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PUERTO RICO NS
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RESOURCE CONSERVATION AND RECOVERY ACT PART B HAZARDOUS WASTE FACILITY PERMIT APPLICATION VOLUME 1 OF 4 FOR ATLANTIC FLEET WEAPONS TRAINING FACILITY NAVAL ACTIVITY PUERTO RICO

6/28/1993

ENVIRONMENT AND SAFETY DESIGNS, INC

AFWTF VIEQUES ISLAND RCRA PART B 93-6

RCRA PART B
HAZARDOUS WASTE FACILITY
PERMIT APPLICATION
VOLUME I

for

ATLANTIC FLEET WEAPONS TRAINING FACILITY
VIEQUES ISLAND, PUERTO RICO

Prepared for

ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA

Prepared by

ENVIRONMENTAL AND SAFETY DESIGNS, INC.
5724 SUMMER TREES DRIVE
MEMPHIS, TENNESSEE 38134
(901) 372-7962

JUNE 28, 1993

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SECTION A

PART A UPDATE

A-1 INTRODUCTION [40 CFR 270.13]

The Atlantic Fleet Weapons Training Facility (AFWTF) Inner Range, Vieques Island, Puerto Rico is seeking a Hazardous Waste Permit for a hazardous waste treatment facility comprised of an open burning unit used for the open burning of propellants, pyrotechnics and other specified ordnance, and an open detonation unit used for the thermal treatment of high explosive wastes such as RDX, HMX, PETN, Amatol and various other explosives described in the waste analysis plan. The facility is located on the Air Impact Area (AIA) portion of the AFWTF.

Naval Station Roosevelt Roads is the owner of the property. AFWTF operates the military installation. Operationally, the Explosive Ordnance Disposal (EOD) detachment is accountable to the Commanding Officer, Naval Station Roosevelt Roads. Administratively, EOD is a component of EOD Group II, Norfolk, Virginia.

Currently, the facility has authorization under interim status for the thermal treatment of waste pyrotechnics, explosives, and propellants (PEPs). The process code for this treatment is T04 for open burning and open detonation. The hazardous waste number for explosive hazardous materials treated at the Inner Range are DOO3, D008 and D009. This revised Part A permit application amends the previous Part A permit application (November 7, 1980).

A-2 CHANGES FROM PREVIOUS PART A APPLICATION

Form 1:

The title, address and telephone number of the facility contact as well as the name and title of the signatory have changed.

Form 3:

The process design capacity has been changed to reflect two T04 units (one open burning and one open detonation). The capacities are given in pounds per burn and pounds per detonation, respectively. Throughout the Part A and B application, pounds is expressed in terms of Net Explosive Weight (NEW) as compared to TNT. This is the reason that the estimated annual amounts are now 5,000 pounds for open burning and 10,000 pounds for open detonation. The waste codes have been altered to reflect that the wastes exhibit heavy metal TCLP toxicity properties as well as the reactivity characteristic.

A more recent photograph and topographic map have been substituted, and a more detailed facility drawing has also been added. The names and titles of the signatories have changed as well.

(fill-in areas are spaced for elite type, i.e., 12 characters/inch). Form Approved OMB No. 158-R0175

FORM 1 GENERAL

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY

GENERAL INFORMATION

Consolidated Permits Program

(Read the "General Instructions" before starting.)

I. EPA I.D. NUMBER

F PRD980536189 D

LABEL ITEMS

I. EPA I.D. NUMBER

III. FACILITY NAME

V. FACILITY MAILING ADDRESS

VI. FACILITY LOCATION

PLEASE PLACE LABEL IN THIS SPACE

GENERAL INSTRUCTIONS

If a preprinted label has been provided, affix it in the designated space. Review the information carefully; if any of it is incorrect, cross through it and enter the correct data in the appropriate fill-in area below. Also, if any of the preprinted data is absent *(the area to the left of the label space lists the information that should appear)*, please provide it in the proper fill-in area(s) below. If the label is complete and correct, you need not complete Items I, III, V, and VI *(except VI-B which must be completed regardless)*. Complete all items if no label has been provided. Refer to the instructions for detailed item descriptions and for the legal authorizations under which this data is collected.

II. POLLUTANT CHARACTERISTICS

INSTRUCTIONS: Complete A through J to determine whether you need to submit any permit application forms to the EPA. If you answer "yes" to any questions, you must submit this form and the supplemental form listed in the parenthesis following the question. Mark "X" in the box in the third column if the supplemental form is attached. If you answer "no" to each question, you need not submit any of these forms. You may answer "no" if your activity is excluded from permit requirements; see Section C of the instructions. See also, Section D of the instructions for definitions of bold-faced terms.

