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Task Order 2
Enhanced Preliminary Assessment

BENNETT ARMY NATIONAL GUARD FACILITY DENVER, COLORADO

Contract Number DAAA15-88-D-0007

January 1990

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Prepared for

U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland 21010-5401

Prepared by

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Report No. CETHA-BC-CR-89362

USATHAMA Task Order 2

ENHANCED PRELIMINARY ASSESSMENT REPORT

BENNETT ARMY NATIONAL GUARD FACILITY
DENVER, COLORADO

Contract No. DAAA15-88-D-0007

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January 1990

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19. An Enhanced Preliminary Assessment was conducted at the Bennett Army National Guard Facility (Bennett ANGF), which is planned for inclusion in the Base Closure Program. Bennett ANGF is a 242-acre facility located approximately 20 miles east of Denver, Colorado, in a rural section of Arapahoe County. Bennett ANGF is located in what was the southeastern corner of the old Lowry Air Force Bombing Range. During the early 1960s, the property was the site of an operational underground Titan ICBM complex. Since 1975 the surface of the property has been used for field exercises by units in the Colorado Army National Guard (CoARGN). No environmentally significant operations (ESOs) that would require immediate action were observed during the site visit on 17 October 1989 or during follow-up interviews. Soil samples are recommended for the five aboveground ESOs: the Sewage Stabilization Pond and Runoff Trench, Chemical Waste Clarifier, Ordnance, and Potential Waste Disposal Areas. Four monitoring wells are recommended near the perimeter of the facility. The objective of the soil samples and the monitoring wells is to detect possible contamination from past releases. Since the underground Titan ICBM complex could not be entered, specific sampling recommendations are not possible. The next stage of activity should be a thorough visual inspection of the entire complex.

DELETE APPENDICES A thru E per Mark Plank
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DISCLAIMER

This Enhanced Preliminary Assessment Report is based primarily on the environmental conditions observed at the Bennett Army National Guard Facility on 17 October 1989. Past site conditions and management practices were evaluated, based on readily available records and the recollections of people interviewed. Every effort was made, within the scope of the task, to interview all identified site personnel, especially those personnel with a historical perspective of site operations.

No environmental sampling was conducted as part of the assessment. The findings and recommendations for further action are based on WESTON's experience and technical judgment, as well as current regulatory agency requirements. Future regulations as well as any modifications to current statutes may affect the compliance status of this site.

WESTON does not warrant or guarantee that the property is suitable for any particular purpose or certify any areas of the property as "clean." A more thorough investigation, including intrusive sampling and analysis for specific hazardous materials, is recommended prior to reporting this property as excess.

WESTON

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Executive Summary

EXECUTIVE SUMMARY

BACKGROUND AND PROCEDURES

This Enhanced Preliminary Assessment (PA) report has been prepared by Roy F. Weston, Inc. (WESTON) at the request of the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) pursuant to Contract DAAA15-88-D-0007, Task Order 2. The purpose of the PA report is to present WESTON's findings as to the environmental conditions at the Bennett Army National Guard Facility (Bennett ANGF) located in Arapahoe County, Colorado.

The objectives of the PA were to:

- Identify and characterize environmentally significant operations (ESOs) associated with the historical and current use of the Bennett ANGF.
- Identify and characterize possible impacts of the ESOs on the surrounding environment.
- Identify additional environmental actions, if any, that should be implemented for the ESOs identified.

Information contained in this PA report was obtained through:

- Visual inspection of the facility.
- Review of available information from the current and former property owners, the U.S. Army and the U.S. Air Force, and the current lessor, the Colorado Army National Guard (CoARNG).
- Review of related regulatory agency files at the state and federal levels.
- Interviews with available personnel associated with the facility.

ENVIRONMENTALLY SIGNIFICANT OPERATIONS

Bennett ANGF is a 242-acre facility that the U.S. Army has leased to CoARNG since 1 January 1978. The property is located 20 miles east of Denver, Colorado.

Through the 1940s and until 1958, the facility was part of the Lowry Air Force Bombing Range, a reservation used for aerial gunnery and bombing practice. In July 1958, construction of an underground Titan missile complex began. The Titan facility was operational from October 1961 to May 1965. From 1965 to 1975 the Bennett facility was inactive. Since 1975, CoARNG has used the property for helicopter drop training and routine field exercises.

ESOs identified on the property include:

- Wastewater discharges. The discharges include the sewage stabilization ponds used for sanitary waste and a chemical waste clarifier for the underground missile complex. Both discharged waste to the Kiowa Creek through arroyos.

- Seal chambers. Conflicting information was received regarding the function of the seal chambers. One person interviewed reported that five seal chambers at the Titan complex were used to eject an unknown waste stream that seeped into the ground. Others contacted felt that these units were part of the ventilation system.

- Ordnance. The property is part of a former bombing range and is located approximately one mile from documented impact areas. Few bombs, if any, are expected to have landed in this particular area, which was probably swept for ordnance prior to construction of the Titan complex.

- Potential polychlorinated biphenyls (PCBs) in transformer oil. Two units mounted on one pole were identified. Both have been destroyed by vandals. Residual oil may still be in the transformers, although most of the oil is expected to have seeped into the soil.

- Potential waste sites. Twenty-three potential ESOs were identified and analyzed by the Environmental Photographic Interpretation Center (EPIC) from aerial photographs taken between 1963 to 1975. These ESOs included mounded material, pits, trenches, containers, tanks, and ground stains. The waste materials associated with these areas are unknown.

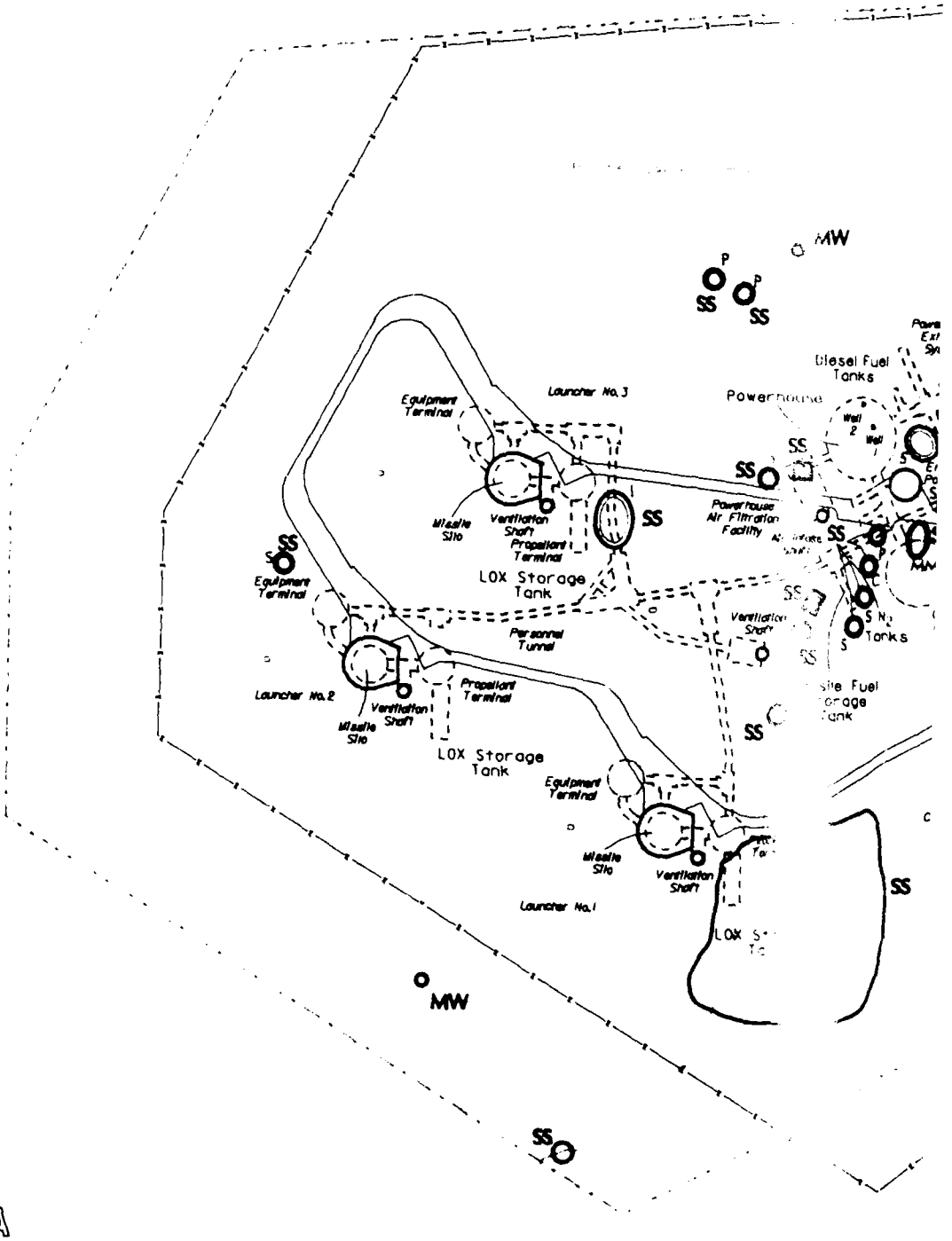
- The Titan missile complex. This underground facility is strewn with discarded materials including insulation that may contain asbestos. It was reported that some oily material was smeared in one area of the facility. Many of the storage tanks present when the facility was operational, are still present. Several sections, including the power house, equipment terminals, propellant terminals, and the missile silos, are partially submerged in water.

Figure ES-1 is a site plan of the Bennett facility with the identified ESOs marked

HUMAN AND ENVIRONMENTAL RECEPTORS

The Bennett ANGF area is sparsely populated and is used mainly for farming and raising livestock. No wetlands, floodplains, or endangered species were identified in the area.

Groundwater is used for domestic drinking, livestock, and irrigation. The nearest well is one-quarter mile from the facility. There are approximately 75 active wells within 2 miles of the installation. Active well depths in the area range from 28 ft to 630 ft.



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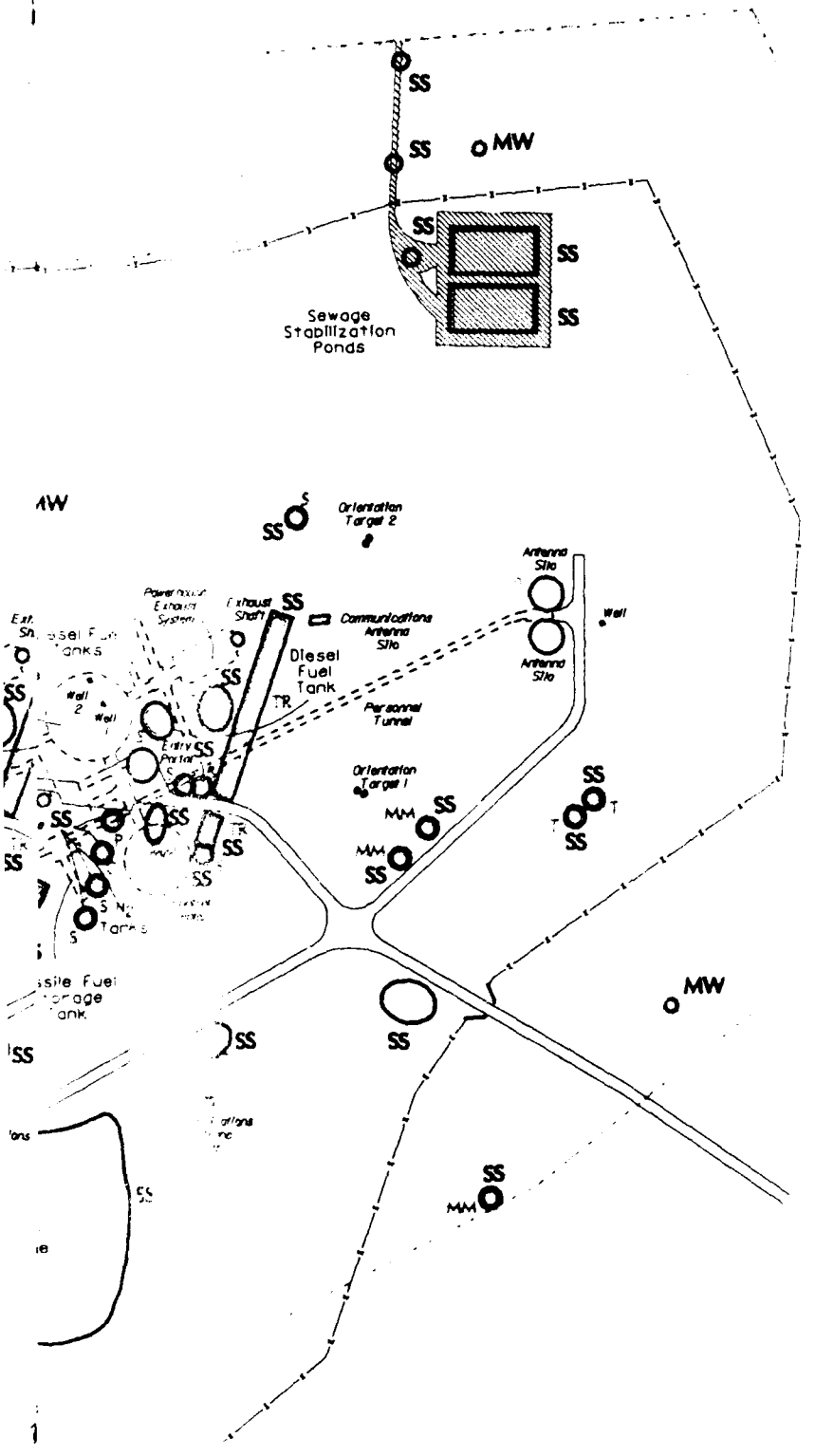
U. S. Army
Base Closure Preliminary Assessment
Bennett Army National Guard Facility
Bennett, CO - November 1989

Figure ES-1 Property Information Composite

Compiled in 1989 from various sources provided by the U.S. Army Toxic and Hazardous Materials Agency



ENVIRONMENTALLY SIGNIFICANT OPERATIONS

- Potential Waste Site
- Transformer
- Chemical Waste Clarifier
- Underground Complex
- Wastewater Ponds and Runoff Trench
- Seal Chamber
- Mounded Material
- SL Standing Liquid
- FA Fill Area
- I Impoundment
- C Container
- T Tank
- S Stain
- TR Trench
- P Pit

RECOMMENDED SAMPLING METHODS

- SS Surface Soil
- MW Monitoring Well

A number of normally dry arroyos convey runoff from the property to the Kiowa Creek, which is normally a dry streambed. After a rainstorm or a snowmelt, the water can be used by livestock and wildlife.

