown and no signs of contamination were visible;

- The RRS grounds were generally clean and free of debris except for a small amount of crushed cans and metal debris located approximately 70 feet east of the dormitory building (see Photo 8, Appendix D). No stained soil was observed; and

- An uncovered disposal area, approximately 0.25 miles east of the RRS, was observed in the middle of a turn loop at the end of the access road (see Photo 9, Appendix D). This disposal area was used while the RRS was operational. At the time of the site visit, the area was overgrown with small trees and shrubs. Rusted metal debris, construction rubble, wood, cans, and bottles were identified at this location. No hazardous wastes were reported to have been disposed of in this area and no evidence of contamination was observed.

V. CONCLUSIONS

Based on information obtained through interviews with Air Force Personnel and review of installation records, small quantities of various types of hazardous materials were handled at Bear Creek RRS while the facility was in operation. Diesel fuel, batteries, and electrical equipment containing PCBs were used to run the communications facility. In addition, gasoline, motor oil, and antifreeze were used for vehicle maintenance.

PCB-contaminated items such as lumber, soil, oil, and electrical equipment were removed from the RRS in 1985. The batteries were also removed. At the time of the site visit, there was no visible evidence of contamination (i.e. stained soil or abandoned drums) at the RRS. The solid waste disposal area that was used while the RRS was operational may contain HM/HW, as it was a common practice at similar facilities to bury drums and liquid wastes. The floor drains at the vehicle maintenance shop may lead to a dry well, which may have received liquid wastes. The only other health and safety concern at Bear Creek RRS is the asbestos that may remain within the buildings.

VI. RECOMMENDATIONS

At the time of the site visit, no visible signs of contamination were evident at the facility. However, it is recommended that further IRP investigation be performed at the solid waste disposal area to determine if its contents are hazardous. If the waste proves to be hazardous, it should be removed along with any contaminated soil and disposed of according to state and Federal regulations. The residual fuel in the petroleum storage tanks should be removed and proper closure procedures executed. The vehicle maintenance shop should be investigated to determine if the floor drains are connected to a dry well and if liquid hazardous wastes were disposed of in this manner. In addition, the Air Force should proceed with abatement of any asbestos remaining within the buildings.

GLOSSARY OF TERMS

ANNUAL PRECIPITATION - The total amount of rainfall and snowfall for the year.

ASBESTOS - A group of silicate minerals that readily form into thin, strong fibers that are flexible, heat resistant, and chemically inert; used commercially in construction.

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

CHERT - A hard, extremely dense or compact sedimentary rock.

CONGLOMERATE - A coarse-grained sedimentary rock, composed of rounded pebbles, cobbles, and boulders, set in a fine-grained matrix of sand or silt, and commonly cemented by calcium carbonate, iron oxide, silica, or hardened clay.

CONGLOMERATIC - Pertaining to a conglomerate.

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:

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

(b) any element, compound, mixture, solution, or substance designated pursuant to Section 102 of this Act,

(c) 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),

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

(e) any hazardous air pollutant listed under Section 112 of the Clean Air Act, and

(f) 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).

CONTINENTAL CLIMATE - The climate of the interior of a continent, characterized by seasonal temperature extremes and by the occurrence of maximum and minimum temperature soon after summer and winter solstice, respectively.

CREEK - A term generally applied to any natural stream of water, normally larger than a brook but smaller than a river.

CRITICAL HABITAT [Fed] - The specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of the Endangered Species Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management consideration or protection; and specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the Endangered Species Act, upon a determination by the Secretary that such areas are essential for the conservation of the species.

CRITICAL HABITAT [Alaska] - Places where protective emphasis is on the environment in which wildlife occurs. Critical habitats may be complete biotic systems -- identifiable environmental units that operate as self-sustaining systems -- or well-defined areas specifically needed by wildlife for certain functions such as nesting or spawning.

DOLOMITE - A carbonate sedimentary rock of which more than 50% by weight or by areal percentages under the microscope consists of the mineral dolomite, or a variety of limestone or marble rich in magnesium carbonate.

DRAINAGE CLASS [natural] - Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained - Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained - Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained - Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained - Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained - Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained - Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough periods during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained - Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

ENDANGERED SPECIES - Any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of the Endangered Species Act would present an overwhelming and overriding risk to man.

FRACTURE - A general term for any break in a rock, whether or not it causes displacement, due to mechanical failure by stress. Fracture includes cracks, joints, and faults.

GRAVEL - An unconsolidated, natural accumulation of rounded rock fragments resulting from erosion, consisting predominantly of particles larger than sand, such as boulders, cobbles, pebbles, granules or any combination of these fragments.

GRAYWACKE - A dark gray firmly indurated coarse-grained sandstone that consist of poorly sorted angular grains of quartz and feldspar, with a variety of dark rock and mineral fragments embedded in a compact clayey matrix.

GREENSTONE - Any compact dark green altered or metamorphosed mafic igneous rock, usually basalt, that owes its color to the presence of chlorite, actinolite, or epidote.

GROUND MORAINE - An accumulation of till after it has been deposited or released from the ice during ablation, to form an extensive area of low relief devoid of transverse linear elements.

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 United States 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 Decembe 1981.)

HAS - Hazard Assessment Score - The score developed by using the Hazardous Assessment Rating Methodology (HARM).