SPECIFIC QUESTIONS	YES	NO	FORM ATTACHED	SPECIFIC QUESTIONS	YES	NO	FORM ATTACHED
A. Is this facility a publicly owned treatment works which results in a discharge to waters of the U.S.? (FORM 2A)		X		B. Does or will this facility *(either existing or proposed)* include a concentrated animal feeding operation or aquatic animal production facility which results in a discharge to waters of the U.S.? (FORM 2B)		X	
C. Is this a facility which currently results in discharges to waters of the U.S. other than those described in A or B above? (FORM 2C)	X			D. Is this a proposed facility *(other than those described in A or B above)* which will result in a discharge to waters of the U.S.? (FORM 2D)		X	
E. Does or will this facility treat, store, or dispose of hazardous wastes? (FORM 3)	X		X	F. Do you or will you inject at this facility industrial or municipal effluent below the lowermost stratum containing, within one quarter mile of the well bore, underground sources of drinking water? (FORM 4)		X	
G. Do you or will you inject at this facility any produced water or other fluids which are brought to the surface in connection with conventional oil or natural gas production, inject fluids used for enhanced recovery of oil or natural gas, or inject fluids for storage of liquid hydrocarbons? (FORM 4)		X		H. Do you or will you inject at this facility fluids for special processes such as mining of sulfur by the Frasch process, solution mining of minerals, in situ combustion of fossil fuel, or recovery of geothermal energy? (FORM 4)		X	
I. Is this facility a proposed stationary source which is one of the 28 industrial categories listed in the instructions and which will potentially emit 100 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5)		X		J. Is this facility a proposed stationary source which is NOT one of the 28 industrial categories listed in the instructions and which will potentially emit 250 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5)		X	

III. NAME OF FACILITY

1 SKIP LANT FLEET WEAPONS TRAIN. FAC. INNER RANGE

IV. FACILITY CONTACT

A. NAME & TITLE (last, first, & title)	B. PHONE (area code & no.)
2 PERKINS SHARON DIR. ENV. ENGR. DIV	809 865 4429

V. FACILITY MAILING ADDRESS

A. STREET OR P.O. BOX

3 BLDG. 31 PUBLIC WORKS

B. CITY OR TOWN	C. STATE	D. ZIP CODE
4 CEIBA	PR	00735

VI. FACILITY LOCATION

A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER

5 EAST VIEQUES

B. COUNTY NAME

A

C. CITY OR TOWN	D. STATE	E. ZIP CODE	F. COUNTY CODE (if known)
6 VIEQUES ISLAND	PR	00765	

EPA Form 3510-1 (6-80) CONTINUE ON REVERSE

CONTINUED FROM THE FRONT

VII. SIC CODES *(4-digit, in order of priority)*

A. FIRST		B. SECOND	
7 9711	*(specify)* National Security	7	*(specify)*
C. THIRD		**D. FOURTH**	
	(specify)	7	*(specify)*

VIII. OPERATOR INFORMATION

A. NAME

8 US NAVAL STATION ROOSEVELT ROADS

B. Is the name listed in Item VIII-A also the owner? [X] YES [ ] NO

F *(specify)*

809 865 4429

BLDG. 31 PUBLIC WORKS

B CEIBA PR 00735

X. EXISTING

9 N PRG 990001 PFE-75-0186-0040-

9 U *(specify)*

(specify)

MAP

Attach to this application the outline of the facility, treatment, storage, or disposal facilities and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in the map area. See instructions for precise requirements.

XII. NATURE OF BUSINESS *(provide a brief description)*

The primary mission of the Atlantic Fleet Weapons Training Facility-Inner Range- is to support the training mission of U.S. Navy Atlantic Fleet. However, Naval Station Roosevelt Roads owns the property and operates the waste treatment facility.

XIII. CERTIFICATION *(see instructions)*

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME & OFFICIAL TITLE *(type or print)*	B. SIGNATURE	C. DATE SIGNED
D.B. Roulston, Captain, USN Commanding Officer		

COMMENTS FOR OFFICIAL USE ONLY

C

EPA Form 3510-1 (6-80) REVERSE

FORM 3 RCRA

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY

HAZARDOUS WASTE PERMIT APPLICATION

Consolidated Permits Program

(This information is required under Section 3005 of RCRA.)

I. EPA I.D. NUMBER

F PRD980536189 1

FOR OFFICIAL USE ONLY

APPLICATION APPROVED	DATE RECEIVED (yr., mo., & day)	COMMENTS

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below *(mark one box only)* to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA I.D. Number, or if this is a revised application, enter your facility's EPA I.D. Number in Item I above.

A. FIRST APPLICATION *(place an "X" below and provide the appropriate date)*

☐ 1. EXISTING FACILITY *(See instructions for definition of "existing" facility. Complete item below.)*

☐ 2. NEW FACILITY *(Complete item below.)*

C 8 | YR. | MO. | DAY | FOR EXISTING FACILITIES, PROVIDE THE DATE *(yr., mo., & day)* OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED *(use the boxes to the left)*

| YR. | MO. | DAY | FOR NEW FACILITIES, PROVIDE THE DATE *(yr., mo., & day)* OPERATION BEGAN OR IS EXPECTED TO BEGIN

B. REVISED APPLICATION *(place an "X" below and complete Item I above)*

☒ 1. FACILITY HAS INTERIM STATUS

☐ 2. FACILITY HAS A RCRA PERMIT

III. PROCESSES – CODES AND DESIGN CAPACITIES

A. PROCESS CODE – Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code*(s)* in the space provided. If a process will be used that is not included in the list of codes below, then describe the process *(including its design capacity)* in the space provided on the form *(Item III-C)*.