CONCLUSIONS AND RECOMMENDATIONS

No environmental conditions were observed on the property that appear to present an immediate, substantial threat to human health or the environment. However, the ESOs discussed in this report have the potential to affect human health and the environment. The recommendations concerning each ESO follow and are summarized in Table ES-1. Recommended sampling locations are shown in Figure ES-1.

It is recommended that four ground monitoring wells be installed. These wells should be distributed near the perimeter of the facility. Samples from these wells should be analyzed initially for volatile organic compounds (VOCs), base neutral acid extractables (BNAs) Resource Conservation and Recovery Act (RCRA) metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, PCBs, and total petroleum hydrocarbons (TPHs). The integrity of existing wells should also be checked. These wells should be sampled and analyzed for VOCs, BNAs, RCRA Metals, PCBs, and TPHs to determine if any cross contamination has occurred.

Wastewater Discharges

Soil samples should be collected from the sewage stabilization ponds, the runoff trench and the chemical waste clarifier. Both the runoff trench and the chemical waste clarifier discharged their effluent offsite.

Seal Chambers

When the complex is inspected, the seal chambers should be investigated more closely to ascertain their function. At that time, an attempt should be made to open the seal chambers from the surface. In addition, a review of the construction records for the facility should be performed.

Ordnance

A records search should be conducted to verify that the facility was cleared of ordnances.

Transformers

Soil samples should be collected around the base of the pole, where the two transformers are located, and analyzed for PCBs.

Potential Waste Sites

Soil samples should be collected at each potential waste site. Four groundwater monitoring wells should be installed to screen these sites.

Table ES-1

ESOs Identified at Bennett ANGF and Recommendations for Further Action

ESO	Concern	Recommended Activity	Number of Samples Recommended	Location	Sample Type	Analysis
Sewage Stabilization Ponds and Runoff Trench	Solvents, fuels, metals	Site investigation	4	2 composites from each pond	Soil	RCRA Metals,* TPHs, BNAs
			3	Along trench	Soil	RCRA Metals, TPHs, BNAs
Chemical Waste Clarifier	Solvents, fuels, metals	Site investigation	1	Composite from location of former clarifier	Soil	RCRA Metals, TPHs, BNAs
			3	Along trench	Soil	RCRA Metals, TPHs, BNAs
Seal Chambers	Unknown	Site investigation Records Search				
Transformers	PCBs	Site investigation	1	Composite from base of pole	Soil	PCBs
Potential Waste Sites	Solvents, fuels, metals	Site investigation	1/site	Composite from each potential site	Soil	RCRA Metals, TPHs, BNAs
Ordnance	UXO Explosive material	Site investigation Records Search				
Control Center	Unknown	Confined space inspection	1/site	Each pool of standing water	Grab	VOCs, TPHs, RCRA Metals, BNAs, pH
Powerhouse Area	Unknown	Confined space inspection	1/site	Each pool of standing water	Grab	VOCs, TPHs, RCRA Metals, BNAs, pH
Launch Areas	Unknown	Confined space inspection	1/site	Each pool of standing water	Grab	VOCs, TPHs, RCRA Metals, BNAs, pH
		Site investigation	4	Distributed along perimeter of property	Wells	VOCs, RCRA metals, TPHs, PCBs, BNAs
	Asbestos	Site investigation		Entire complex	Asbestos Survey	Asbestos

*RCRA metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver.

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Titan Missile Complex

This underground complex should undergo a thorough visual inspection. An asbestos survey should be completed and the pools of water in the underground Titan complex also should be sampled. After the complex is inventoried, a more thorough series of sampling recommendations may be proposed.

Section 1
Introduction

SECTION 1

INTRODUCTION

1.1 BACKGROUND

Roy F. Weston, Inc. (WESTON) has been retained by the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) to conduct waste site characterizations of specific army properties under the authority of Contract DAAA15-88-D-0007, Task Order 2. This work is being performed within the scope of the U.S. Army Installation Restoration Program (IRP). As part of this contract, WESTON also has been asked to prepare enhanced preliminary assessment reports of selected properties destined to be included as part of the Base Closure Program. The purpose of these reports is to provide WESTON's findings as to the environmental conditions at the properties and to provide recommendations for further action. The recommendations will serve as a guide to the U.S. Army in prioritizing the activities necessary to report the properties as excess.

This document discusses the enhanced preliminary assessment (PA) of the Bennett Army National Guard Facility (Bennett ANGF), a former Titan missile complex located 20 miles east of Denver, Colorado. A site visit was performed on 17 October 1989.

1.2 OBJECTIVES

This enhanced PA report was prepared using existing information obtained from property records and personnel familiar with the Bennett ANGF property. No sampling activities were completed as part of the assessment. The objectives of the PA were to:

- Identify and characterize the environmentally significant operations (ESOs) associated with the historical and current use of the Bennett ANGF property.
- Identify and characterize possible impacts of the ESOs on the surrounding environment.
- Identify additional environmental actions, if any, that should be initiated for the ESOs identified.

Certain issues have been excluded from consideration as ESOs for the purposes of this report. First, painted surfaces will not be identified as ESOs solely because there is a potential for their containing lead. Second, drinking water will not be designated as an ESO solely because there is a potential for lead contamination due to piping solder or piping materials. Third, the presence of radon gas in buildings will not be considered as an ESO. A radon survey of all buildings will be performed utilizing the guidelines set forth in the Army Radon Program.

1.3 PROCEDURES

The information contained in this enhanced PA report is based on the following data-gathering activities:

- Visual inspections of the facility.
- Review of available Army documentation.
- Review of U.S. Environmental Protection Agency (EPA) Region VIII files.
- Contact with the Colorado Department of Health.
- Interviews with persons associated with Bennett ANGF or the former Titan Intercontinental Ballistic Missile (ICBM) complex.

No sampling or analysis was conducted as part of the investigation. The former Titan missile complex was not entered during the site visit.

1.4 REPORT FORMAT

This enhanced PA report presents an evaluation of the relevant data for the Bennett ANGF site.

Section 2 describes the property and the surrounding environment and land uses. Section 3 identifies and characterizes all ESOs related to known and suspected releases to the environment. The potential impact of these operations on the local environment and human receptors is discussed in Section 4. Section 5 summarizes the findings and conclusions, discusses the quality and reliability of the supporting information, identifies areas requiring further action, and suggests how such actions may be accomplished. Section 6 lists the pertinent materials reviewed and the agencies that were contacted. Photographs of the items that were investigated for this assessment are provided in Section 7. Supporting documentation is provided in Appendices A through E.

References are presented throughout this report, where appropriate, by means of a letter and number designation in brackets, as follows: I refers to direct interviews; T refers to telephone conversations; and R refers to reports or other written documents. The number following the letter refers to the specific item in the respective lists provided in Section 6.

Section 2
Property Characterization

SECTION 2

PROPERTY CHARACTERIZATION

2.1 GENERAL PROPERTY INFORMATION

Bennett ANGF is located in the southeastern corner of the former Lowry Air Force Bombing Range. In the 1940s and 1950s, the Air Force conducted air-to-ground gunnery and bombing practice. During the early 1960s the property housed a Titan ICBM complex. Since 1975, the Colorado Army National Guard (CoARNG) has used the grounds for training. In 1978, the property was transferred to the U.S. Army. Figure 2-1 is a site location map. A property information summary is presented in Table 2-1. A chronology of the site is presented in Table 2-2.

2.2 HISTORY AND DESCRIPTION OF FACILITIES

On 18 November 1940, the City and County of Denver donated land to the Department of War to establish an area suitable for an aerial gunnery and bombing range. This area was known as the Lowry Air Force Bombing Range. Operations were discontinued in 1958. On 24 May 1963, the majority of the Lowry Air Force Bombing Range was cleared for unrestricted use; however, property comprising the Bennett facility was not certified free of ordnance (Appendix A).

Bombing practice on the Lowry Air Force Bombing Range was discontinued in part to permit construction of four separate launch complexes for the Titan ICBM. One of these launch complexes is the Bennett facility, initially known as 2A. The facility was built of heavily reinforced concrete and was buried underground. This construction provided the facility with the ability to withstand the high explosive pressures that would be experienced during a "near-miss" nuclear detonation.

The Bennett facility was closed and the missiles removed in May 1965. On 1 July 1971, the General Services Administration (GSA) assumed responsibility for the facility. The equipment was offered for bid on salvage rights and the contract was awarded to Desert Salvage, Inc. [R-6]. Before the salvage operation could be completed, Desert Salvage, Inc. entered bankruptcy and the project was closed. Much of the salvageable equipment remained [I-1].

On 17 December 1974, the property was reported as excess and CoARNG expressed an interest in the property. On 25 September 1975, a Right-of-Entry, renewable every six months, was granted to CoARNG by the Department of the Army. The property remained in that status until 1 January 1978 when the Army leased the property for 5 years to CoARNG. Ownership of the property was not transferred to the Army until 16 January 1978.

CoARNG has used the property for unit training including helicopter drop training and routine field exercises. Weapons training has not been allowed, and no helicopter maintenance or refueling activities have occurred at the site [I-2; R-12]. CoARNG was authorized to use only the surface of the property; no official activities were allowed in the underground complex.

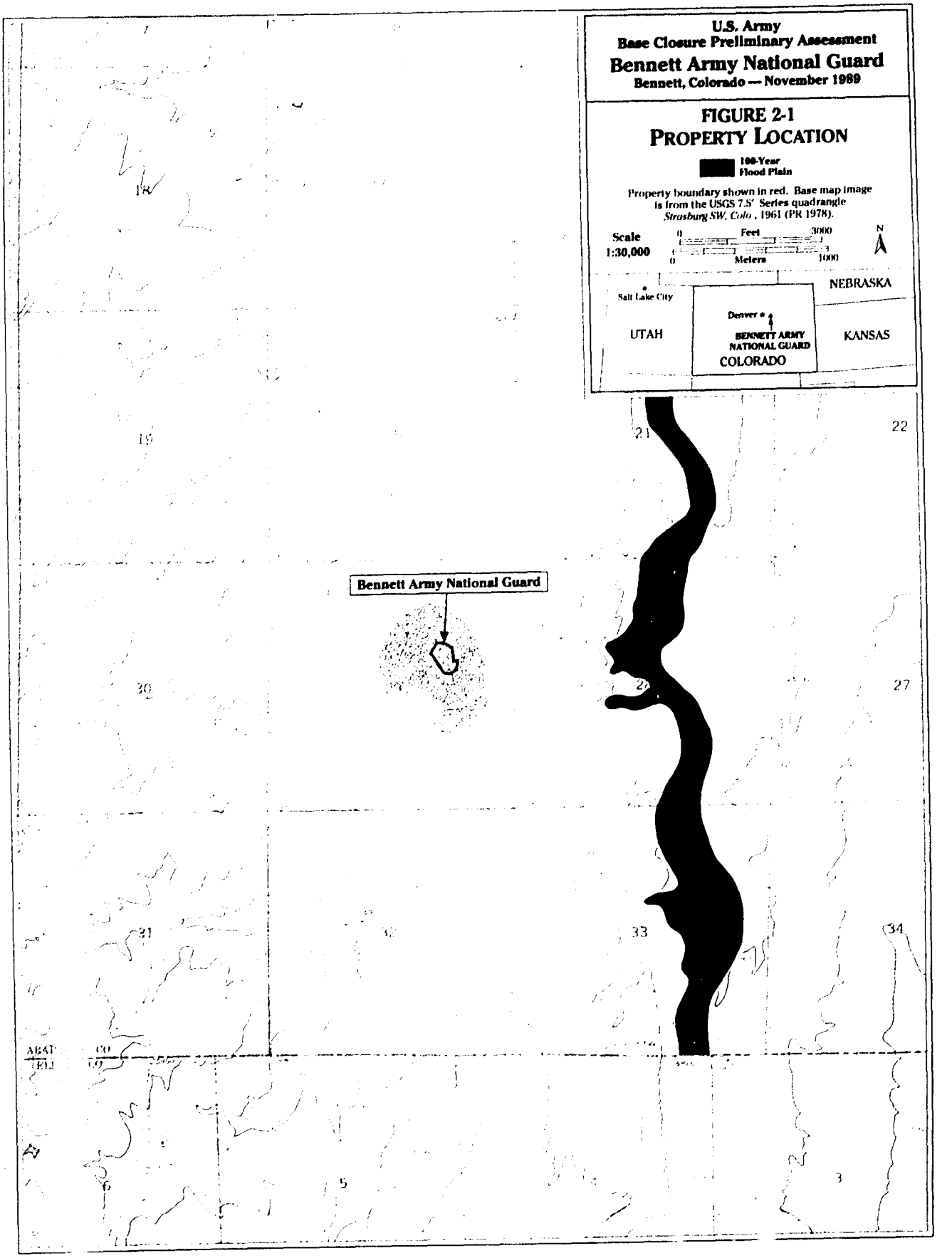

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Table 2-1

Property Information Summary

Name:	Bennett Army National Guard Facility
Property Number:	08015
Command:	U.S. Army Corps of Engineers - Omaha District
Location:	The facility is sited approximately 20 miles east of Denver, Colorado.
Installation Coordinates:	39°35'N 104°28"W
Mission:	The facility is currently leased to the Colorado Army National Guard.
Operations:	The Colorado Army National Guard uses the property for the training of National Guard units. In the past, the National Guard has used the property for helicopter and night exercises.