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:

a. cause, or significantly contribute to, an increase in mortality or an increase in serious or incapacitating reversible illness, or

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

HILL - A natural elevation of the land surface, rising rather prominently above the surrounding land, usually of limited extent and having a well defined outline (rounded) and generally considered to be less than 1,000 feet from base to summit.

JOINTS - A surface of fracture or parting in a rock, without displacement.

KLYSTRON TUBE - An electron tube for generating and amplifying ultrahigh frequency currents by means of a flow of electrons between cavities within which they are rhythmically accelerated and retarded by electrical oscillations.

LENS - A geologic deposit bounded by converging surfaces (at least one of which is curved), thick in the middle and thinning out toward the edges, resembling a convex lens. A lens may be double-convex or plano-convex.

LICHENS - Any of various flowerless plants composed of fungi and algae, commonly growing on rocks and trees.

LIMESTONE - A sedimentary rock consisting primarily of calcium carbonate, primarily in the form of the mineral calcite.

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

METAMORPHIC ROCK - Any rock derived from pre-existing rocks by mineralogical, chemical, and/or structural changes, essentially in solid state, in response to marked changes in temperature, pressure, shearing stress, and chemical environment, generally at depth in the Earth's crust.

MICA - Any mineral of the mica group of complex phyllosilicates. These minerals are monoclinic, and are characterized by low hardness and perfect basal cleavage.

MICACEOUS - Consisting of or containing mica.

MOSSES - Bryophytic plants having a stem and distinct leaves growing in tufts or clusters on the ground or on rocks or wood.

MOTTLED - Irregularly marked with spots or patches of different colors, usually indicating poor aeration or seasonal wetness in soils.

NATURAL AREA - An area of land or water that has retained its wilderness character, although not necessarily completely natural and undisturbed, or that has rare or vanishing flora, fauna, archaeological, scenic, historical, or similar features of scientific or educational value.

PALEOZOIC - An era of geologic time, from the end of the Precambrian to the beginning of the Mesozoic, or from 570 to about 225 million years ago.

PARK - An area of public land known for its natural scenery and preserved for public recreation by a State or national government.

PEAT - An unconsolidated deposit of semicarbonized plant remains in a water-saturated environment and of persistently high moisture content (at least 75%).

PEBBLE - A general term for a small, roundish stone; a rock fragment larger than a granule and smaller than a cobble; having the diameter in range of 4-64 mm (1/6 to 2.5 in).

PERMAFROST - Rock or soil material that has remained below 0°C continuously for two or more years. Permafrost is defined solely on the basis of temperature.

PHYLLITE - A metamorphosed rock, intermediate in grade between slate and mica schist.

PHYSIOGRAPHIC PROVINCE - Region of similar structure and climate that has had a unified geomorphic history.

POLYCHLORINATED BIPHENYLS (PCBs) - A family of aromatic hydrocarbons in which two or more chlorine atoms have replaced hydrogen atoms in biphenyl rings. At least 100 different compounds are known as PCBs; these differ in their toxic effects as well as in their chemical and physical properties. PCBs were widely used as insulating fluids in electrical transformers and capacitors.

PRECAMBRIAN - All geologic time, and its corresponding rocks, before the beginning of the Paleozoic; it is equivalent to about 90% of geologic time.

PRESERVE - An area maintained and protected especially for regulated hunting and fishing.

PRISTINE - Something that is still pure or untouched; uncorrupted; unspoiled.

QUARTZ - A crystalline silica, an important rock forming mineral: SiO_2. Occurs either in transparent hexagonal crystals (colorless or colored by impurities) or in crystalline masses. Forms the major proportion of most sands and has a widespread distribution in igneous, metamorphic and sedimentary rocks.

QUARTZITE - A granoblastic metamorphic rock consisting mainly of quartz and formed by recrystallization of sandstone or chert by either regional or thermal metamorphism.

RECHARGE AREA - An area in which water is absorbed that eventually reaches the zone of saturation in one or more aquifers.

RIVER - A general term for a natural freshwater surface stream of considerable volume and a permanent or seasonal flow, moving in a definite channel toward a sea, lake, or another river.

SAND - A rock or mineral particle in the soil, having a diameter in the range 0.52 - 2 mm.

SANDSTONE - A medium-grained fragmented sedimentary rock composed of abundant round or angular fragments of sand, set in a fine-grained matrix (silt or clay) and more or less firmly united by a cementing material (commonly silica, iron oxide, or calcium carbonate).

SANDY LOAM - A soil containing 43 - 85% sand, 0 - 50% silt, and 0 - 20% clay, or containing at least 52% sand and no more than 20% clay and having the percentage of silt plus twice the percentage of clay exceeding 30, or containing 43 - 52% sand, less than 50% silt, and less than 7% clay.

SCHIST - A medium or coarse-grained, strongly foliated, crystalline rock; formed by dynamic metamorphism.

SCHISTOCITY - The foliation in schist or other coarse-grained, crystalline rock due to the parallel, planar arrangement of mineral grains of the platy, prismatic, or elliposoidal type, usually mica.

SCHISTOSE - Said of a rock displaying schistocity.

SEDGE - Any of various grasslike herbs typically found in marshy places.

SHALY - Pertaining to, composed of, or having the character of shale.

SHEAR ZONE - A tabular zone of rock that has been crushed and brecciated by many parallel fractures due to shear strain.

SHRUBS - A woody perennial plant of low stature.

SILT [geol] - A rock fragment or detrital particle smaller than a very fine sand grain and larger than coarse clay, having a diameter in the range of 0.004 to 0.063 mm.