B. PROCESS DESIGN CAPACITY – For each code entered in column A enter the capacity of the process.

1. AMOUNT – Enter the amount.
2. UNIT OF MEASURE – For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
CONTAINER *(barrel, drum, etc.)*	S01	GALLONS OR LITERS
TANK	S02	GALLONS OR LITERS
WASTE PILE	S03	CUBIC YARDS OR CUBIC METERS
SURFACE IMPOUNDMENT	S04	GALLONS OR LITERS
Disposal:		
INJECTION WELL	D79	GALLONS OR LITERS
LANDFILL	D80	ACRE-FEET *(the volume that would cover one acre to a depth of one foot)* OR HECTARE-METER
LAND APPLICATION	D81	ACRES OR HECTARES
OCEAN DISPOSAL	D82	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	D83	GALLONS OR LITERS
Treatment:		
TANK	T01	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	T02	GALLONS PER DAY OR LITERS PER DAY
INCINERATOR	T03	TONS PER HOUR OR METRIC TONS PER HOUR; GALLONS PER HOUR OR LITERS PER HOUR
OTHER *(Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Item III-C.)*	T04	GALLONS PER DAY OR LITERS PER DAY

UNIT OF MEASURE	UNIT OF MEASURE CODE	UNIT OF MEASURE	UNIT OF MEASURE CODE	UNIT OF MEASURE	UNIT OF MEASURE CODE
GALLONS	G	LITERS PER DAY	V	ACRE-FEET	A
LITERS	L	TONS PER HOUR	D	HECTARE-METER	F
CUBIC YARDS	Y	METRIC TONS PER HOUR	W	ACRES	B
CUBIC METERS	C	GALLONS PER HOUR	E	HECTARES	Q
GALLONS PER DAY	U	LITERS PER HOUR	H		

EXAMPLE FOR COMPLETING ITEM III *(shown in line numbers X-1 and X-2 below)*: A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

C | DUP | T/A | C 1

LINE NUMBER	A. PROCESS CODE (from list above)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (specify)	2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY	LINE NUMBER	A. PROCESS CODE (from list above)	B. PROCESS DESIGN CAPACITY 1. AMOUNT	2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY
X-1	S 0 2	600	G		5				
X-2	T 0 3	20	E		6				
1	T 0 4	5,000 LB/Burn			7				
2	T 0 4	5,000 LB/Deton.			8				
3					9				
4					10				

III. PROCESSES (continued)

C. SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESSES (code "T04"). FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAPACITY.

1) Open burning unit for explosive hazardous waste. Weight is in net explosive weight.
2) Open detonation unit for explosive hazardous waste. Weight is in net explosive weight.

IV. DESCRIPTION OF HAZARDOUS WASTES

A. **EPA HAZARDOUS WASTE NUMBER** — Enter the four–digit number from 40 CFR, Subpart D for each listed hazardous waste you will handle. If you handle hazardous wastes which are not listed in 40 CFR, Subpart D, enter the four–digit number*(s)* from 40 CFR, Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.

B. **ESTIMATED ANNUAL QUANTITY** — For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non–listed waste*(s)* that will be handled which possess that characteristic or contaminant.

C. **UNIT OF MEASURE** — For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

'acility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into ɔunt the appropriate density or specific gravity of the waste.

D. **PROCESSES**

1. PROCESS CODES:

For listed hazardous waste: For each listed hazardous waste entered in column A select the code*(s)* from the list of process codes contained in Item III to indicate how the waste will be stored, treated, and/or disposed of at the facility.

For non–listed hazardous wastes: For each characteristic or toxic contaminant entered in column A, select the code*(s)* from the list of process codes contained in Item III to indicate all the processes that will be used to store, treat, and/or dispose of all the non–listed hazardous wastes that possess that characteristic or toxic contaminant.

Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code*(s)*.

2. PROCESS DESCRIPTION: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER — Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. Select one of the EPA Hazardous Waste Numbers and enter it in column A. On the same line complete columns B,C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In column D(2) on that line enter "included with above" and make no other entries on that line.
3. Repeat step 2 for each other EPA Hazardous Waste Number that can be used to describe the hazardous waste.

EXAMPLE FOR COMPLETING ITEM IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* — A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non–listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

LINE NO.	A. EPA HAZARD. WASTE NO *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
X-1	K 0 5 4	900	P	T 0 3 D 8 0	
X-2	D 0 0 2	400	P	T 0 3 D 8 0	
	D 0 0 1	100	P	T 0 3 D 8 0	
X-4	D 0 0 2				*included with above*

EPA Form 3510-3 (6-80)

EPA I.D. NUMBER (enter from page 1)