Table 2-2

History of Bennett ANGF

18 November 1940	Property donated to U.S. Government by the City and County of Denver, Colorado.
1941-1958	Lowry Air Force Bombing Range used for gunnery and bombing practice.
1 July 1959	Construction of Titan ICBM complex commenced.
October 1961	Titan facility became active.
May 1965	Titan facility closed; missiles removed.
22 June 1971	Equipment offered for bid on salvage rights.
1 July 1971	General Services Administration assumed responsibility for facility.
14 September 1971	Bid for salvage awarded to Desert Salvage, Inc.
1972	Salvage operation not completed. Desert Salvage, Inc. entered bankruptcy.
17 December 1974	Property reported as excess.
25 September 1975	Right-of-Entry granted to Colorado Army National Guard; renewable every six months.
1 January 1978	Facility leased by the Department of the Army to the Colorado Army National Guard for 5 years.
16 January 1978	Ownership of property assigned to the Department of the Army.
1 January 1983	Property leased by the Department of the Army to the Colorado Army National Guard for 25 years.

There is evidence that since 1983 vandals have entered the Titan complex. In March 1987, a compliance inspection of the property by the Corps of Engineers revealed that:

> "Cover to the entrance port on the main silo was pried open and the silo entered by unknown persons. Inspection of the main silo revealed drawings (satanic words and symbols) on the walls and trash deposited at the bottom of the silo (cans, bottles, and paper containers). It appears that a cult . . . are using the silo . . . The open shaft next to the stairs represents a dangerous hazard."
>
> "The area surrounding the silos are littered with trash (cans, bottles, broken glass and waste paper products)."
>
> "The adjacent property owners . . . that groups of people came out to the site every weekend and at other times during the week to party. The trespassers are rowdy and sometimes destroy private property." [R-7]

Response units from CoARNG have searched accessible sections of the Titan complex. Subsequently, entry ways were blocked (photo 1).

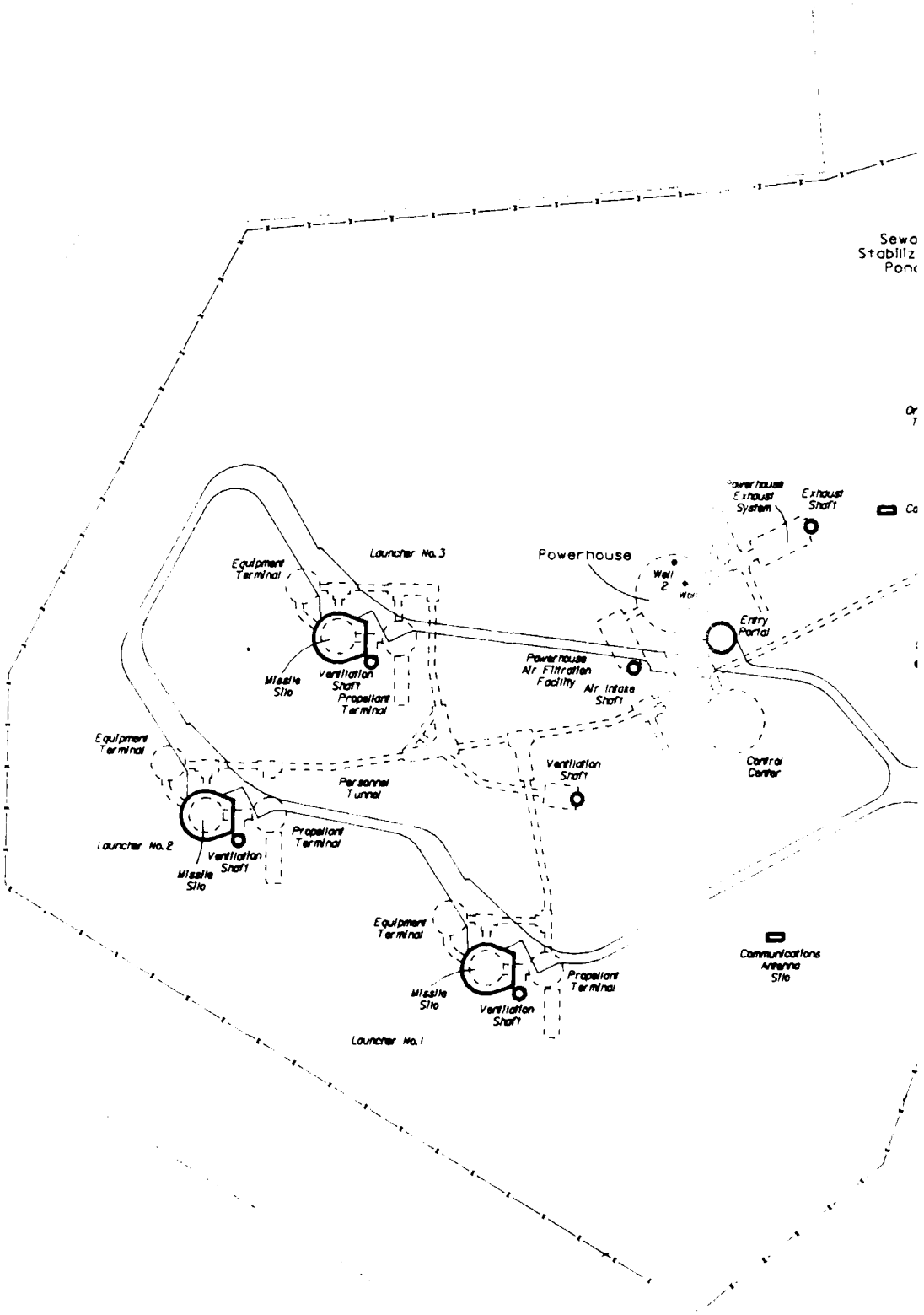
2.2.1 LAUNCH COMPLEX

The underground launch complex can be divided roughly into three operational subgroups: the Powerhouse, the Control Center, and the Launch Areas (Figure 2-2) (Appendix B, p. 2, 3). The following description is based on the report entitled The 451st Strategic Missile Wing and the Titan Launch Complexes [R-1].

Powerhouse

The powerhouse provided electric power, heat, air conditioning, and water for the facility (Appendix B, p. 4). This dome-shaped structure, with walls from 12 in. to 30 in. thick, is 120 ft in diameter and 46 ft high. To strengthen the concrete structure, over 190 miles of prestressed wire was wrapped around the base of the powerhouse.

Four large diesel generators, each capable of producing approximately 1,000 kilowatts of electric power, were located on the first level. The powerhouse had two large air conditioning units, each with a 250-ton capacity to provide the necessary air to cool these generators. Three supplemental ice banks were installed on the first floor as a backup for this equipment, with each bank holding 30,000 lbs of ice. The resulting cool air was used to reduce the temperature within the powerhouse and in the guidance equipment in the launch control center. Heat produced by the generators was used to provide hot water throughout the complex and to heat various facilities. Also included on this first level were the water filtration equipment and water and fuel pumps.



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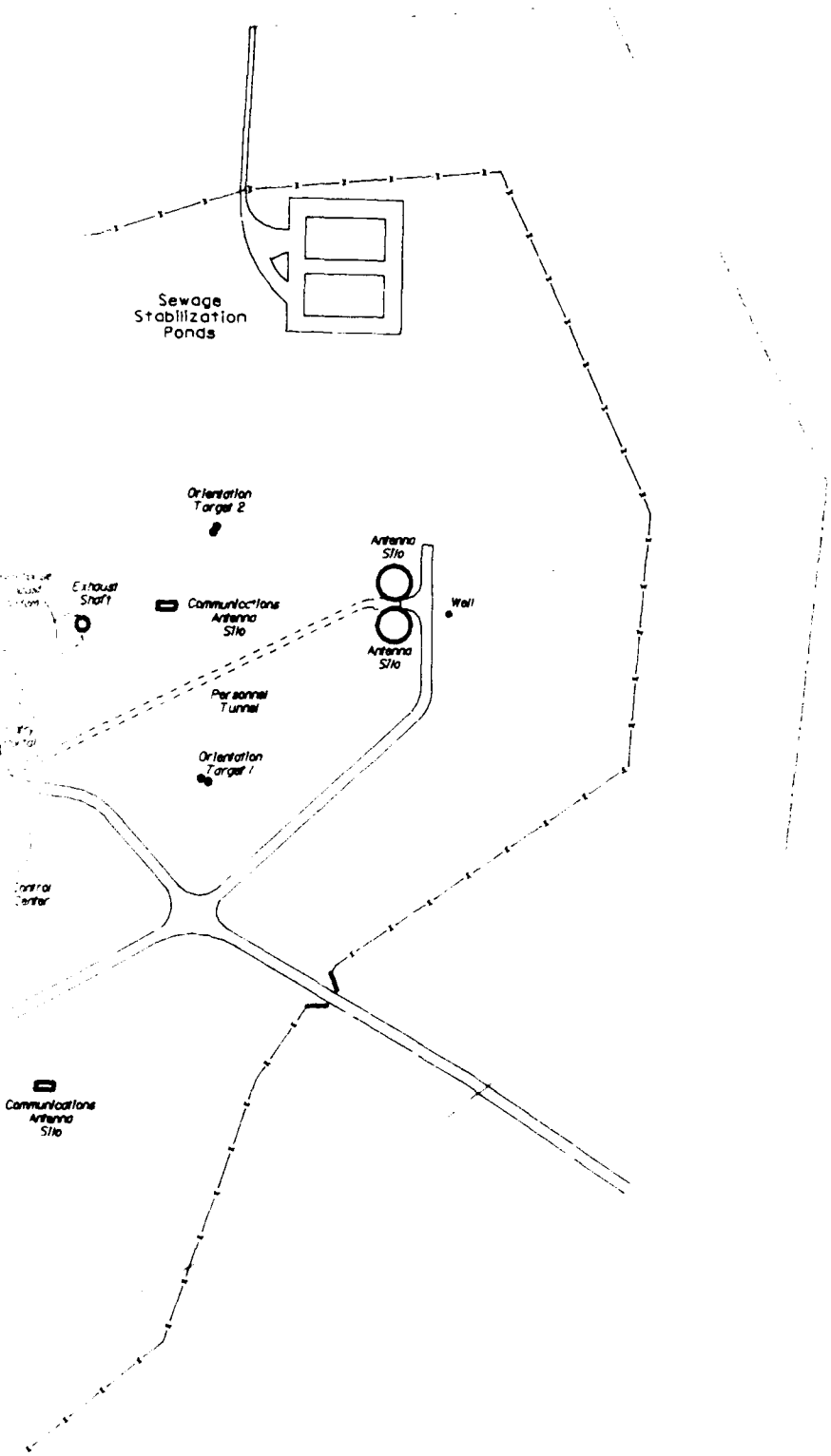
Army Toxic and Hazardous Materials Agency

U. S. Army
Base Closure Preliminary Assessment
Bennett Army National Guard Facility
Bennett, CO - November 1989

Figure 2-2
Site Plan

Compiled in 1989 from various sources provided by the U.S. Army Toxic and Hazardous Materials Agency



N

0 meters 80

0 feet 300

The domestic water facilities consisted of chlorinators, tanks, and pumps. Located beneath the powerhouse are two wells, each about 1,800 ft deep. These wells provided water for the entire complex.

Adjacent to the powerhouse were a number of storage tanks. These included two diesel fuel tanks, each with a capacity of 67,000 gal for operating the generators, water storage tanks with a total capacity of 60,000 gal, and one fuel tank holding 40,000 gal of RP-1 missile fuel. RP-1 is a kerosene-alcohol based propellant. There was also one 5,000-gal diesel fuel tank, called the "start tank," that provided the fuel to start the generators.

During salvage operations, both 67,000-gal diesel fuel tanks were removed. The other tanks are still in place and assumed empty, although the 5,000-gal diesel tank is open and there is a noticeable odor of fuel oil [I-1].

Control Center

The launch control center was the command center of the entire missile complex. It is a two level, dome-shaped structure, slightly smaller than the powerhouse. Its inside dimensions are 105 ft in diameter at the first floor level and 85 ft at the upper level. The lower level housed the living and working areas and was divided into ready rooms, dining hall and kitchen, air conditioning and electrical equipment rooms, and an equipment maintenance ready room. The top level contained various consoles, time display and status boards, and electronic and communications equipment. This equipment controlled and monitored the operations within the complex and was capable of giving an immediate visual status of the weapon system's state of readiness.

Associated with the control center, yet separated from the rest of the complex, are two antenna silos 27 ft in diameter and 71 ft high. The equipment in each silo was identical, with one used as backup for the other in the event one was destroyed or rendered inoperative.

Launch Areas

The Titan installation was equipped with three identical launch areas. Each launch area can be divided into three subareas: the propellant terminal, the equipment terminal, and the missile silo (Appendix B, p. 6, 7, 9, 10).

The propellant terminal is a two-level, silo-type structure 47 ft high and 40 ft in diameter. Liquid nitrogen and helium were stored here to provide the pressure to load the fuel and liquid oxygen (LOX) aboard the missiles. Also located within this terminal were the LOX and helium subcoolers and the LOX sump. The LOX subcooler was a large tank through which the liquid oxygen passed and was cooled by the colder liquid nitrogen prior to being loaded into the missiles. The purpose of the helium cooler was to cool the helium, which was then pumped into the LOX tanks to provide the necessary pressure to prevent fuel sloshing in the tanks.

The first level of the propellant terminal contained the LOX sump pumps and a drainage facility for the liquid oxygen overflow. In addition, there were nine clusters of nitrogen and helium tanks that extended upwards into the second level and one 3,500-gal tank that contained sulfuric acid. No other major equipment was present on the second level.