SILT [soil] - (a) A rock or mineral particle in the soil, having a diameter in the range 0.002-0.005 mm; (b) A soil containing more than 80% silt-size particles, less than 12% clay, and less than 20% sand.

SILT LOAM - A soil containing 50 - 88% silt, 0 - 27% clay and 0 - 50% sand.

SILTSTONE - A rock whose composition is intermediate between those of sandstone and shale and of which at least two-thirds is material of silt size.

SLATE - A compact, fine-grained metamorphic rock that possesses slaty cleavage and hence can be split into slabs and thin plates. Most slate was formed from shale.

SOIL PERMEABILITY - The characteristic of the soil that enables water to move downward through the profile. Permeability is measured as to the number of inches per hour that water moves downward through the saturated soil.

Terms describing permeability are:

Very Slow	- less than 0.06 inches per hour (less than 4.24×10^{-5} cm/sec)
Slow	- 0.06 to 0.20 inches per hour (4.24×10^{-5} to 1.41×10^{-4} cm/sec)
Moderately Slow	- 0.20 to 0.63 inches per hour (1.41×10^{-4} to 4.45×10^{-4} cm/sec)
Moderate	- 0.63 to 2.00 inches per hour (4.45×10^{-4} to 1.41×10^{-3} cm/sec)
Moderately Rapid	- 2.00 to 6.00 inches per hour (1.41×10^{-3} to 4.24×10^{-3} cm/sec)
Rapid	- 6.00 to 20.00 inches per hour (4.24×10^{-3} to 1.41×10^{-2} cm/sec)
Very Rapid	- more than 20.00 inches per hour (more than 1.41×10^{-2} cm/sec)

(Reference: U.S.D.A. Soil Conservation Service)

SOIL REACTION - The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests at pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

SOIL STRUCTURE - The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are -- platty (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

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

THREATENED SPECIES - Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

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

TRIBUTARY - A stream feeding, joining, or flowing into a larger stream or into a lake.

TUFACEOUS - Pertaining to or like tufa, a chemical sedimentary rock composed of calcium carbonate formed by evaporation around the mouth of a calcareous spring or along a stream or lake that carries calcium carbonate in solution.

TUNDRA - A rolling, treeless, often marshy plain of arctic regions.

TUSSOCK - A tuft or clump of grass or sedge.

UPLAND - A general term for high land or an extensive region of high land, especially in the interior of a country.

VEIN - A thin, sheetlike igneous intrusion into a fissure.

VEINLETS - Small veins.

WETLANDS - Are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of the Classification of Wetlands and Deepwater Habitats of the United States, wetlands must have one or more of the following three attributes: (1) at least periodically , the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

WILDERNESS AREA - An area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this chapter of the Wilderness Act, an area of underdeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or an primitive and unconfined type of recreation; (3) has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic or historical value.

YIELD - The amount of water that can be taken continuously from a well.

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APPENDIX A

RESUMES OF PRELIMINARY ASSESSMENT TEAM MEMBERS

NAICHIA YEH

EDUCATION

Ph.D., Environmental Sciences, The University of Texas at Dallas, 1987
M.S., Environmental Sciences, The University of Texas at Dallas, 1984
B.S., Physics, National Taiwan Normal University, 1978

EXPERIENCE

Nine years of combined academic and technical experience in hazardous waste management and in supplying technology-based solutions to environmental problems, including environmental assessment and evaluation of the nature and the potential environmental impacts of hazardous waste. Has extensive knowledge in computer-aided modeling methodology.

EMPLOYMENT

Dynamac Corporation (1987-present): Environmental Scientist

Conducts preliminary assessments of suspected hazardous materials/hazardous waste sites at military installations in order to identify, and evaluate potentially hazardous waste disposal sites. Also, quantifies contamination at these sites and analyzes the data in order to determine both short-term and long-term public health effect as well as future risks that may result from exposure to the site contaminants.

Provides technical information consultation to clients with inquiries regarding state-of-the-art technology, current regulations and hazards associated with usage of hazardous materials. Also provides guidance on proper transportation and disposal methods of hazardous wastes, safe storage and handling for hazardous materials, and hazards associated with chemicals and substances.

Provides computerized management services support for environmental contracts to the Hazardous Material Management Division of the Dynamac Corporation. Conducts scientific data processing and data analysis, and develops databases for managing work assignments and contracts.

Developed an electronic hazardous assessment rating system which is a fully computerized version of the U.S. Air Force Hazardous Assessment Rating System. Designed a technical inquiry data base system to keep track of the technical inquiry service requests received by the Hazardous Materials Technical Center operated by Dynamac Corporation. Implemented an efficient methodology for preparing the project expense reports to support program management functions.

The University of Texas at Dallas (1985-1987): Research Assistant

Participated in an environmental assessment and design project which involved the evaluation of the nature and potential impact of hazardous waste. This project included the design of field and laboratory programs for the collection of data used with computer-aided modeling, the site assessment of the proposed hazardous waste facilities, the field sampling and hazardous waste characterization, the zoning of polluted site, the design of remedial cleanup program, and the conceptual design of the hazardous waste disposal plan based on the onsite investigation and computer modeling results.

The University of Texas at Dallas (1984-1985): Computer Laboratory Consultant

Instructed students in microcomputer application and computer programming languages. Conducted scientific data processing and data analysis. Developed a regression analysis program with Lotus 1-2-3. The program integrates five regression mechanisms and takes full advantage of Lotus 1-2-3's keyboard macro and graphic abilities.