W P R D 9 8 0 5 3 6 1 8 9 | T/A | C: 1

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W DUP | T/A | C: 2 | DUP

IV. DESCRIPTION OF HAZARDOUS WASTES (continued)

LINE NO.	A. EPA HAZARD. WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)				D. PROCESSES 2. PROCESS DESCRIPTION (if a code is not entered in D(1))
1	D003	5,000	P	T04				Open Buring
2	D008		P	T04				Same as Above
3	D009		P	T04				Same as Above
4	D003	10,000	P	T04				Open Detonation
5								
6								
7								
8								
9								
10								
11								
12								
14								
15								
16								
17								
18								
19								
20								
21								
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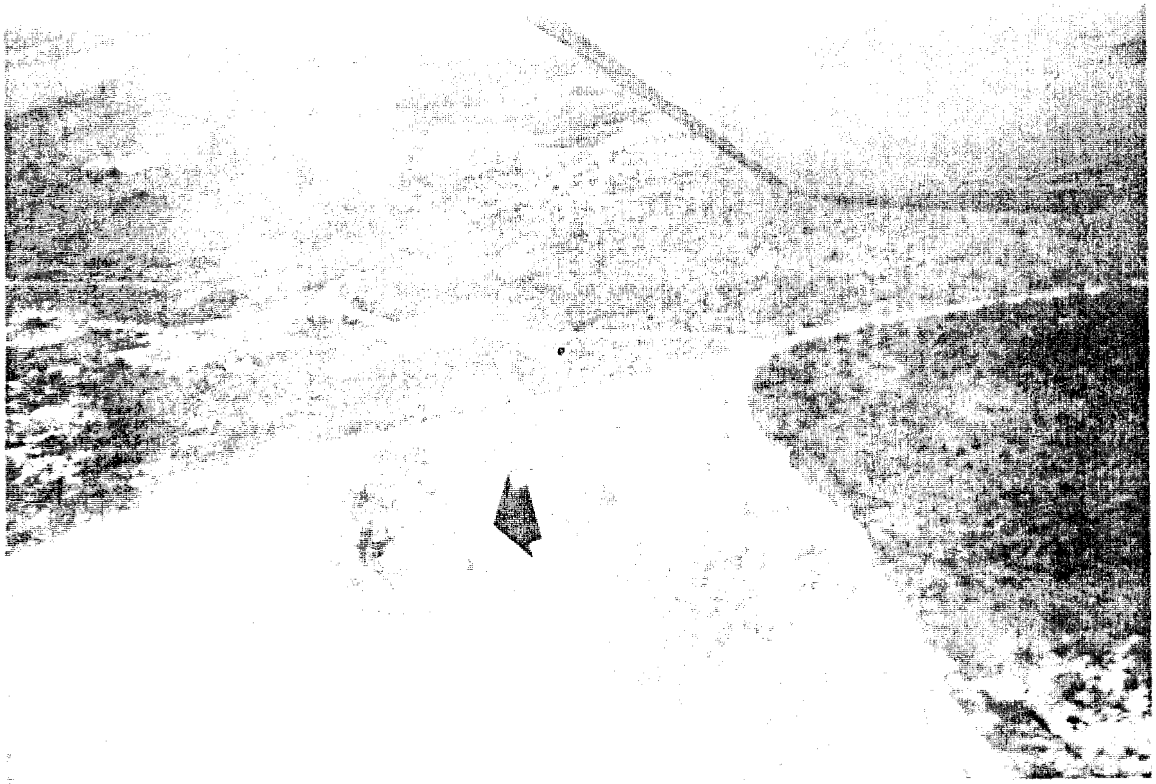
26								

EPA Form 3510-3 (6-80)

CONTINUE ON REVERSE

AERIAL PHOTOGRAPHS OF OPEN BURNING/OPEN DETONATION PIT



Continued from page 4.

V. FACILITY DRAWING *(see page 4)*

See Figure B-2

SECTION B

FACILITY DESCRIPTION

B-1 GENERAL FACILITY DESCRIPTION [40 CFR 270.14(b)(1)]

Vieques Island is located approximately seven miles southeast of the U.S. Naval Station Roosevelt Roads, Puerto Rico. With a total surface area of roughly 33,000 acres, approximately 22,600 acres of Vieques Island are owned by the U.S. Navy. This is comprised of three areas: (1) the Naval Ammunition Facility (NAF), comprised of 8,000 acres and located on the westernmost tip of the island; (2) the Eastern Maneuver Area (EMA), comprised of 11,000 acres and located within the east-central portion of the island; and (3) the Atlantic Fleet Weapons Training Facility, comprised of 3,600 acres and located on the eastern portion of the island. EMA and AFWTF are collectively known as the Inner Range, which encompasses the area extending to a limit of three miles from the shoreline. The AIA is located within the AFWTF; this impact range is primarily utilized for the above-described gunfire and ordnance delivery training activities. Figure B-1 presents a vicinity map which shows the AFWTF location relative to Puerto Rico, Naval Station Roosevelt Roads, and other nearby islands.

Within the Inner Range, the Atlantic Fleet's ships, aircraft and marine forces carry out training in all aspects of naval gunfire support, air-to-ground ordnance delivery, air-to-surface mine delivery, amphibious landings, small arms, artillery and tank fire, and combat engineering. In addition, the AIA is used semiannual for the treatment of retrograde (unserviceable ordnance) which is classified as a hazardous waste. These materials are treated through open burning/open detonation (OB/OD).

The AFWTF, located on the eastern tip of the island, is tasked with providing facilities and scheduling naval gunfire support and air-to-ground ordnance delivery training for Atlantic Fleet ships, NATO ships, air wings, and smaller air units from other allied nations and the Puerto Rican National Guard. In addition, AFWTF operates other military facilities which are not located on Vieques.

The Eastern Maneuver Area is located adjacent to and to the west of the AFWTF. Fleet Marine Force, Atlantic, conducts training for Marine amphibious units, battalion landing teams and combat engineering units on the Eastern Maneuver Area. On occasion, other allies having a presence in the Caribbean and the Puerto Rican National Guard also utilize the Eastern Maneuver Area.