Adjacent to the propellant terminal was a 26,000-gal LOX storage tank. Reportedly during the salvage operations, all LOX storage tanks and the other miscellaneous tanks found on the first floor of the three propellant terminals were removed. All that remains are the three tanks that contained sulfuric acid.

Like the propellant terminal, the equipment terminal is a silo-shaped structure located next to the missile silo. This structure stored much of the equipment used to prepare and launch the missiles. It consists of four levels and is 62 ft high and 43 ft in diameter. The first was called the powerpack room and contained the launcher logic racks, which provided automatic checkout of the launcher equipment and the hydraulic equipment used to raise and lower the missile launch platform. The second level contained the air conditioning unit which maintained proper temperature and humidity in the silo. The third level distributed electric power for the ground operating equipment, missile electrical system, ground hydraulic power unit, and the missile air conditioning system. Also located on this third level were the fuel loading and unloading equipment. On the fourth level, the power produced by the four diesel generators in the powerhouse was stepped down from 2,400 volts to 480 volts. The electrical transformers were reportedly removed during the salvage operation.

The missile silo is that portion of the launch complex in which the missile was housed during its prelaunch period. It measures 163 ft from ground level to the base of the foundation and has an inside diameter of 40 ft. The foundation is 8 ft; the walls vary in thickness from 2 ft to 11 ft. On top of the missile silo are two 116-ton doors that were raised and lowered hydraulically (photo 2).

Since all of the facilities that make up the missile launch complex were spread out underground, a series of personnel and utility tunnels was necessary to permit movement of personnel and to provide access to all parts of the site. These tunnels were built of corrugated steel sections 9.5 ft in diameter. Located about 45 ft underground, they provide almost 2,100 ft of passageways. Another purpose of the tunnels was to provide a passageway for about 3 miles of utility pipes and over 3 million ft of power lines and electronic cables [R-1].

2.2.2 GENERATION AND DISPOSAL OF WASTES

No onsite waste disposal was reported to have occurred from CoARNG activities. The only waste produced since 1975 has been as a result of routine training activities. Any waste generated during these training sessions has been removed and disposed of offsite.

During operation of the Titan complex, sanitary wastewater was discharged into two sewage stabilization ponds located in the southeastern corner of the property. The effluent was conveyed by a drainage ditch that discharged to an intermittent stream which led to Kiowa Creek (photo 3).

A chemical waste clarifier was installed to handle an unknown waste stream from the complex. The effluent from the clarifier was conveyed by a trench that drained to an intermittent stream. This stream ultimately discharged into Kiowa Creek.

The solid waste disposal practices at this facility during operation of the Titan complex and the subsequent salvage operation are not known. In EPIC's assessment of the facility, a possible fill area and pits were detected; therefore, it is possible that onsite solid waste disposal was practiced [R-5].

2.3 PERMITTING STATUS

Bennett ANGF does not currently operate under any environmental permits. The Colorado Department of Health and EPA Region VIII have no record of any permits having been issued. The regulatory agencies contacted are listed in Section 6 [T-3; R-8, R-9].

2.4 GENERAL ENVIRONMENTAL INFORMATION

2.4.1 DEMOGRAPHICS AND ADJACENT LAND USE

Bennett ANGF is largely surrounded by farming or ranching operations. The land surface can be described as rolling. Since 1980 a few houses have been built in the area. This land use pattern is not expected to change significantly during the 1990s. Plans exist to replace the Denver Stapleton Airport with a facility that would be located north of Interstate 70 and west of Bennett, Colorado. This airport would be located approximately 15 miles northwest of the Bennett ANGF. However, the area is not expected to undergo rapid commercial and residential expansion around this site [T-1].

2.4.2 CLIMATE

Denver Stapleton Airport is the location of the nearest weather monitoring station. Bennett ANGF is approximately 18 miles east of the airport.

Denver's climate is influenced by the following features:

- Inland continental location.
- Mountain ranges.

Denver has a highland or mountain climate. Denver's inland location places it far from major sources of moisture (Pacific Ocean and the Gulf of Mexico). As storms move eastward from the Pacific Ocean, they lose much of their moisture in passing over the mountain ranges. Denver does not experience

the extremely cold mornings of high elevations or the hot summer afternoons of the lower valley altitudes. Air masses from the Arctic, Gulf of Mexico, the southwest desert, and the Pacific Ocean influence Denver's weather [R-10, R-11].

Figure 2-3 depicts a wind rose for Denver for the year 1988. Normal annual prevailing wind direction is from the south. During 1988, south winds occurred most frequently with a secondary maximum of south-southwest winds. Because the city is located in a mountainous area, the winds measured at the airport may be significantly different from other areas.

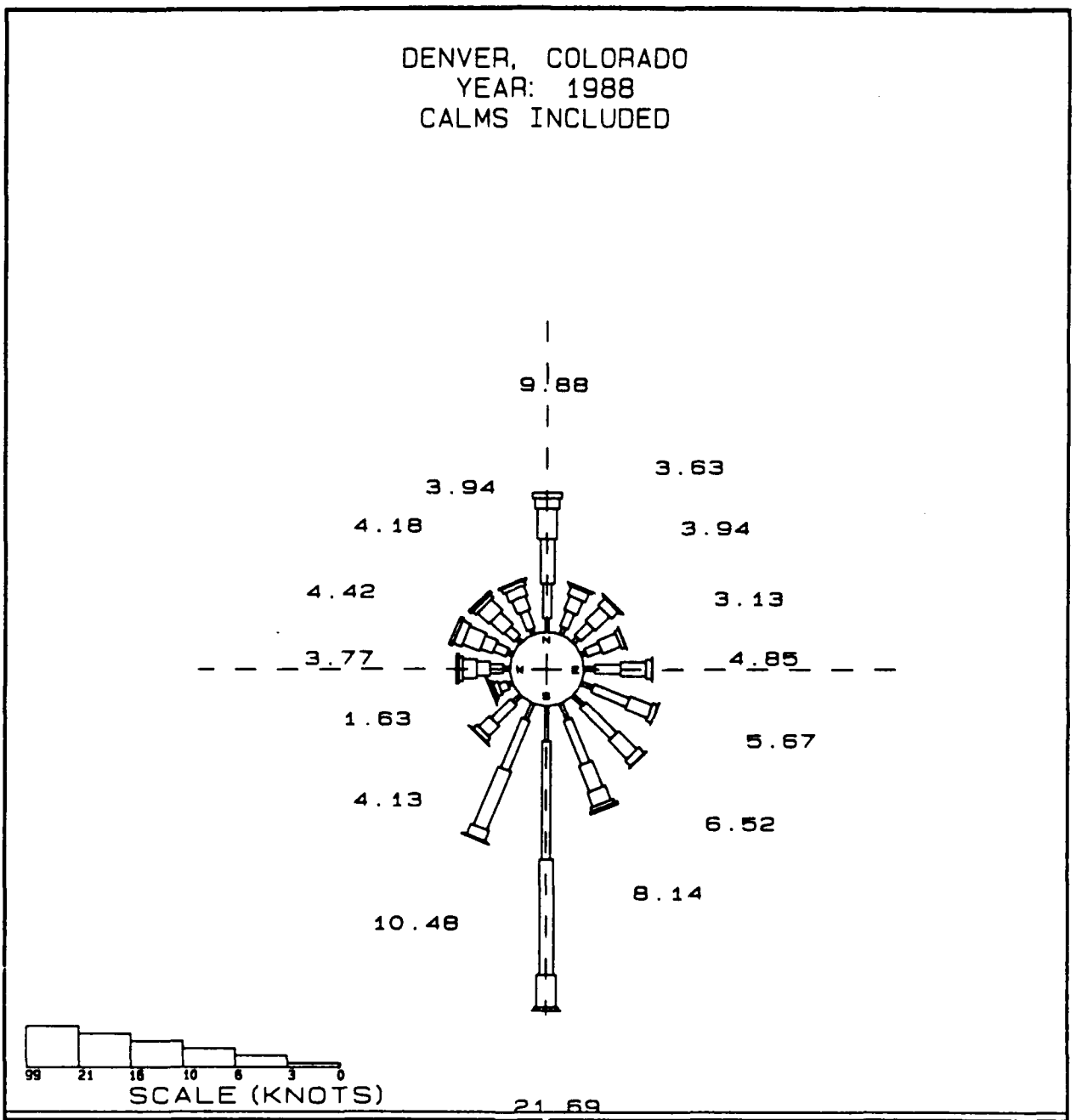
The maximum amount of rainfall occurs during the spring and summer months. The majority of spring precipitation is caused by the collision of warm, moist Gulf of Mexico air and cold arctic air. Much of this precipitation falls as snow. Summer rainfall is caused mainly by showers and thundershowers. The normal annual precipitation is 15.31 in. May is the wettest month with normal precipitation of 2.47 in. January is the driest month with normal precipitation of 0.51 in. Average yearly snowfall is 59.9 in. Measurable snowfall has been recorded from September through June. March receives the highest total snowfall with a mean amount of 12.8 in. The maximum snowfall recorded in a 24-hour period was 23.6 in. The maximum monthly snowfall recorded was 39.1 in. during November 1946.

Temperatures vary moderately from season to season. January is the coldest month with an average monthly temperature of 29.5°F, a daily maximum temperature of 43.1°F, and a daily minimum temperature of 15.9°F. July is the warmest month with an average monthly temperature of 73.3°F, a daily maximum temperature of 88.0°F, and a daily minimum temperature of 58.7°F. During the winter and spring, rapid temperature increases are caused by Chinook winds. These winds are caused when surges of air are moderated on their descent down the east face of the Rockies. Chinook winds can raise the temperature above 90°F and occur on the average of 33 days per year. Daily minimum temperatures of 32°F and lower occur on an average of 157 days per year; daily minimum temperatures of 0°F and lower occur on an average of 9 days per year. The record highest temperature recorded is 104°F, which occurred in June 1936 and July 1939. The record lowest temperature is -30°F, which was recorded in February 1936.

Severe thunderstorms with large hail, heavy rain, and high winds occasionally occur. Tornadoes are rare in Colorado and cause relatively minor damage [R-10, R-11].

2.4.3 SURFACE WATER AND PHYSIOGRAPHY

Bennett ANGF is located on a relatively high topographic position in relation to the surrounding landscape. All surface water runoff flows offsite through intermittent feeder streams to the Kiowa Creek, which is also an intermittent stream. There are no permanent surface water bodies present within the facility boundaries; only normally dry arroyos exist. The site is located within an area classified by the Federal Emergency Management Agency's Flood Insurance Map as Zone X. A Zone X classification signifies that the property is outside of the 500-year floodplain [R-3].



	WIND SPEED (KNOTS) 0-3	3-6	6-10	PERCENT OCCURRENCE 10-16	16-21	>21
N	0.96	2.47	3.20	2.14	0.72	0.40
NNE	0.51	1.22	1.06	0.66	0.16	0.02
NE	0.46	1.25	1.41	0.66	0.13	0.03
ENE	0.34	1.09	1.34	0.33	0.02	0.00
E	0.73	1.86	1.80	0.43	0.03	0.00
ESE	0.89	2.69	1.66	0.41	0.02	0.00
SE	0.99	3.07	1.66	0.56	0.06	0.00
SSE	1.24	3.39	1.98	1.07	0.28	0.17

	WIND SPEED (KNOTS) 0-3	3-6	6-10	PERCENT OCCURRENCE 10-16	16-21	>21
S	2.62	8.44	8.17	2.30	0.24	0.02
SSW	1.25	3.66	4.47	0.79	0.09	0.02
SW	0.70	1.92	1.06	0.39	0.06	0.02
WSW	0.34	0.60	0.35	0.19	0.09	0.05
W	0.46	0.94	0.94	0.97	0.26	0.20
WNW	0.39	0.97	0.91	1.29	0.59	0.27
NW	0.36	0.92	1.24	1.06	0.33	0.23
NNW	0.36	1.33	1.01	0.74	0.33	0.14

FIGURE 2-3 WIND ROSE

2.4.4. SOILS

The soil on Bennett ANGF is classified in the soil survey for Arapahoe County, Colorado, as Colby silt loam with 1 to 5 percent slopes. The Colby series consists of deep, well-drained, gently sloping to steep soils that occur on ridgetops and on a few short steep slopes in the eastern three-fourths of the county [R 4].

The Colby soils have a moderate rate of water intake, moderate permeability, and high available water-holding capacity. They are moderate in natural fertility, but are highly susceptible to soil blowing and water erosion unless a vegetative cover is maintained. The hazard of erosion is increased in bare areas because they tend to slicken when wet. These soils are suited to wheat and other nonirrigated crops, if protected against soil blowing and water erosion.

In a typical profile occurring in an undisturbed state, the surface layer is a light brownish-gray limy silt loam about 5 in. thick. The next layer, about 7 in. thick, is pale-brown silt loam that contains much lime and is easily penetrated by roots and water. The underlying material is very pale brown and pale brown limy silt loam to a depth of 60 in. The soils present at the Bennett facility were extensively disturbed during construction of the Titan complex. While the basic characteristics of the soils remain intact, the structure of the soil has been destroyed.

2.4.5 GROUNDWATER AND HYDROLOGY

Groundwater in this region has multiple uses. Within a 2-mile radius of Bennett ANGF there are approximately 75 wells (see Appendix C). One-quarter of these wells are used as a domestic source; the remainder are used for irrigation and livestock. The nearest active well is located approximately one-quarter mile from the facility. Active well depths range from 28 ft to 630 ft and water levels in these wells range from 7 ft to 264 ft. Wells throughout this range of depths are used to supply drinking water. The Denver Aquifer is the main source of water for wells installed around Bennett ANGF. The Denver groundwater basin underlies a 6,700 square-mile area extending from Greely in the north, to Colorado Springs in the south, and from the Front Range in the west, to Limon, Colorado in the east. The four major bedrock aquifers that occur in the basin are the Laramie-Fox Hills (deepest), the Arapahoe, the Denver, and the Dawson (uppermost).