The University of Texas at Dallas (1983): Teaching Assistant

Taught numerical analysis and applied mathematics in environmental engineering.

Peitou High School (1979, 1982): Science Teacher

Taught physics, mathematics, computer sciences, and environmental education.

ROC Army (1980-1981): Research Scientist

Conducted environmental surveys and evaluations.

HARDWARE

IBM 360/370., IBM 4341, IBM 4381, IBM PC/XT/AT, IBM PS/2 and compatibles, TI Professional, TI 59, TI 990, and Apple computer family

SOFTWARE

Wylber, Music, CMS, SAS, MS-DOS, CP/M, and various PC-based software systems such as Lotus 1-2-3, DBaseIII^{+}, plus different graphics and data communication utilities; languages used include FORTRAN, BASIC, PL/I, and Pascal

JANET SALYER EMRY

EDUCATION

M.S., geology, Old Dominion University, 1987
B.S. (cum laude), geology, James Madison University, 1983

EXPERIENCE

Three years' technical experience in the fields of hydrogeology and environmental science, including drilling and placement of wells, well monitoring, aquifer testing, determination of hydraulic properties, computer modeling of aquifer systems, and field and laboratory soils analysis.

EMPLOYMENT

Dynamac Corporation (1987-present): Staff Scientist/Hydrogeologist

Responsibilities include Preliminary Assessments, Site Investigations, Remedial Investigations, Feasibility Studies, and Emergency Responses to include providing geological and hydrological assessments of hazardous waste disposal/spill sites, determination of rates and extents of contaminant migration, and computer modeling of groundwater flow and contaminant transport. Projects are for the U.S. Air Force and Air National Guard Installation Restoration Program.

Froehling and Robertson, Inc. (1986-1987): Geologist/Engineering Technician

Performed both field and laboratory engineering soils tests.

The Nature Conservancy (1985-1986): Hydrogeologist

Investigated groundwater geology of the Nature Conservancy's Nags Head Woods Ecological Preserve in Dare County, North Carolina. Study included installing wells, monitoring water table levels, determination of hydraulic parameters through a pumping test, stratigraphic test borings, and computer modeling.

Old Dominion University (1983-1985): Teaching Assistant, Department of Geological Sciences

Taught laboratory classes in Earth Science and Historical Geology.

PROFESSIONAL AFFILIATIONS

Geological Society of America
National Water Well Association/Association of Ground Water Scientists and Engineers

PUBLICATION

Impact of Municipal Pumpage Upon a Barrier Island Water Table, Nags Head and Kill Devil Hills, North Carolina. *In:* Abstracts with Programs, Geological Society of America, Vol. 19, No. 2, February 1987.

KATHRYN A. GLADDEN

EDUCATION

B.S., chemical engineering (minor in biological sciences), University of Washington, 1978

SECURITY CLEARANCE

Secret DOD clearance

EXPERIENCE

Seven years of experience in hazardous waste consulting and plant process engineering. Experience includes development of engineering alternatives for reduction of in-plant effluents and preparation of RCRA background listing documents for the plastics industry.

EMPLOYMENT

Dynamac Corporation (1985-present): Staff Engineer

Performs studies on the feasibility of solvent recycling, including the evaluation of several alternatives. Studies to date have included 15 sites. For each site, prepared reports describing present practice for solvent use and disposal, and conducted economic analyses of options.

Conducted preliminary site investigations and ranking of hazardous waste sites for the U.S. Federal Bureau of Prisons. Prepared reports detailing site investigation findings and recommendations for Phase II monitoring and sampling.

Preparing statement of work for a Phase IV-A remedial action plan for the Air Force's Installation Restoration Program.

Conducted analysis of public comments on Advanced Notice of Public Rulemaking to establish National Primary Drinking Water Regulations for radionuclide contaminants.

Peer Consultants (1984-1985): Staff Engineer

Developed background documents for listing of RCRA hazardous wastes.

Engineering Science (1983-1984): Staff Engineer

Conducted regulatory policy review and technology assessment of transportation and decontamination procedures for acutely hazardous wastes. Project engineer for development of a cost analysis methodology for the U.S. Army Toxic and Hazardous Materials Agency Installation Restoration Program.

Weyerhaeuser Company (1978-1983): Chemical Engineer

Conducted plant environmental audits to develop in-plant effluent load balances; developed capital alternatives and improved operating procedures for in-plant effluent reduction; developed and implemented recommendations for plant energy conservation and process optimization programs; investigated industrial hygiene impacts of wood pyrolysis air emissions, and performed pilot trials for wood gasification and pyrolysis technology development.

PROFESSIONAL AFFILIATIONS

Tau Beta Pi Engineering Honorary
Society of Women Engineers

MARK D. JOHNSON

EDUCATION

B.S., Geology, James Madison University, 1980

EXPERIENCE

Eight years' technical and management experience including geologic mapping, subsurface investigations, foundation inspections, groundwater monitoring, pumping and observation well installation, geotechnical instrumentation, groundwater assessment, preparation of Air Force Installation Restoration Program Guidance, preparation of statements of work for environmental field monitoring and feasibility studies for the Air Force and the Air National Guard, development of environmental field monitoring programs, and preparation of Preliminary Assessments for the Air National Guard.