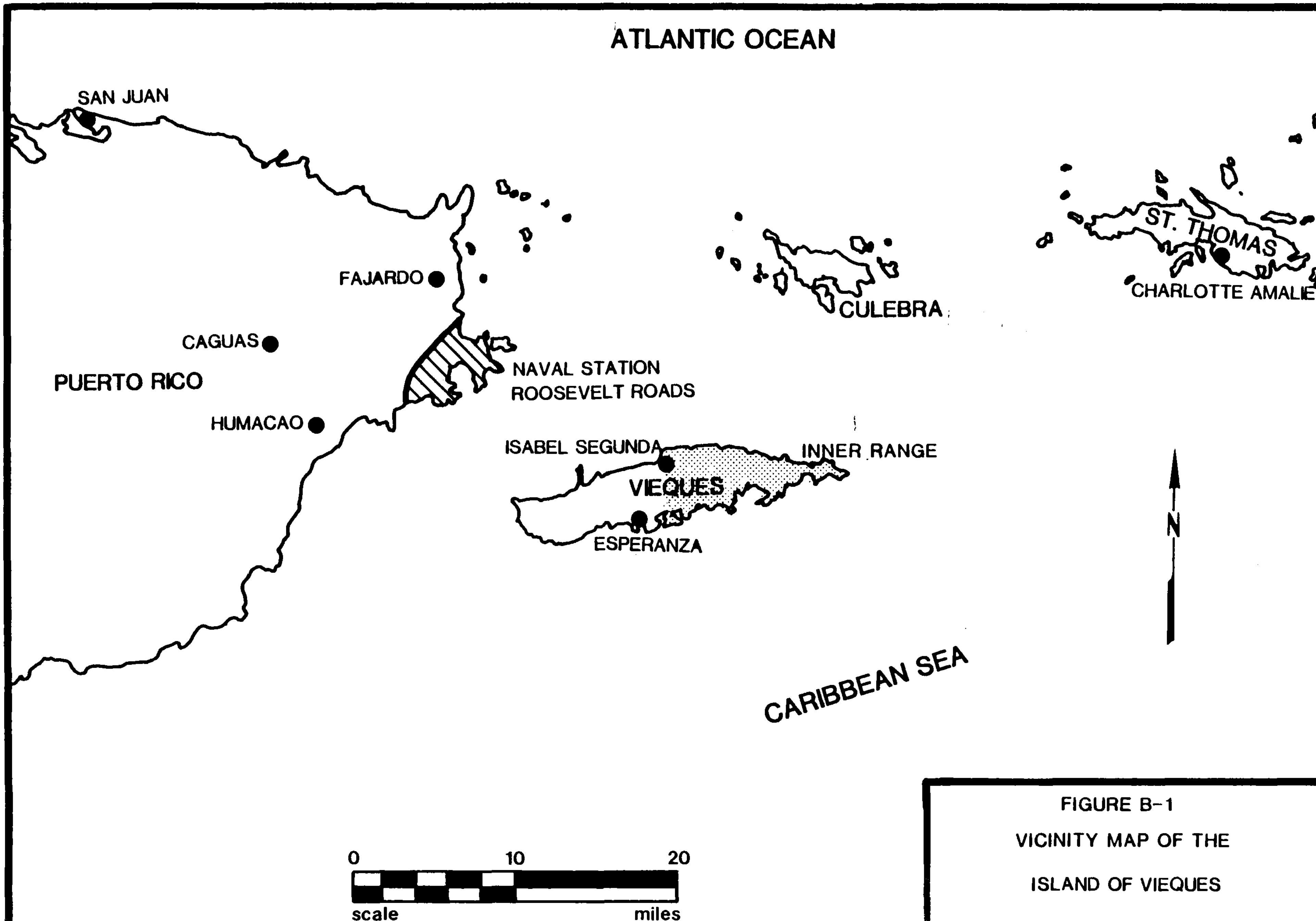


FIGURE B-1

VICINITY MAP OF THE

ISLAND OF VIEQUES

Ammunition is stored at the Naval Ammunition Facility on the western tip of Vieques Island. Operated by the Weapons Department of Naval Station Roosevelt Roads, the Naval Ammunition Facility's mission is to receive, store and issue all ordnance authorized by Naval Station Roosevelt Roads for support of the Atlantic Fleet units.

The west-central portion of the island is privately owned. Several small towns and villages are located within this area. Cattle grazing is the primary land use in this area. In addition, sections of the EMA, excluding the AIA, are leased to local ranchers for cattle grazing.

These three facilities constitute 22,000 acres of the 33,000 acres of Vieques Island. The remainder of the island is owned by either the Commonwealth of Puerto Rico or private individuals. The activities of the AFWTF, the Eastern Maneuver Area and the Naval Ammunition Facility function under the consolidated command of Commander Fleet Air Caribbean and Naval Forces Caribbean, whose headquarters are at Naval Station Roosevelt Roads. The commanding officer of AFWTF has jurisdiction over scheduling all naval exercises in the Inner Range.

The facility location is:
Atlantic Fleet Weapons Training Facility
Vieques Island, Puerto Rico

The facility mailing address is:
Naval Station Roosevelt Roads
Building 31
Public Works Department
Ceiba, Puerto Rico 00735

The facility contact is:
Lt. Sharon L. Perkins
Environmental Officer
Naval Station Roosevelt Roads
Building 31
Public Works Department
Ceiba, Puerto Rico 00735
(809) 865-4429

B-2 TOPOGRAPHIC MAP [40 CFR 270.14(b)(19)]

Figure B-2 is a topographic map of the facility and its surrounding area at a scale of 1" =2,500'. Figures B-2(a) and B-2(b) are topographic maps of the facility and the surrounding area at a scale of 1" = 200', extending 1,000 feet beyond the perimeter of the facility. Figures B-2, B-

2(a), and B-2(b) are located in the map pocket at the end of the application. There are no intake structures, discharge structures, or injection or withdrawal wells within 1,000 feet of the facility. The hazardous waste treatment units and the surface water bodies are shown. The are no specific drainage patterns within the AIA since the area is comprised of a series of small drainage basins and the continuing changes from bombing activities. However, drainage is generally in a southwesterly direction toward Laguna Anones. No permanent decontamination areas are located at either the open burning or detonation units.