The Denver Aquifer underlies 3,200 square miles in east-central Colorado and is the primary water source for Western Arapahoe County. Geologically, the Denver Formation sandstone and the Dawson Arkose (Arkosic sandstone) form the saturated sections of the Denver Aquifer. The water-bearing layers of sandstone and siltstone occur in poorly defined, irregular beds that are dispersed within relatively thick sequences of claystone and shale. The sandstone and siltstone are moderately consolidated and more coarse-grained than the claystone and shale. This allows for a better flow rate compared to the claystone and shale.

Near the Bennett ANGF site, the aquifer is less defined and more irregular, and, in most cases, only partially saturated. In the margin areas of the Denver Aquifer, the groundwater level is below the top of the Denver Formation. It appears near the site as a partially saturated alluvial aquifer.

According to the well history of a water well drilled at the site, the depth to the Denver Aquifer at the Bennett site can be determined to be 420 ft deep. Away from the site, partially saturated alluvial aquifers occur above the Denver Formation and are shown in Figure 2-4.

Perched water zones are found in this region. The depth of the shallow aquifer in the region ranges from 7 ft in the southeast portion of Section 32 to 60 ft in the southwestern portion of the same section (Figure 2-5).

Twelve selected histories of wells within 2 miles of Bennett ANGF were obtained from the Colorado Division of Water Resources (see Appendix D) and are listed in Table 2-3 and located in Figure 2-5. These represent depths of water from 18 ft to 420 ft, the shallowest of which is located in the northwestern most corner of Section 33. If the groundwater were contaminated, the population affected would depend on the direction of the plume. Groundwater flow in the vicinity of the Bennett site was determined to be north-northeasterly toward the Bennett and Strasburg communities. Water moves from higher points within the aquifer towards lowest points, which in the Denver Aquifer, is the South Platte River and Commerce City, just north of Denver.

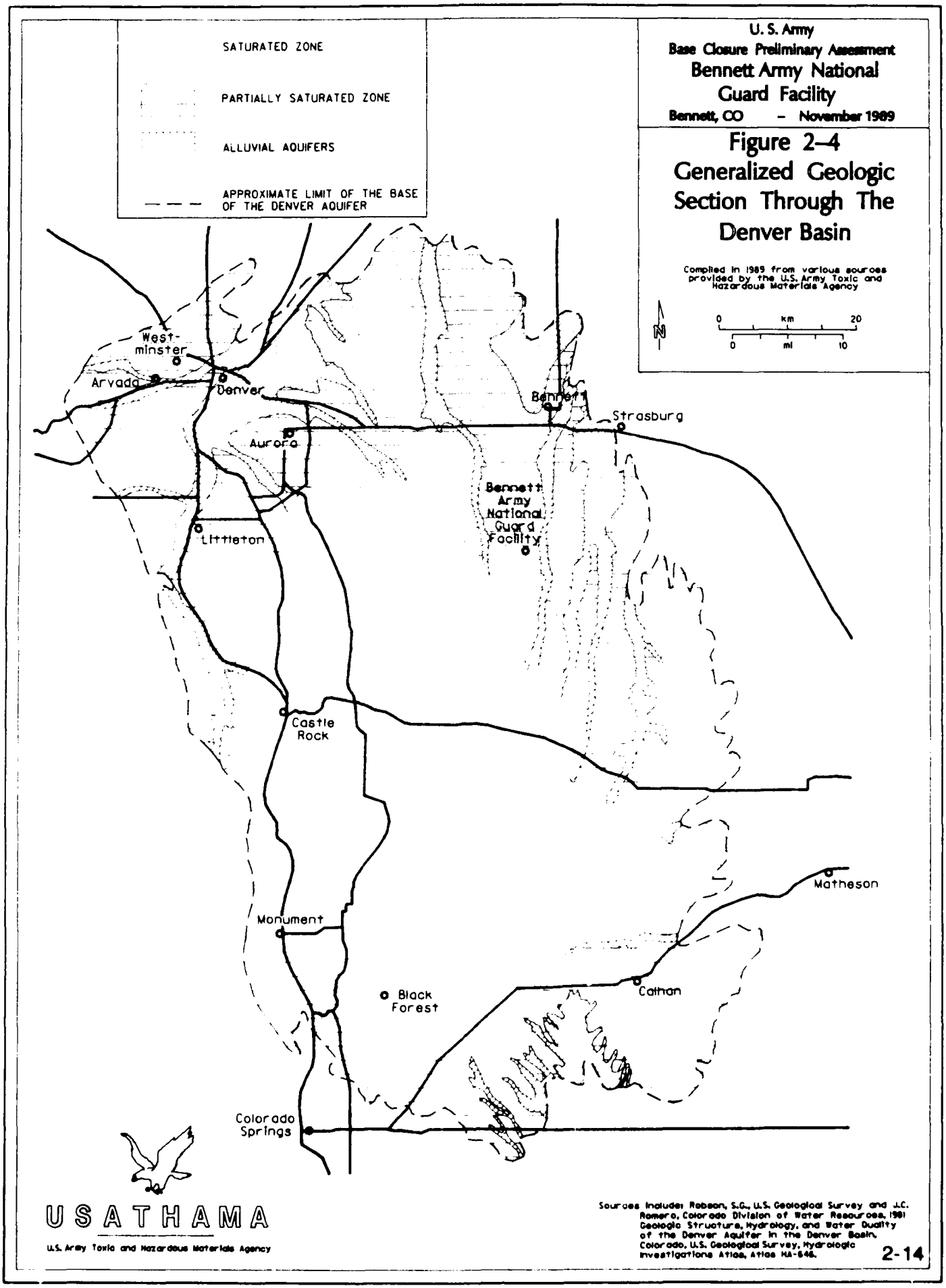
2.4.6 GEOLOGY

The site is situated on a broad plateau capped with alluvial materials of the Pleistocene Age. Bedrock material beneath the Bennett site has been identified as the Denver Formation. The Denver Formation is from the Paleocene Age and consists primarily of fine-grained sandstone, shale, and lignite facies. The composition of alluvial and bedrock materials is discussed further below.

Alluvial materials overlie bedrock in the vicinity of the Bennett site. These are broken down in three main groups, all of the Pleistocene Age. The Louviers, Slocum, and Broadway Alluvium groups are present on and near the site.

The Louviers Alluvium consists of grayish-brown to yellowish-brown clayey silt and coarse-to-cobbly clayey sands with gravel. The soil is well developed near the top of the ground surface and exhibits graded bedding with clay and silt layers.

The Slocum Alluvium consists of yellowish-brown to grayish-brown well stratified clayey sands containing lenses of silt, pebbles and cobbles in sediment and terrace deposits. The Broadway Alluvium consists of grayish-brown to moderate yellowish-brown, fine-to-coarse-grained, well-sorted stratified sand and finer-grained, silty humic sand. Well-developed soils are locally present in undisturbed areas on terraces above stream valleys.


SATURATED ZONE
PARTIALLY SATURATED ZONE
ALLUVIAL AQUIFERS
APPROXIMATE LIMIT OF THE BASE OF THE DENVER AQUIFER
U. S. Army
Base Closure Preliminary Assessment
Bennett Army National Guard Facility
Bennett, CO - November 1989
Figure 2-4
Generalized Geologic Section Through The Denver Basin
Compiled in 1989 from various sources provided by the U.S. Army Toxic and Hazardous Materials Agency
N
0 km 20
0 mi 10
West-minster
Arvada
Denver
Aurora
Bennett
Strasburg
Bennett Army National Guard Facility
Littleton
Castle Rock
Matheson
Monument
Black Forest
Calhan
Colorado Springs
USATHAMA
U.S. Army Toxic and Hazardous Materials Agency
Sources include: Robson, S.G., U.S. Geological Survey and J.C. Romero, Colorado Division of Water Resources, 1981 Geologic Structure, Hydrology, and Water Quality of the Denver Aquifer in the Denver Basin, Colorado, U.S. Geological Survey, Hydrologic Investigations Atlas, Atlas HA-646.

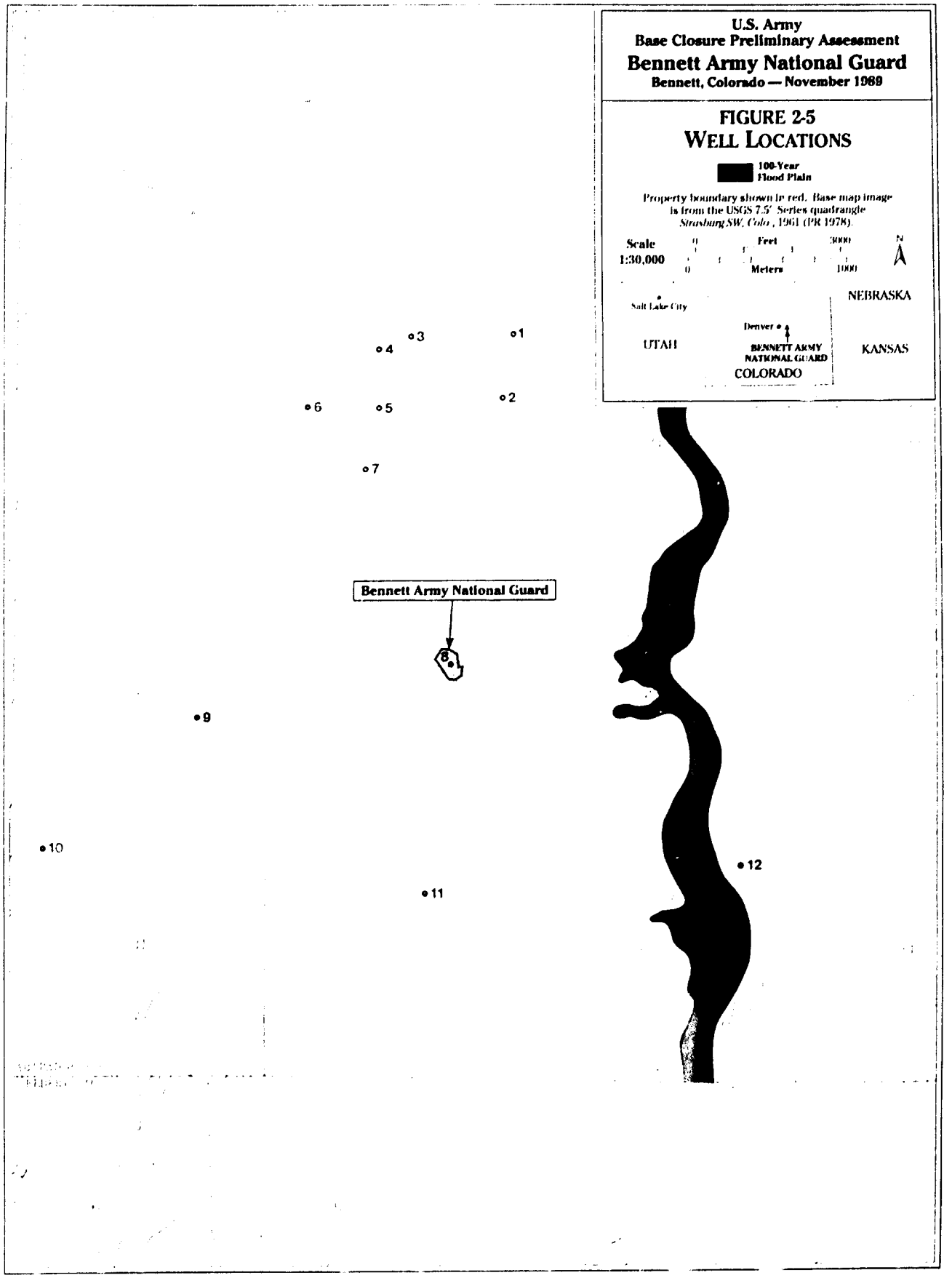


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Table 2-3

Selected Area Wells

Well Number	Well Permit Number	Depth (ft)	Water Level (ft)	Bedrock (ft)
1	135684	533	220	3
2	139648	630	220	10
3	129581	533	216	2
4	132193	600	167	1
5	133709	610	200	1
6	140351	624	210	10
7	130447	540	120	20
8	2409F	1804	420	2
9	5425	31	20	NA
10	23607	175	135	NA
11	146928	515	264	3
12	19702A	35	18	14

NA = Not available.
Well Number corresponds to wells indicated on Figure 2-5.

Valley Fill Alluvium, of the Holocene Age, is localized in stream beds and in terrace walls above stream beds. Locally, the Piney Creek Alluvium consists of light yellowish-gray to dark gray unconsolidated silt, sand, and coarse pebbly to cobbly gravel, containing interbedded dark brown clayey and silty lenses. This particular deposit is most noted in and above Kiowa Creek located just to the east of the facility.

The Denver Formation is found beneath the alluvial layers at the Bennett site. The Denver Formation is of the Paleocene Age and consists of yellowish-gray to light gray arkosic sandstones and claystones. Sandstones are generally coarse to fine-grained, iron stained, locally conglomeritic, and massive. Interbedded argillaceous arkose and feldspathic sandstones containing gray to greenish-gray claystones exist along the locally thin carbonaceous shale lenses.

Directly beneath the Bennett site, bedrock depth is approximately 18 ft. A lithologic log of a well drilling indicated depth to bedrock was obtained from the Colorado Division of Water Resources. This particular well is located within the Bennett site in Section 29, Township 55, Range 63W, and was drilled to a total depth of 1,804 ft. Sandstone was encountered at 18 ft below ground surface. Below the sandstone, several claystone layers were identified as well as a 5 ft coal bed from 68 ft to 73 ft.

2.4.7 FLORA AND FAUNA

A variety of wild grasses and shrubs grow on Bennett ANGF and the surrounding properties. Winter wheat is cultivated on many of the surrounding farms. There are few trees or other types of protective cover. Some livestock is raised in the area, and cattle occasionally stray onto the property [R-12].