EMPLOYMENT

Dynamac Corporation (1984-present): Senior Staff Scientist/Geologist

Primarily responsible for developing and managing technical support programs relevant to CERCLA related activities for the Air Force, Air National Guard, Department of Justice and Coast Guard. These activities include Statements of Work for Site Investigations (SI), Remedial Investigations (RI), and Feasibility Studies (FS); assessing groundwater at hazardous waste disposal/spill sites for the purpose of determining rates and extents of contaminant migration and for developing SI and RI programs and identifying remedial actions; reviewing SI, RI and FS contractor work plans for various government clients, developing technical and contractual requirements for SI, RI and FS projects, managing the development and preparation of Preliminary Assessments, and assisting clients in the development of their environmental management programs, which included preparation of the Air Force's Installation Restoration Program Management Guidance document.

Bechtel Associates Professional Corporation (1981-1984): Geologist

Performed the following duties in conjunction with major civil engineering projects including subways, nuclear power plants and buildings: prepared geologic maps of surface and subsurface facilities in rock and soil including tunnels, foundations and vaults; assessed groundwater conditions in connection with construction activities and groundwater control systems; monitored the installation of permanent and temporary dewatering systems and observation wells; monitored surface and subsurface settlement of tunnels; and participated in subsurface investigations.

Schnabel Engineering Associates (1981): Geologist

Inspected foundations and backfill placement.

PROFESSIONAL CREDENTIALS

Registered Professional Geologist, South Carolina, #116, 1987

PROFESSIONAL AFFILIATIONS

Association of Engineering Geologists
National Water Well Association/Association of Ground Water Scientists and Engineers

RAYMOND G. CLARK, JR.

EDUCATION

Completed graduate engineering courses, George Washington University, 1957
B.S., Mechanical Engineering, University of Maryland, 1949

SPECIALIZED TRAINING

Grad. European Command Military Assistance School, Stuttgart, 1969
Grad. Army Psychological Warfare School, Fort Bragg, 1963
Grad. Sanz School of Languages, D.C., 1963
Grad. DOD Military Assistance Institute, Arlington, 1963
Grad. Defense Procurement Management Course, Fort Lee, 1960
Grad. Engineer Officer's Advanced Course, Fort Belvoir, 1958

CERTIFICATIONS

Registered Professional Engineer: Kentucky (#4341); Virginia (#8303); Florida (#36228)

EXPERIENCE

Thirty-one years of experience in engineering design, planning and management including construction and construction management, environmental, operations and maintenance, repair and utilities, research and development, electrical, mechanical, master planning and city management. Over six years' logistical experience including planning and programming of military assistance materiel and training for foreign countries, serving as liaison with American private industry, and directing materiel storage activities in an overseas area. Over two years' experience as an engineering instructor. Extensive experience in personnel management, cost reduction programs, and systems improvement.

EMPLOYMENT

Dynamac Corporation (1986-present): Program Manager/Department Manager

Responsible for activities relating to Preliminary Analysis, Site Investigations, Remedial Investigations, Feasibility Studies, and Remedial Action for the Installation Restoration Program for the U.S. Air Force, Air National Guard, Bureau of Prisons, and the U.S. Coast Guard, including records search, review and evaluation of previous studies; preparation of statements of work, feasibility studies; preparation of remedial action plans, designs and specifications; review of said studies/plans to ensure that they are in conformance with requirements; review of environmental studies and reports; preparation of Air Force Installation Restoration Program Management Guidance; and preparation of Part B permits.

Howard Needles Tammen & Bergendoff (HNTB) (1981-1986): Manager

Responsible, as Project Manager, for: design of a new concourse complex at Miami International Airport to include terminal building, roadway system, aircraft apron, drainage channel relocation, satellite building with underground pedestrian tunnel, and associated underground utility corridors, to include subsurface aircraft fueling systems, with an estimated construction cost of $163 million; a cargo vehicle tunnel under the crosswind runway with an estimated construction cost of $15 million; design and construction of two large corporate jet aircraft hangars; and for the hydrocarbon recovery program to include investigation, analysis, design of recovery systems, monitoring of recovery systems, and planning and design of residual recovery systems utilizing biodegradation. Participated, as sub-consultant, in Air Force IRP seminar.

HNTB (1979-1981): Airport Engineer

Responsibilities included development of master plan for Iowa Air National Guard base; project initiation assistance for a new regional airport in Florida; engineering assistance for new facilities design and construction for Maryland Air National Guard; master plan for city maintenance facilities, Orlando, Florida; in-country master plan and preliminary engineering project management for Madrid, Spain, International Airport; and project management of master plan for Whiting Naval Air Station and outlying fields in Florida.

HNTB (1974-1979): Design Engineer

Responsibilities included development of feasibility and site selection studies for reliever airports in Cleveland and Atlanta; site selection and facilities requirements for the Office of Aeronautical Charting and Cartography, NOAA; and onsite mechanical and electrical engineering design for terminal improvements at Baltimore-Washington International Airport, Maryland.

HNTB (1972-1974): Airport Engineer

Responsible for development of portions of the master plan and preliminary engineering for a new international airport for Lisbon, Portugal, estimated to cost $250 million.

Self-employed (1971-1972): Private Consultant

Responsible for engineering planning and installation of a production line for multimillion-dollar contract in Madrid, Spain, to fabricate transmissions and differentials for U.S. Army vehicles.