Figure B-3 is a map showing the land use of the Atlantic Fleet Weapons Training Facility. As indicated, all the land is used for military purposes. Figure B-4 shows the major features of the Air Impact Area, including some of the major targets and the roads leading in and out of the facility. This drawing also shows the legal boundaries of the AFWTF. Elevation contours are shown on Figure B-2. OP-1 is an observation tower located on the western border of the AIA; it provides an unrestricted view of the entire AIA area.

Figure B-5 contains the most recent wind rose for the area. Appendix B-1 contains wind data compiled from wind surveys performed at Naval Station Roosevelt Roads, the closest location for which data exists. Prevailing winds are from the southeast at approximately 3 to 8 miles per hour.

There are no fences, injection wells, withdrawal wells, runoff control structures, sewers or fire control facilities at the hazardous waste management area. Access to the area is controlled through use of guards and an observation tower (OP-1). The open burning and open detonation sites are shown in Figure B-2(b). The hazardous waste loading/unloading area is immediately adjacent to the units. The only surface waters within a one-thousand feet radius of the units is the Laguna Anones. Vieques itself, being an island, is surrounded by the Caribbean Sea.

B-3 LOCATION INFORMATION [40 CFR 270.14(b)(11)]

SEISMIC STANDARDS

Vieques Island is not included in the list found in Appendix VI in 40 CFR 264; therefore, the seismic standard does not apply.

FLOODPLAIN STANDARDS

No Federal Insurance Administration (FIA) maps have been prepared for the current portion of Vieques Island occupied by the Air Impact Area. Reportedly, FIA maps for the civilian area of the island are in preparation. Preliminary maps (panels 60B, 60D, 61A and 61C, prepared for the Junta de Planification de Puerto Rico) identify narrow 100-year floodplain zones along internal drainage streams called *quebradas*. The typical floodplain depth for those areas is less