2.4.8 SENSITIVE ENVIRONMENTS

No endangered or threatened species are recorded on Bennett ANGF. No wetlands were identified in this area [T-4].

Section 3
Environmentally Significant Operations

SECTION 3

ENVIRONMENTALLY SIGNIFICANT OPERATIONS

The objective of this section is to document areas where hazardous materials may have been managed and to identify known potential releases of these materials into the environment and their likely migration pathways. The locations of all identified ESOs are shown in Figure 3-1.

3.1 SEWAGE STABILIZATION PONDS AND RUNOFF TRENCH

3.1.1 DESCRIPTION

During the operational stage of the Titan ICBM complex, two sewage stabilization ponds were used to receive sanitary wastewater from the facility. The ponds were operated on a semicontinuous basis. A drain line was opened daily and the water level was drawn down 6 in. to 12 in. Each pond is approximately 5 ft deep and has a surface area of 1,000 ft. The ponds are still present, although the area is overgrown and there is no standing liquid present. The ponds appeared to be clay-lined. The wastewater drained through a ditch, off the property, and into an offsite arroyo that leads to the Kiowa Creek [I-1].

3.1.2 KNOWN AND SUSPECTED RELEASES

It is possible, that in addition to sanitary wastewaters, other materials, especially solvents from maintenance activities, were discharged into the sewage stabilization ponds. At the time of the site survey, there was no liquid present. The soil in the ponds is presently supporting vegetation.

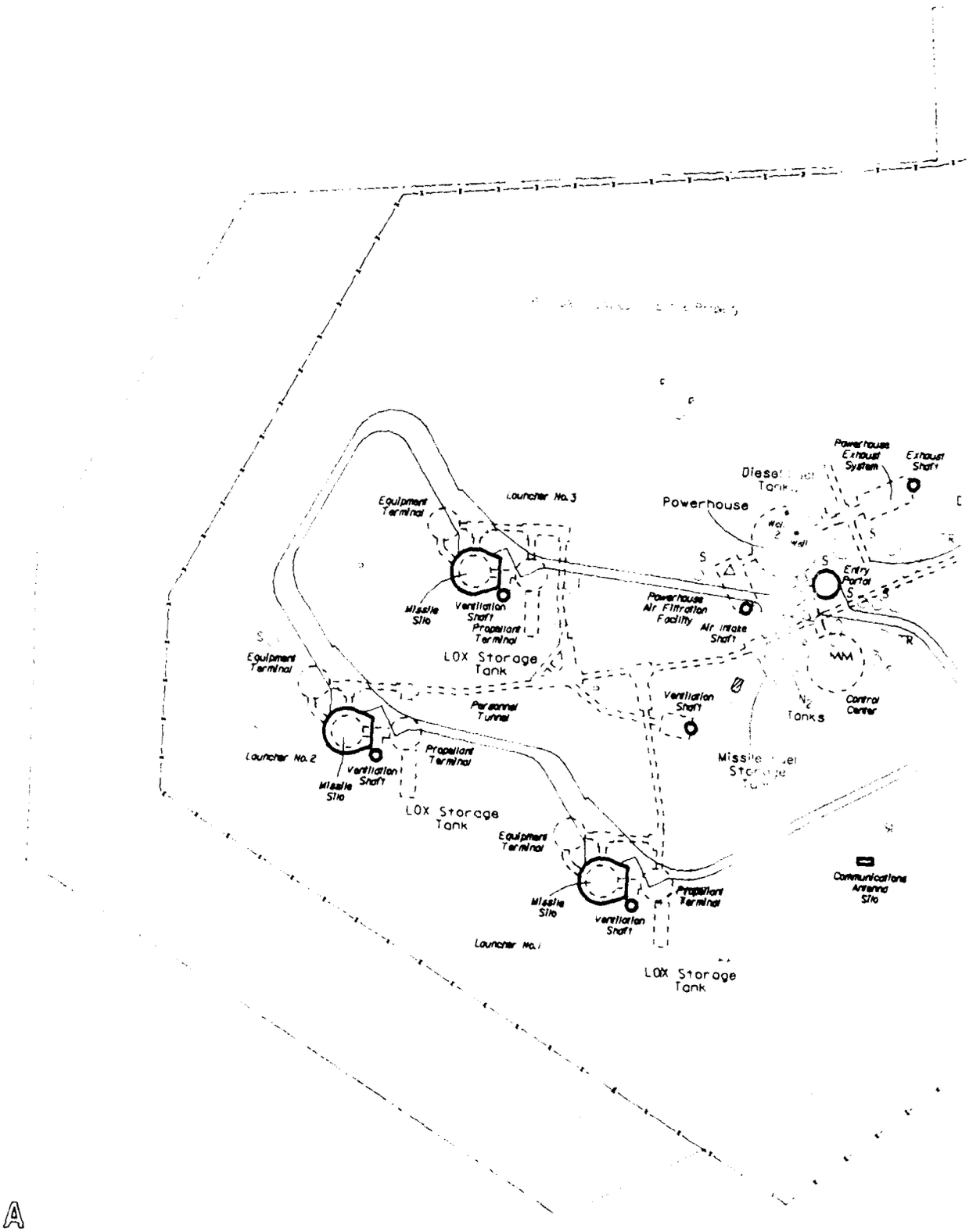
3.2 TRANSFORMERS

3.2.1 DESCRIPTION

There are two pole-mounted transformers at the site. Both units have been severely damaged and are marked with numerous bullet holes. Presumably, most of the dieletric fluid has escaped (see photo 5). Given the age of the facility, it is possible that both may have contained polychlorinated biphenyls (PCBs).

3.2.2 KNOWN AND SUSPECTED RELEASES

It is expected that the fluid that leaked from the damaged transformers has seeped into the ground. No staining was visible. Some residual fluid may still be present on interior surfaces of the transformers.



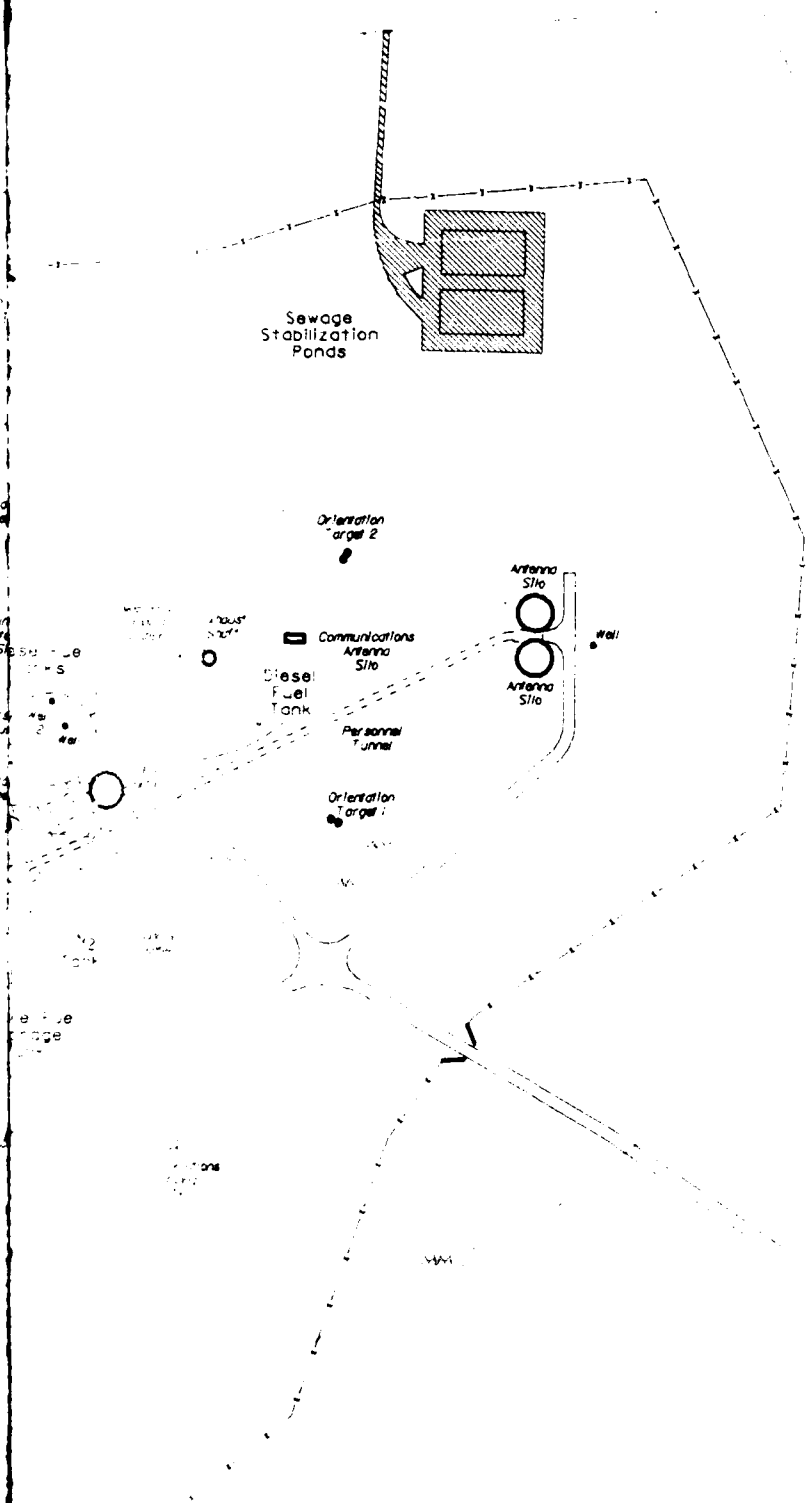
USATHAMA

U.S. Army Toxic and Hazardous Materials Agency

U. S. Army
Base Closure Preliminary Assessment
Bennett Army National Guard Facility
Bennett, CO - November 1989

Figure 3-1
Environmentally Significant Operations

Compiled in 1989 from various sources provided by the U.S. Army Toxic and Hazardous Materials Agency



N

0 meters 80
0 feet 300

ENVIRONMENTALLY SIGNIFICANT OPERATIONS
- Potential Waste Site
- Transformer
- Chemical Waste Clarifier
- Underground Complex
- Wastewater Ponds and Runoff Trench
- Seal Chamber
- Mounded Material
- Standing Liquid
- FA Fill Area
- Impoundment
- Container
- Tank
- S Stain
- TR Trench
- P Pit

3.3 CHEMICAL WASTE CLARIFIER

3.3.1 DESCRIPTION

A chemical waste clarifier was installed to treat wastes from the Titan complex. The materials processed in the clarifier remain unknown. The effluent was conveyed by a trench to an intermittent stream. There were no visible remnants of the chemical waste clarifier at the time of the survey.

3.3.2 KNOWN AND SUSPECTED RELEASES

Runoff discharged to an adjacent trench from which it would either seep into the ground or drain offsite, eventually reaching the Kiowa Creek [I-1; T-2; R-5].

3.4 SEAL CHAMBERS

3.4.1 DESCRIPTION

The concrete tops of five, 4 ft by 4 ft seal chambers, were visible at the time of the site visit. The purpose of these units remains unknown and conflicting information was received. One person interviewed reported that the seal chambers were used to eject waste from the underground complex. This individual had no information regarding the materials that would have been processed through these seal chambers. [T-2] Others contacted felt that these units were part of the ventilation system. [T-3, T-6]

3.4.2 KNOWN AND SUSPECTED RELEASES

The person who reported that the seal chambers ejected waste believed that the waste was allowed to seep into the surrounding soil. There were no apparent drainage trenches or discharge ports visible during the site visit. There was no evidence of staining or stressed vegetation.

3.5 ORDNANCE

3.5.1 DESCRIPTION

The Bennett facility is located on land that was used for air-to-ground gunnery and precision bombing practice. Live and practice rounds were used. The land immediately surrounding the facility was cleared 6 June 1963 of all unexploded ordnance (UXO) and ordnance residue, "reasonably possible to detect" (see Appendix A) and was certified for unrestricted uses. The Bennett facility was well removed from the designated impact areas used in the 1950s; the edge of the nearest impact area is one mile. Bombing activities in the 1940s, however, were not well documented.

3.5.2 KNOWN AND SUSPECTED RELEASES

Few, if any, bombs would have impacted the property because it was separated from the impact areas. Although the documentation has not been found, it is probable that the entire property was swept to clear the area of any UXOs prior to construction between 1959 and 1961. Given the large amount of excavation work involved during construction of the Titan complex, it is unlikely that any UXOs would remain.

3.6 POTENTIAL WASTE SITES

3.6.1 DESCRIPTION

The Environmental Photographic Interpretation Center (EPIC) report (Figure 3-1) identified 23 areas where wastes could have been disposed. From 1963 to 1985, mounded material, ground stains, containers, trenches, tanks, and pits were detected at several locations throughout the facility [R-5]. These areas ranged from storages less than 10 sq ft to a fill area of almost 100,000 sq ft.

3.6.2 KNOWN AND SUSPECTED RELEASES

Past waste disposal practices at the facility are not well documented. None of the waste areas detected in the EPIC survey were in evidence during WESTON's site visit; therefore, it is not possible to identify the materials disposed, if any, at these locations. Given the lack of information on the types of waste materials generated and the manner of waste disposal at the site, the potential contaminants at these locations cannot be assessed.

3.7 CONTROL CENTER

This area was not entered during the site survey. The following description is based on information obtained from personnel who have entered the facility during the past three years [I-1, I-3, I-4]. The facility was last entered in 1988 for the purpose of clearing and searching the complex prior to blocking the entrances.

3.7.1 DESCRIPTION

The control center housed much of the command equipment needed to operate the ICBM complex. The center is a two-level concrete-domed underground structure 105 ft in diameter. An equipment maintenance room was located on the lower level as were living quarters. Associated with the control center were partially underground, concrete, antenae silos. A more thorough record of equipment potentially present is provided in Appendix E.

There was no standing water present in this part of the Bennett facility. The control center is strewn with refuse including discarded insulation that could contain asbestos. No other hazardous materials were readily visible to entrants in this part of the complex [I-1, I-3].