U.S. Army, Corps of Engineers (1969-1971): Chief, Materiel & Programs

Directed materiel planning and military training programs of military assistance to the Spanish Army. Controlled arrival and acceptance of materiel by host government. Served as liaison/advisor to American industry interested in conducting business with Spanish government. Was Engineer Advisor to Spanish Army Construction, Armament and Combat Engineers, also the Engineer Academy and Engineer School of Application.

Corps of Engineers (1968-1969): Chief, R&D Branch, OCE

Directed office responsible to Chief of Engineers for research and development. Developed research studies in new concepts of bridging, new explosives, family of construction equipment, night vision equipment, expedient airfield surfacing, expedient aircraft fueling systems, water purification equipment and policies, prefabricated buildings, etc. Achieved Department of Army acceptance for development and testing of new floating bridge. Participated in high-level Department Committee charged with development of a Tactical Gap Crossing Capability Model.

Corps of Engineers (1967-1968): Division Engineer

Facilities engineer in Korea. Was fully responsible for management and maintenance of 96 compounds within 245 square miles including 6,000+ buildings, 1 million linear feet of electrical distribution lines, 18 water purification and distribution systems, sanitary sewage disposal systems, roads, bridges, and fire protection facilities with real property value of more than $256 million. Planned and developed the first five-year master plan for this area. Administered $12 million budget and $2 million engineer supply operation. Was in responsible charge of over 500 persons. Developed and obtained approval for additional projects worth $9 million for essential maintenance and repair. Directed cost reduction programs that produced more than $500,000 savings to the United States in the first year.

Corps of Engineers (1963-1967): Engineer Advisor

Engineer and aviation advisor to the Spanish Army. Developed major modernization program for Spanish Army Engineers, including programming of modern engineer and mobile maintenance equipment. Directed U.S. portion of construction, testing and acceptance of six powder plants, one shell loading facility, an Engineer School of Application, and depot rebuild facilities for engineer, artillery, and armor equipment. Planned and developed organization of a helicopter battalion for the Spanish Army. Responsible for sales, delivery, assembly and testing of 12 new helicopters in country. Provided U.S. assistance to unit until self-sufficiency was achieved. Was U.S. advisor to Engineer Academy, School of Application and Polytechnic Institute.

Corps of Engineers (1960-1963): Deputy District Engineer

Responsible for planning and development of extensive construction projects in the Ohio River Basin for flood control and canalization, including dam, lock, bridge, and building construction, highway relocation, watershed studies, real estate acquisitions and dispositions. Was contracting officer for more than $75 million of projects per year. Supervised approximately 1,300 personnel, including 300 engineers. Planned and directed cost reduction programs amounting to more than $200,000 per year. Programmed and controlled development of a modern radio and control net in a four-state area.

Corps of Engineers (1959-1960): Area Engineer

Directed construction of a large airfield in Ohio as Contracting Officer's representative. Assured that all construction (runway, steam power plant, fuel transfer and loading facilities, utilities, buildings, etc.) complied with terms of plans and specifications. Was onsite liaison between Air Force and contractors.

Corps of Engineers (1958-1959): Chief, Supply Branch

Managed engineer supply yard containing over $21 million construction supplies and engineer equipment. Directed in-storage maintenance, processing and deprocessing of equipment. Achieved complete survey of items on hand, a new locator system and complete rewarehousing, resulting in approximately $159,000 savings in the first year.

Corps of Engineers (1957-1958): Student

U.S. Army Engineer School, Engineer Officer's Advanced Course.

Corps of Engineers (1954-1957): Engineer Manager

Managed engineer construction projects and was assigned to staff and faculty of the Engineer School. Was in charge of instruction on engineer equipment utilization, management and maintenance. Directed Electronic Section of the school. Coordinated preparation of five-year master plan for the Department of Mechanical and Technical Equipment.

Corps of Engineers (1949-1954): Engineer Commander

Positions of minor but increasing importance and responsibility in engineering management, communications, demolitions, construction administration and logistics.

PROFESSIONAL AFFILIATIONS

Member, National Society of Professional Engineers
Fellow, Society of American Military Engineers
Member, American Society of Civil Engineers
Member, Virginia Engineering Society
Member, Project Management Institute

APPENDIX B

OUTSIDE AGENCY CONTACT LIST

OUTSIDE AGENCY CONTACT LIST

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U.S. Geological Survey
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APPENDIX C

USAF HAZARD ASSESSMENT RATING METHODOLOGY AND GUIDELINES

USAF HAZARD ASSESSMENT RATING METHODOLOGY

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

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

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Preliminary Assessment 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 U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DoD program needs.

The model uses data readily obtained during the Preliminary Assessment 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 flow chart (Figure 1 of this report). The site rating form and the rating factor guideline are provided at the end of this appendix.