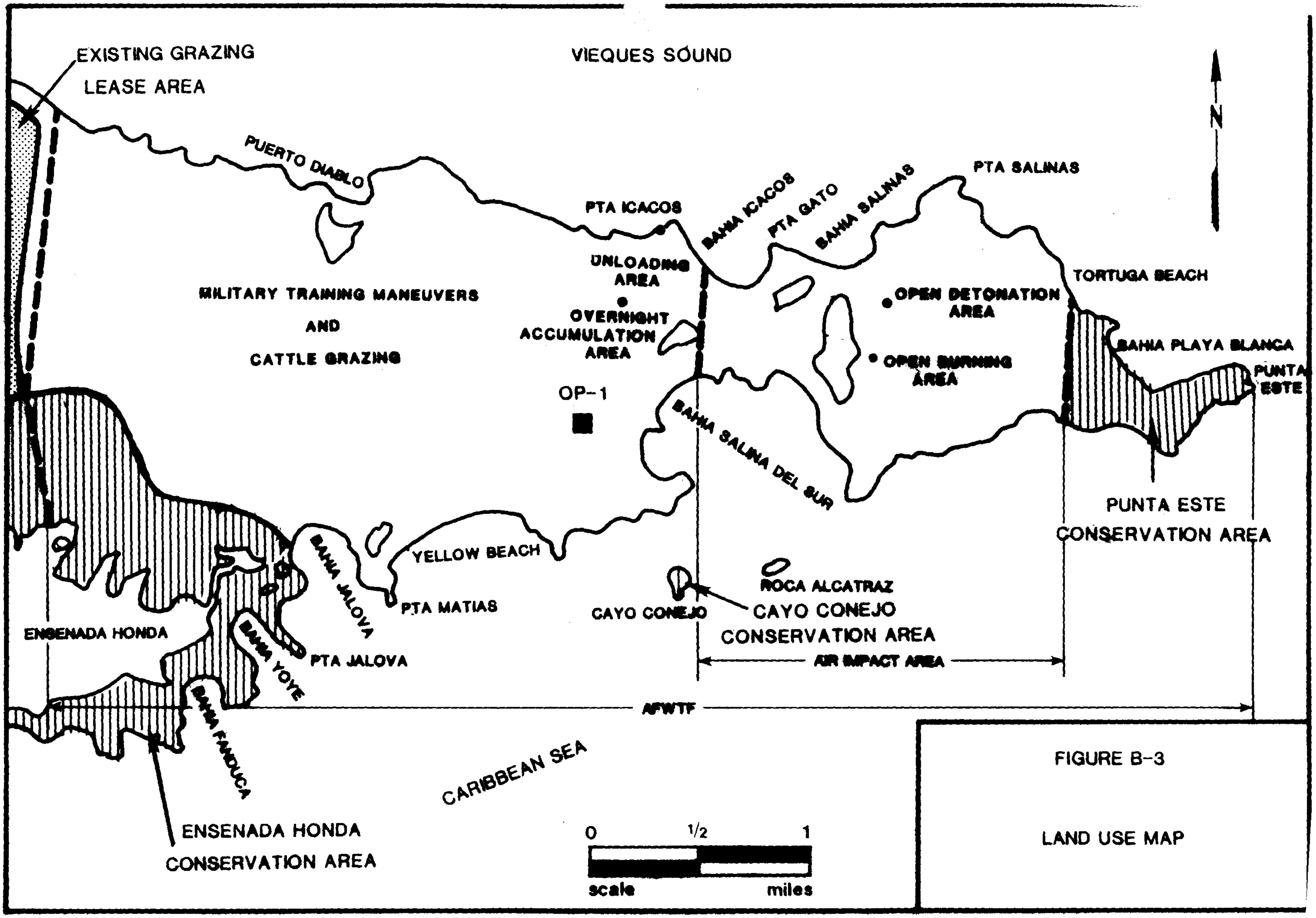


FIGURE B-3

LAND USE MAP

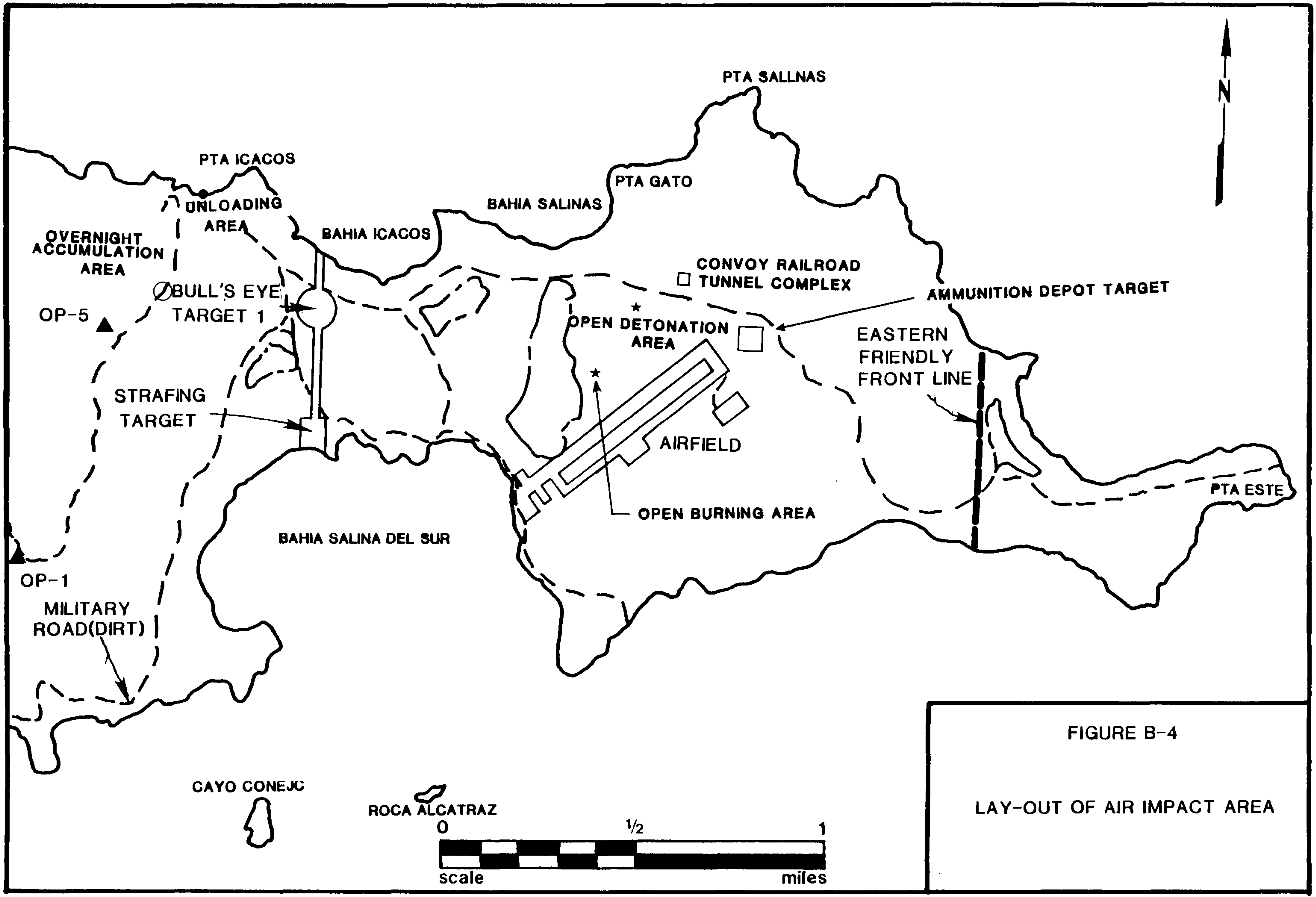
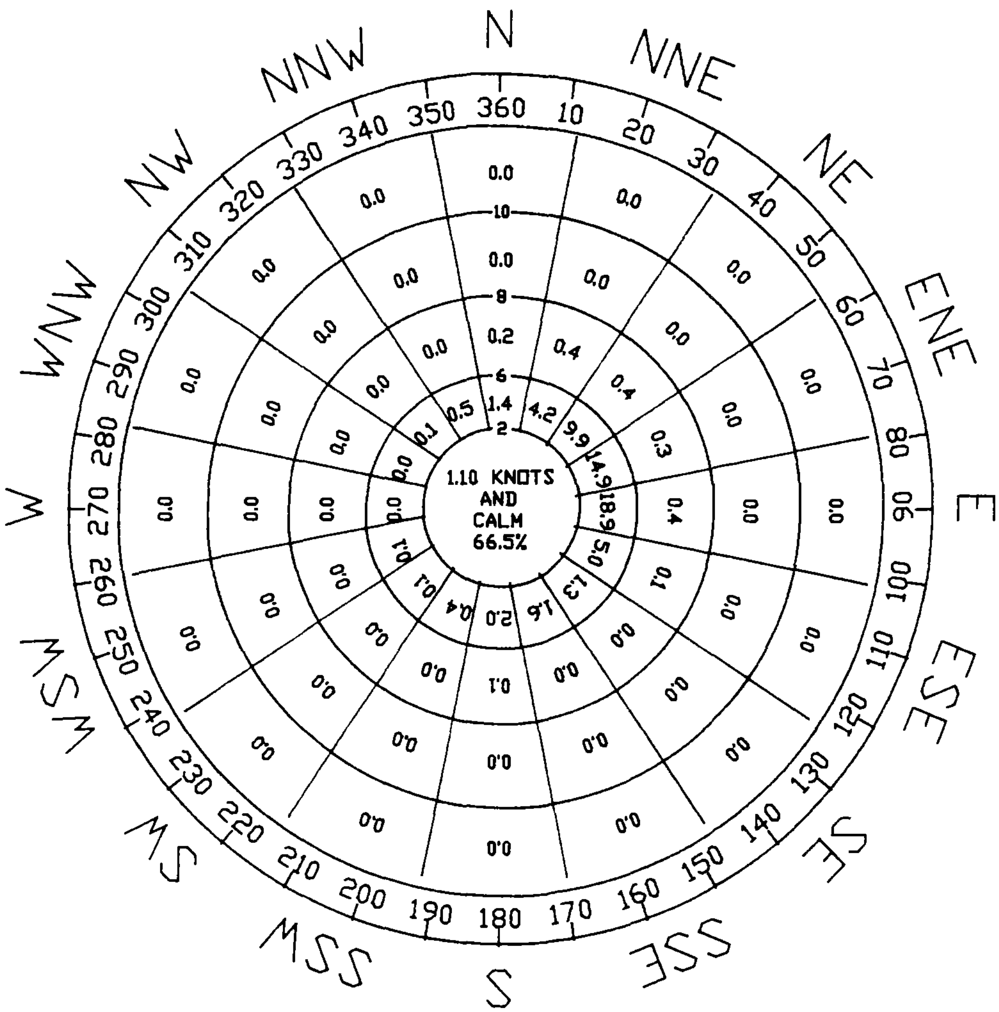