3.7.2 KNOWN AND SUSPECTED RELEASES

There was no evidence of any releases to the environment. Other than the materials that may contain asbestos, there was no visible evidence of releases within the control center proper or the antenae silos [I-1, I-3].

3.8 POWERHOUSE AREA

This area was not entered during the site survey. The following description is based on information obtained from personnel who have entered the facility during the past three years [I-1, I-3, I-4].

3.8.1 DESCRIPTION

The powerhouse produced electric power, heat, air conditioning, and water for the entire Titan complex. This concrete, underground dome is 46 ft high and 120 ft in diameter and has walls that vary in thickness from 12 in. to 30 in. Much of this area is covered with 1 ft to 3 ft of water. During operation, this area housed an extensive array of equipment including tanks, pumps, air compressors, air dryers, and transformers. A complete list of items potentially present is provided in Appendix D. Two 67,000-gal diesel tanks have been removed. These two tanks were located in concrete vaults adjacent to the powerhouse. A 5,000-gal diesel tank is still in place in an adjacent concrete vault. A noticeable diesel odor exists in the area of an open manhole. Two 30,000-gal water tanks and a 40,000-gal RP-1 tank also are present. All are located in separate concrete vaults and are reportedly empty.

All transformers were reportedly removed, but much of the equipment apparently remains. The area is filled with refuse, including discarded insulation, which may contain asbestos. Approximately one gal of an oily substance is splattered around the area on equipment surfaces.

3.8.2 KNOWN AND SUSPECTED RELEASES

Despite the appearance of the powerhouse, there was no direct evidence of releases to the environment. The remaining tanks are reportedly empty, although a diesel fuel odor emanates from one open tank. None of these tanks were leaking. An oily material was splattered on equipment surfaces. The amount of water present in the powerhouse is an order of magnitude greater than could be attributed to direct precipitation through all surface openings during the past 25 years.

3.9 LAUNCH AREAS

This area was not entered during the site survey. The following description is based on information obtained from personnel who have entered the facility during the past three years [I-1, I-3, I-4].

3.9.1 DESCRIPTION

There are three launch areas; each consists of an equipment terminal, a propellant terminal, and a missile silo. The areas are scattered with debris, including insulation, which could potentially contain asbestos. The propellant terminals are concrete, underground silos 47 ft high and 40 ft in diameter. Within each propellent terminal are nine clusters of tanks that were used to store helium and nitrogen. These tanks are reportedly still in place, but are empty. Additionally, in each propellant terminal there is a 3,500-gal sulfuric acid tank. Although the acid tanks are empty, one of the tanks has a hole in it. A 26,000-gal LOX tank formerly was present in a concrete vault adjacent to each propellant terminal. The propellant terminals contain water to a depth of 3 ft.

Like the propellant terminals, the equipment terminals are concrete, underground silos. The equipment terminals have four levels and are 62 ft high and 43 ft in diameter. During operation, these areas housed an extensive array of equipment including tanks, pumps, air compressors, air dryers, and transformers. A partial listing of equipment, formerly and perhaps still present, is included in Appendix D. All transformers were removed. The status of other equipment is uncertain. The entire lower level of the equipment terminals is submerged in water.

The missile silos are concrete, underground structures, 163 ft high and 43 ft in diameter. An armed nuclear missile was kept in each silo from 1961 to 1965. The missiles have been removed. The silos are filled with water to a depth of 20 ft to 30 ft.

3.9.2 KNOWN AND SUSPECTED RELEASES

Previous entrants observed no hazardous materials present, other than material that potentially contains asbestos. Despite the appearance of the launch areas, there was no evidence of releases to the environment. The amount of water present in the equipment terminals and the missile silos is an order of magnitude greater than could be attributed to direct precipitation through all surface openings during the past 25 years.

Section 4
Human and Environmental Receptors

SECTION 4

HUMAN AND ENVIRONMENTAL RECEPTORS

In this section, the pathways by which human and environmental receptors may be exposed to site-related chemicals are discussed.

4.1 GROUNDWATER

Groundwater in the area is used as a domestic water supply and for irrigation and livestock. The depth of the shallow aquifer in the region ranges from 7 ft to 30 ft. Shallow groundwater in this area is found mainly as perched sources. The primary source of drinking water in the region is the Denver Aquifer, which is 420 ft deep according to the well history at the site. Given the high water table in the area, it is likely that some of the mobile contaminants (e.g., solvents, fuels, and metals, if present) would eventually reach perched groundwater unless contaminated materials are removed. The rate of percolation is expected to be slow, given net rainfall conditions.

The nearest identified active well is one-quarter mile from the site. There are approximately 75 registered wells within a 2-mile radius, with one-quarter of these serving as a domestic water source. If the groundwater were contaminated, the population affected would depend on the direction of the plume. Groundwater flow characteristics at the Bennett facility were not available. The groundwater in the region generally flows to the northeast.

4.2 SURFACE WATER

There are no surface water bodies onsite. During periods of high rainfall or snowmelt, water might pond and be available for use by fauna. It is highly unlikely that any contamination will reach the Kiowa Creek, which is an intermittent stream one-half mile from the site. In the past, however, effluent from the sewage stabilization ponds and the chemical waste clarifier was directed through ditches and arroyos toward Kiowa Creek. Contaminants (if present) from these discharges, may have impacted Kiowa Creek water and sediments. Significant attenuation would be expected, however, due to the distance between the site and the creek.

4.3 SOIL

Contaminated surface soils, if present, may present a direct contact or ingestion hazard to wildlife. This land is sometimes used for grazing by cattle. Contaminants that are persistent in soil, such as PCBs and metals, would present the greatest exposure hazard among the identified site contaminants. There is no evidence of vegetation stress.

4.4 AIR

No permanent sources of air contaminants were identified at the site that would impact human or environmental receptors. In the unlikely event of people frequenting the Titan complex, the potential for exposure to asbestos exists, from discarded insulation that may contain asbestos.

4.5 OTHER HAZARDS

4.5.1 FIRE AND EXPLOSION

No fire or explosion hazards are known to exist at the Bennett site. Unexploded ordnance and compressed gases, if present, would present an explosion hazard.

4.5.2 DIRECT CONTACT

Other than possible soil contamination, there were no direct contact hazards identified aboveground. Within the underground complex, potentially contaminated surfaces could pose a direct contact hazard. In addition, there are a few animal carcasses that could present a health hazard.

4.5.3 PHYSICAL HAZARDS

At the present time, entrances to the complex are well blocked. If entry in the future is obtained, the risk of personal injury exists. The complex is unlit and strewn with debris; water present in the facility is deep in several areas.

Section 5
Conclusions and Recommendations

SECTION 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The Bennett ANGF is an abandoned Titan ICBM complex. The entrances to the underground complex are blocked. The surface of the installation has been used since 1975 as a training area for CoARNG. There are no buildings remaining on the property. No ESOs were identified that were a result of CoARNG activities.

This facility is located in a rural area. Groundwater is used for domestic drinking, irrigation, and livestock. Any surface runoff would discharge to the Kiowa Creek. There are few former operations that would adversely impact local human and environmental receptors.

The identified ESOs can be divided into two groups: the underground Titan complex and the aboveground operations.

5.1.1 TITAN COMPLEX

The underground operations are comprised of three ESOs discussed in Section 3: Powerhouse Area, Control Center, and Launch Areas. It is not possible to identify positively the hazardous materials currently present since the complex could not be surveyed during the assessment. Environmentally significant materials possibly encountered include:

RP-1
Sodium Hydroxide
Sodium Hypochlorite
Water Demineralizing Chemicals
Sulfuric Acid
Diesel Fuel
Hydraulic Fluid
PCBs
Ethylene Glycol
Compressed Oxygen
Compressed Helium
Compressed Nitrogen
Refrigerant
Asbestos

The complex is built with reinforced concrete and steel. When operational, most of the hazardous materials were stored in the concrete sections. Large quantities of discarded, potentially asbestos-containing insulation was reported throughout the complex. A large amount of debris is also present.

Other than the insulation, few hazardous materials were reported. The tanks remaining in the facility are believed to be empty except for potential residual material. A small quantity of an oily substance splattered on equipment in the powerhouse area.

There is evidence that groundwater may be entering the facility; many parts of the complex are partially submerged in water. The amount of water reported in the complex is greater than would be expected from direct precipitation and runoff through surface openings. A contaminant release within the facility could impact the shallow groundwater.

5.1.2 ABOVEGROUND OPERATIONS

For any ESOs located aboveground, any releases would have likely entered the soil and could eventually reach the shallow groundwater. At the same time, it is possible, especially in the cases of the chemical waste clarifier and the sewage stabilization ponds and runoff trench, that wastes could have been washed into the Kiowa Creek.

A number of surface activities could be identified on a series of aerial photographs taken when the Titan complex was active. In the EPIC survey, several pits, tanks, trenches, groundstains, and mounds of material were detected. Activities at many of these sites remain unknown and were not observed during the onsite survey. Given the hazardous materials handled at the Titan facility, the concerns would include metals, fuels, and solvents.

Two ESOs were identified that were involved in processing wastewater: the sewage stabilization ponds and runoff trench, and the chemical waste clarifier. The sewage stabilization ponds and runoff trench were used to process sanitary wastewater. The runoff trench conveyed the sanitary wastewater offsite to the Kiowa Creek. Given the lack of information on operating practices associated with the Titan complex, it is possible that other waste streams were discharged here. The chemical waste clarifier was installed to handle an unknown waste stream. The clarifier effluent was conveyed by a trench to an arroyo that eventually drains to the Kiowa Creek.

Conflicting information was received regarding the function of the seal chambers. One source interviewed reported that five seal chambers were used to eject an unidentified waste stream from the Titan complex. This waste reportedly was allowed to seep into the ground. Others, however, felt that these units were part of the ventilation system.

The property was part of a bombing range in the 1940s and 1950s. The Bennett property is located in the southeastern corner of the Lowry Air Force Bombing Range, away from any documented impact areas. Few bombs, if any, are expected to have impacted on the Bennett property. A large portion of the property was excavated during construction of the Titan complex. Although no documentation could be found, it is expected that an ordnance sweep would have been made prior to construction of the facility.

Two aboveground pole-mounted transformers were identified on the property. Both had numerous bullet holes. It is expected that most of the transformer fluid seeped into the ground underneath. Some residual fluid, however, could remain trapped on interior transformer surfaces. Given the estimated age of these devices, it is possible that a fluid containing PCBs was employed.

5.2 RECOMMENDATIONS FOR FURTHER ACTION

No conditions were observed on the property that appear to represent an immediate substantial threat to human health or the environment. However, ESOs discussed in Section 3 have the potential to affect human health or the environment. Recommendations are summarized in Table 5-1 and shown in Figure 5-1. Accordingly, sampling of the property is recommended.

5.2.1 TITAN COMPLEX

Since the Titan complex could not be entered, specific sampling recommendations are not possible. The next stage of activity should be a thorough visual inspection of the entire complex. This inspection should be conducted using a strict confined space entry protocol. At this stage some preliminary sampling recommendations would be possible. The entire complex should be surveyed for asbestos since loose insulation was reported as common. The pH of the pools of water should be tested and samples obtained. Initially, these samples should be checked for volatile organic compounds (VOCs), Total Petroleum Hydrocarbons (TPHss), Resource Conservation and Recovery Act (RCRA) metals; arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, and PCBs. After the complex is inventoried, a more thorough series of sampling recommendations may be proposed.

5.2.2 ABOVEGROUND OPERATIONS

Further investigation of past surface activities should proceed in a staged manner. The first stage of analyses is intended only to identify areas of contamination. Many of the areas of concern were identified through analysis of aerial photography. The materials handled can be tentatively identified based on the activities expected at the Titan complex. The results from the analyses from this stage should be used to plan subsequent activities.

Soil samples from different locations should be obtained at each of the potential waste sites identified in the EPIC survey. An 18-in. split-spoon sample should be collected at each site that would be expected to show near-surface contamination: mounded material, standing liquid, ground stains, tanks, and containers. At sites that would be expected to show deeper contamination (pits and trenches), samples should be collected at 3 ft, 6 ft, and 10 ft. The samples should be composited from each depth sampled and within each potential waste site and analyzed for RCRA metals, base neutral acid extractables (BNAs), and TPHs.