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

The receptors category rating is based on four rating factors: the potential for human exposure to the site, the potential for human ingestion of contaminants should underlying aquifers be polluted, the current and anticipated uses of the surrounding area, and 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 1,000 feet of the site, and the distance between the site the 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 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 (0-3) 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 stages. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The 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 together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Scores for sites with no containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

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

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

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

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)	S = Suspected confidence level
o Verbal reports from interviewer (at least 2) or written information from the records	o No verbal reports or conflicting verbal reports and no written information from the records
o Knowledge of types and quantities of wastes generated by shops and other areas on base	Logic based on the 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 be[illegible] 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
60	S	C	H
	M	C	M
	L	S	M
50	L	C	L
	M	S	H
	S	C	M
	S	S	H
40	M	S	M
	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, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

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

B-1 Potential for Surface Water Contamination

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (including drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to +20 inches	Greater than +20 inches	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1-year 24-hour rainfall (Number of thunderstorms)	<1.0 inch (0-5)	1.0 to 2.0 inches (6-35)	2.1 to 3.0 inches (36-49)	>3.0 inches (>50)	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 Ground-Water 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	8
Soil permeability	Greater than 50% clay ($<10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($>10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8

B-3 Potential for Ground-Water Contamination -Continued

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
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

Spills:

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

Surface Impoundments:

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

Fire Protection Training Areas:

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

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

APPENDIX D

PHOTOGRAPHS

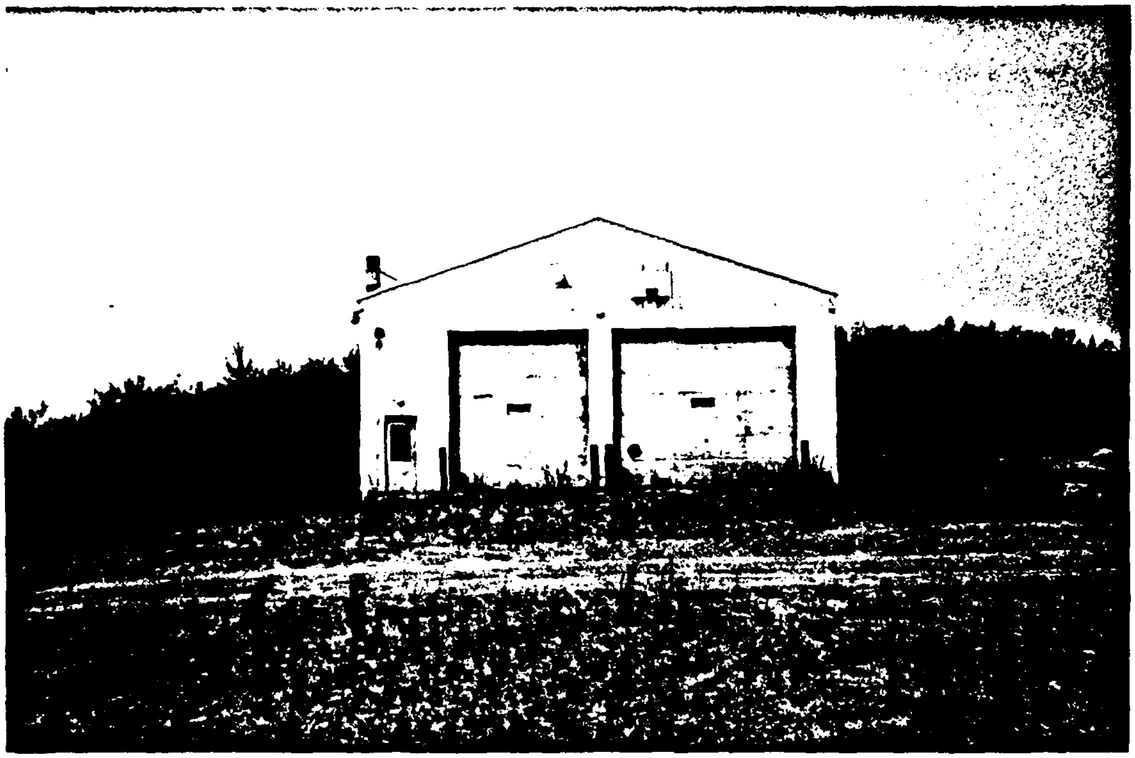

Photo 1. Vehicle maintenance shop at Bear Creek RRS.

Photo 2. Interior of vehicle maintenance shop.

Photo 3. Electrical equipment remaining within the radio relay building.

Photo 4. Electrical equipment remaining with the radio relay building.

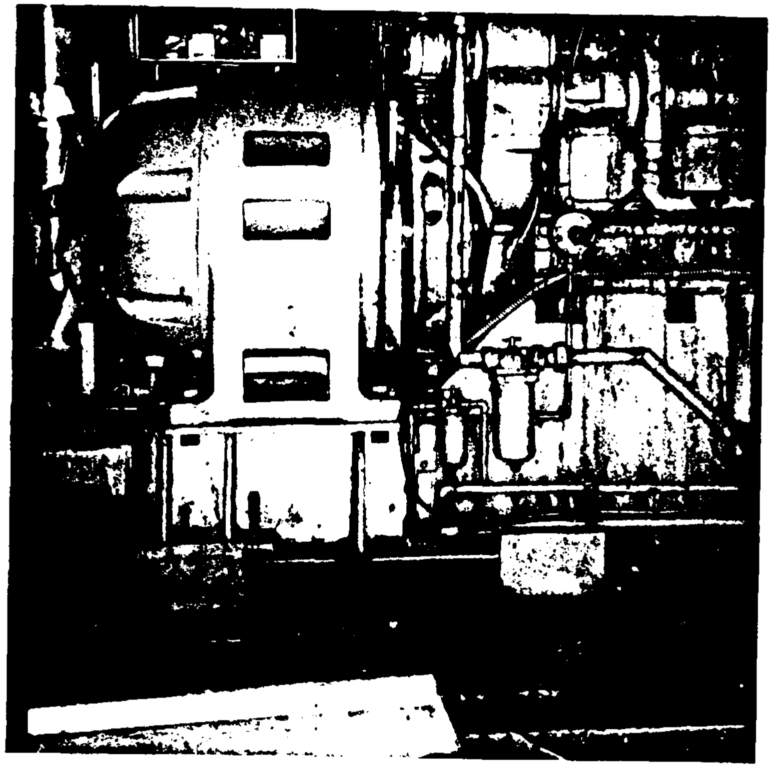

Photo 5. Generator within radio relay building. Note oil leaks around the base of the generator.

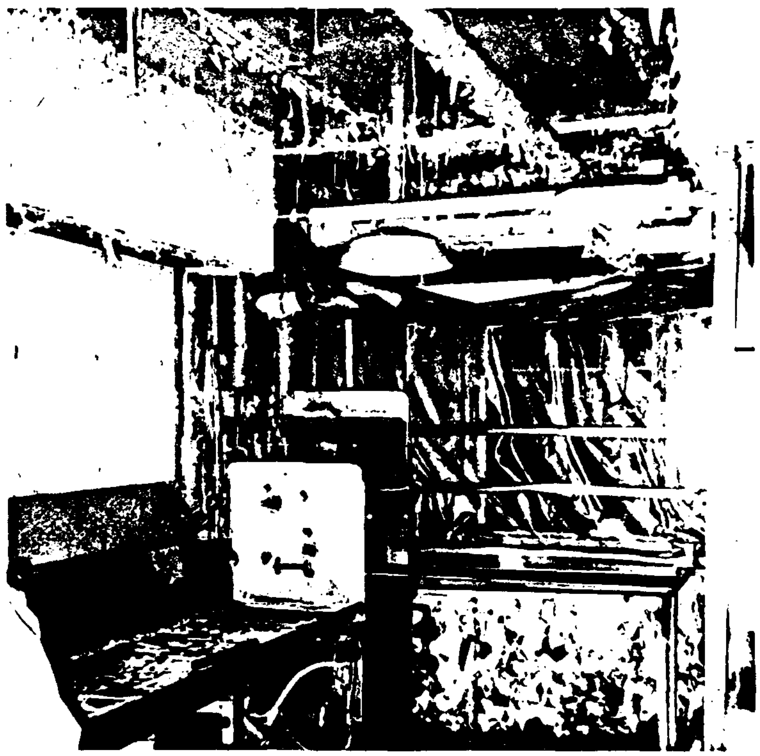

Photo 6. Paint scaling off the ceiling and walls of the kitchen.

Photo 7. Aboveground petroleum storage tanks.

Photo 8. Debris near dormitory building.

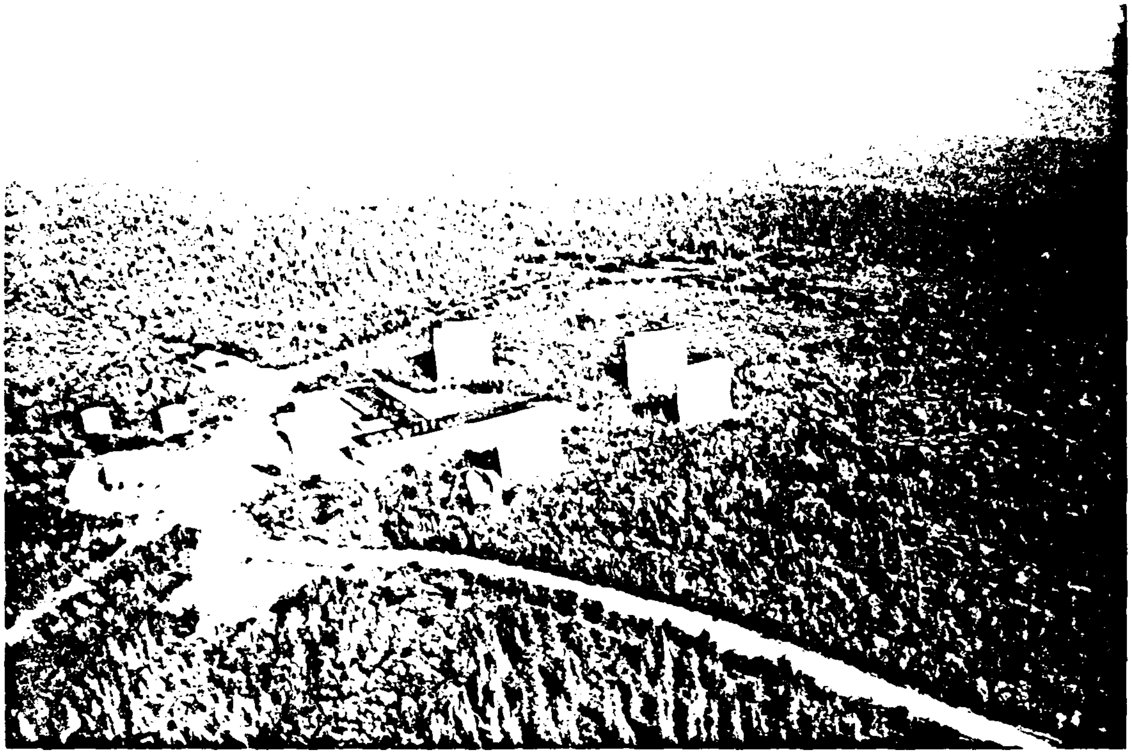

Photo 9. Aerial view of Bear Creek RRS. Note turn loop beyond facility.