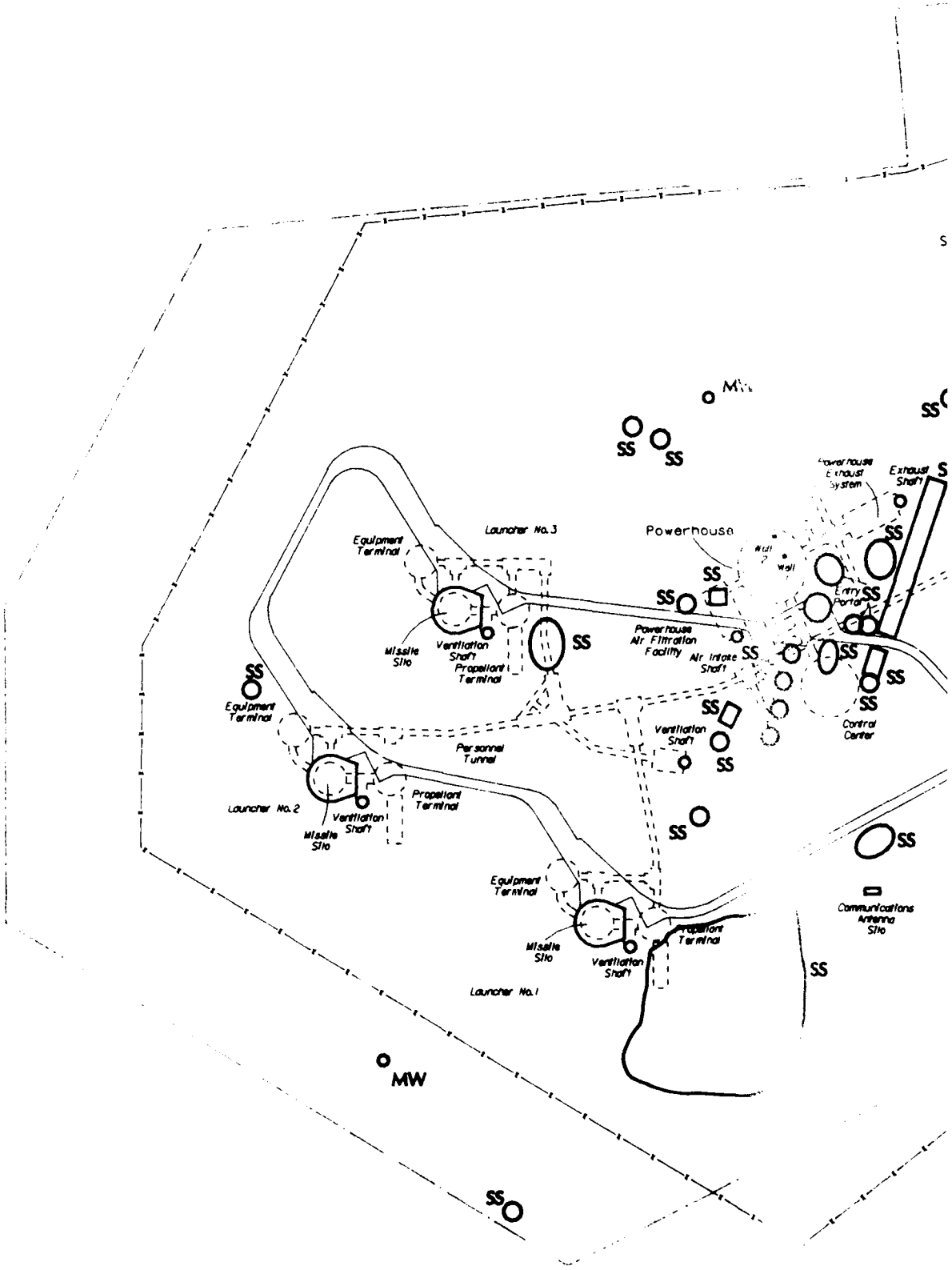
Table 5-1

ESOs Identified at Bennett ANGF and Recommendations for Further Action

ESO	Concern	Recommended Activity	Number of Samples Recommended	Location	Sample Type	Analysis
Sewage Stabilization Ponds and Runoff Trench	Solvents, fuels, TPHs, metals	Site investigation	4	2 composites from each pond	Soil	RCRA Metals,* BNAs
			3	Along trench	Soil	RCRA Metals, TPHs, BNAs
Chemical Waste Clarifier	Solvents, fuels, metals	Site investigation	1	Composite from location of former clarifier	Soil	RCRA Metals, TPHs, BNAs
			3	Along trench	Soil	RCRA Metals, TPHs, BNAs
Seal Chambers	Unknown	Site investigation Records Search				
Transformers	PCBs	Site investigation	1	Composite from base of pole	Soil	PCBs
Potential Waste Sites	Solvents, fuels, metals	Site investigation	1/site	Composite from each potential site	Soil	RCRA Metals, TPHs, BNAs
Ordnance	UXO Explosive materials	Site investigation Records Search				
Control Center	Unknown	Confined space inspection	1/site	Each pool of standing water	Grab	VOCs, TPHs, RCRA Metals, BNAs, pH
Powerhouse Area	Unknown	Confined space inspection	1/site	Each pool of standing water	Grab	VOCs, TPHs, RCRA Metals, BNAs, pH
Launch Areas	Unknown	Confined space inspection	1/site	Each pool of standing water	Grab	VOCs, TPHs, RCRA Metals, BNAs, pH
		Site investigation	4	Distributed along perimeter of property	Wells	VOCs, RCRA metals, TPHs, PCBs, BNAs
	Asbestos	Site investigation		Entire complex	Asbestos Survey	Asbestos

*RCRA metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver.

1081M2-2



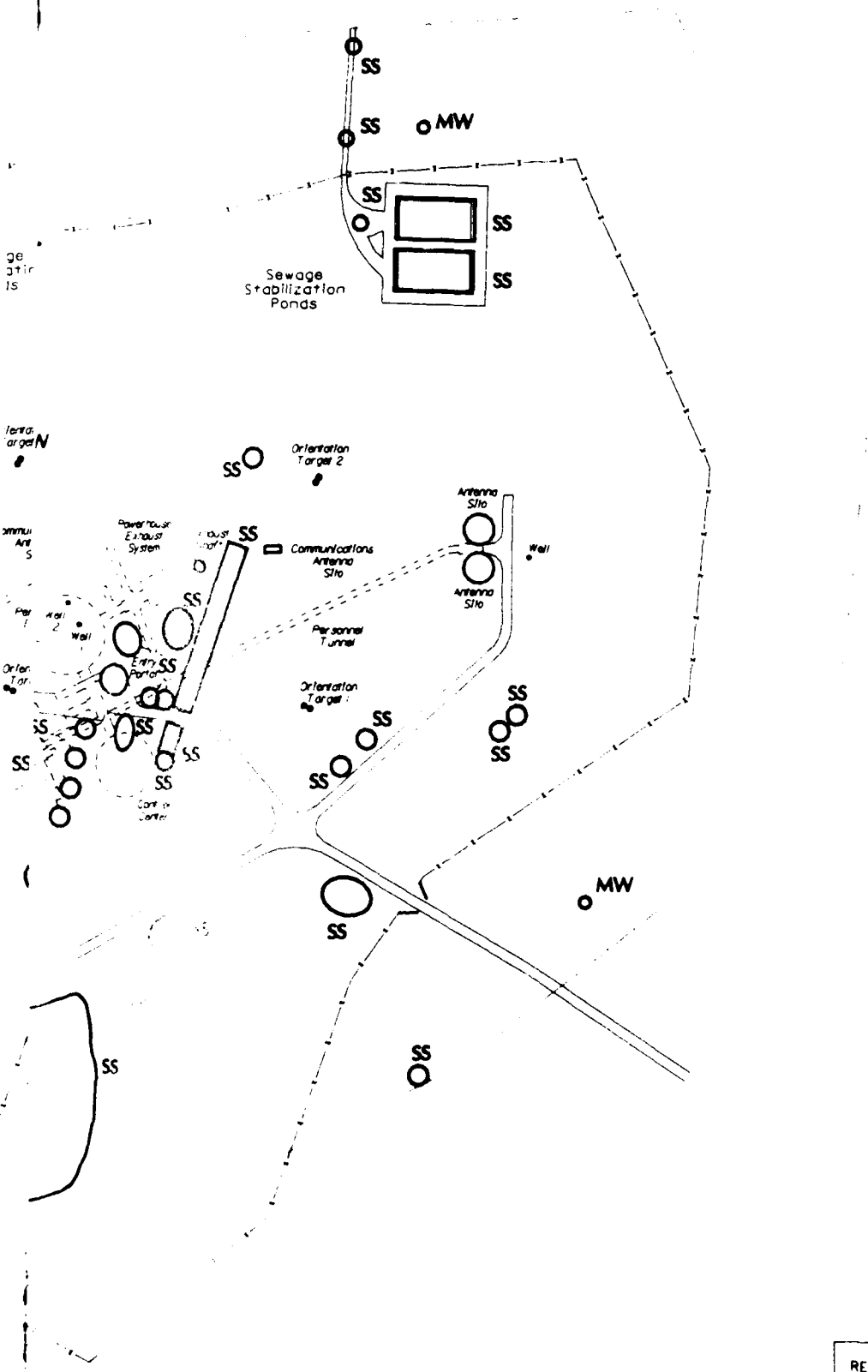
USATHAMA

U.S. Army Toxic and Hazardous Materials Agency

U. S. Army
Base Closure Preliminary Assessment
Bennett Army National Guard Facility
Bennett, CO - November 1989

Figure 5-1
Recommended Sampling Locations

Compiled in 1989 from various sources provided by the U.S. Army Toxic and Hazardous Materials Agency



0 meters 80
0 feet 300

RECOMMENDED SAMPLING METHODS
SS Surface Soil
MW Monitoring Well

The sewage stabilization ponds also would be expected to result in some deeper contamination. Samples should be distributed across each pond at six locations at depths of 3 ft, 6 ft, and 10 ft. These samples can be composited into two samples at each depth per pond and analyzed for RCRA metals, BNAs, and TPHs. Three 18-in. split-spoon samples along the runoff trench also should be obtained and analyzed for RCRA metals, BNAs, and TPHs.

Three 18-in. split-spoon samples should be collected from the chemical waste clarifier site. These samples should be composited and analyzed for RCRA metals, BNAs, and TPHs.

When the complex is inspected, the seal chambers should be investigated closely to ascertain their function. At that time an attempt should be made to open the seal chambers from the surface. In addition, a review of the construction records for the facility should be performed.

Three 18-in. split-spoon samples should be collected around the base of the transformer pole. The composited sample should be analyzed for PCBs.

A records search should be conducted to verify that the property was swept for ordnance in the past. If this search does not confirm that the facility has been cleared, an ordnance sweep will be needed.

Finally, it is recommended that four groundwater monitoring wells be installed. These wells should be distributed near the perimeter of the facility. This action is recommended because of the large number of potential waste sites distributed throughout the facility. Samples from these wells should be analyzed initially for VOCs, RCRA metals, PCBs, BNAs, and TPHs. The integrity of existing wells should also be checked. These wells should be sampled and analyzed for VOCs, RCRA metals, PCBs, BNAs, and TPHs to determine if any cross contamination has occurred.

Section 6
References

SECTION 6

REFERENCES

6.1 DIRECT INTERVIEWS

I-1 Former Base Volunteer Historian
Lowry Air Force Base, Aurora, Colorado
18 October 1989.

I-2 Environmental Specialist
Camp George West, Golden, Colorado
17 October 1989.

I-3 Civil Engineering Technician
Camp George West, Golden, Colorado
17 October 1989.

I-4 Environmental Protection Specialist
Camp George West, Golden, Colorado
17 October 1989.

I-5 Real Property Office
Lowry Air Force Bombing Range, Aurora, Colorado
18 October 1989.

6.2 TELEPHONE INTERVIEWS

T-1 Chief, Long Range Planning
Arapahoe County Planning Commission
7 November 1989.

T-2 Former Base Volunteer Historian
Lowry Air Force Bombing Range, Aurora, Colorado
26-28 September, 13 October, 19 November, 22 December 1989.

T-3 Colorado Department of Health
Water Quality Control Division
Engineering Technician, 22 September 1989.
Hazardous Materials and Waste Management Division
22 September 1989.
Air Quality Control Section
Permit Processing Engineer, 27 September 1989.

T-4 U.S. Department of the Interior, Fisheries and Wildlife Service, 8 November 1989.

T-5 Martin-Marietta, Inc., Denver Office, 22 December 1989, 3,4,8,9 January 1990.

T-6 Engineer, Colorado Engineering, Inc., 8 January 1990.

6.3 REPORTS AND OTHER DOCUMENTS

R-1 The 451st Strategic Missile Wing and the Titan Launch Complexes, Directorate of Information, 451st Strategic Missile Wing, Lowry Air Force Base, Colorado, 1961.

R-2 "Well File Master Listing," Colorado Department of Health, Division of Water Resources, Ground Water Section, 1989.

R-3 "Flood Insurance Rate Map," Arapahoe County, Colorado and Incorporated Areas, Federal Emergency Management Agency, 1989.

R-4 Soil Survey, Arapahoe County, Colorado, U.S. Department of Agriculture Soil Conservation Service In Cooperation with Colorado Agricultural Experiment Station, 1971.

R-5 Installation Assessment Army Base Closure Program, Bennett Army National Guard, Arapahoe County, Colorado, Interim Report, The Bionetics Corporation, 1989.

R-6 "Notice of Property Sale, Titan Missile Complex," General Services Administration, Property Management and Disposal Service, Denver, Colorado, 1971.

R-7 Compliance Inspection for Property Granted Under License No. DACA45-3-83-6008, Bennett Army National Guard Facility.

R-8 Administrative Officer, Colorado Department of Health, Hazardous Materials, and Waste Management Division, 16 October 1989 letter to Roy F. Weston, Inc.

R-9 Director, Hazardous Waste Management Division, U.S. Environmental Protection Agency Region VIII, 19 October 1989 letter to Roy F. Weston, Inc.

R-10 Climate of the States 2, Western States, Water Information Center, Inc., Port Washington, New York, 1974.

R-11 "1988 Local Climatological Data, Annual Summary with Comparative Data, Denver, Colorado," National Oceanic and Atmospheric Administration, Asheville, North Carolina.

R-12 Acting Director of Facilities, Colorado Army National Guard, 6 June 1988 letter to Director of Real Estate Sales, General Services Administration, Region No. 7.

R-13 "Geologic Map of the Denver 1° x 2° Quadrangle, North-Central Colorado," Bryant, Bruce. L.W. McGrew, Reinhard A. Wobus, 1981, U.S. Geological Survey, Miscellaneous Investigation Series, Map I-1163.

R-14 "Geologic Structure, Hydrology, and Water Quality of the Denver Aquifer in the Denver Basin, Colorado." Robson, S.G., U.S. Geological Survey and J.C. Romero, Colorado Division of Water Resources, 1981, U.S. Geological Survey, Hydrologic Investigations Atlas, Atlas H-646.

Section 7
Photographs

SECTION 7

PHOTOGRAPHS

This section contains copies of photographs of ESOs taken during WESTON's site visit.

1. PERSONNEL ENTRANCE TO TITAN MISSILE COMPLEX

2. MISSILE SILO COVER

3. RUNOFF TRENCH FOR WASTEWATER PONDS

4. SURROUNDING LAND USE

5. TRANSFORMERS