FIGURE B-4

LAY-OUT OF AIR IMPACT AREA

DATE: 10/28/88
REVISION NO. 0
SECTION B



VELOCITY IN METERS PER SECOND

SOURCE: NATIONAL WEATHER SERVICE
STATION: ROOSEVELT ROADS, PR.
PERIOD: 01/01/64 - 12/31/78

FIGURE B-5
WIND ROSE
VIEQUES OB/OD

than six meters. By this estimation, the hazardous waste units are outside the 100-year floodplain. Unfortunately, copies of these preliminary maps are unavailable to the general public.

If and when FIA maps are prepared for the area, they will be submitted as an addendum to this application.

B-4 TRAFFIC INFORMATION [40 CFR 270.14(b)(10)]

PATTERNS AND VOLUMES

The units for open burning and open detonation of hazardous waste are located within the Air Impact Area. This area contains numerous targets for ordnance delivery training. Twice each year, usually June 15 through July 15 and December 15 through January 15, such training at the AFWTF is suspended. During those periods, the Explosive Ordnance Detachment (EOD) clears all accessible areas (Figure B-4) in the Air Impact Area of all unexploded ordnance. In the interest of safety, such unexploded ordnance must be destroyed on the range, since ordnance that has failed to function as designed is inherently dangerous to move or even to leave in place. Destruction of unexploded ordnance found on the range is an integral part of the training and testing missions and is therefore considered to be outside the scope of RCRA.

Once the area is safe, heavy equipment is brought into the area to restore the targets to useful condition. Also during this period, explosive ordnance from the Naval Ammunition Facility is shipped to the Air Impact Area for hazardous waste treatment by either open burning or open detonation, conducted by EOD. These are the only times that there is traffic on the roads. Typically, the number of vehicles used for transportation will be five jeeps, two van/maintenance trucks (5 ton) and eight heavy equipment vehicles.

The average quantity of waste ordnance transported at any one time to the OB facility is 3,000 pounds; the maximum is 5,000 pounds. The average and maximum quantity of waste ordnance transported at any one time to the OD facility is 5,000 pounds.

TRAFFIC CONTROL

There is no traffic control by way of signs or lights. Some movement is directed by hand signals.

LOAD-BEARING CAPACITY

The roads are made of native soils. In this location, the native soils are comprised of rock and clay. The roads meet the load-bearing requirements for hazardous waste transportation.

APPENDIX B-1

FACILITY WIND DATA

ROOSEVELT ROADS, PR

DIRECTOR

NAVAL OCEANOGRAPHY AND METEOROLOGY

SMOS

(Summary of Meteorological Observations, Surface)

Prepared by

Naval Weather Service Detachment

Federal Building

Asheville, N. C. 28801

NAVAL WEATHER SERVICE

Job Number: 72006

Period: 1948-77

Station: #11630

Date: JULY, 1978

SUMMARY OF METEOROLOGICAL OBSERVATIONS, SURFACE

DIRNAVOCEANMET ltr 3146 Ser 1032 dated 26 August 1977 (NOTAL) established the following policy for SMOS production and updating:

1. Ten years of data will be used as the standard period of record (POR).

2. All available data will be used for extreme values.

3. Summarize (update) every five years.

   a. Summarize the five year period (1973-1977) for all sections of the SMOS except extremes. The 5 year summary will be an intermediate SMOS to show secular trends. All available data through 1977 will be included for extreme values.

   b. The update in 1983 will include the POR 1973 through 1982, with all available data through 1982 for extreme values.

   c. The update in 1988 will be an intermediate SMOS (POR 1983-1987). All available data through 1987 will be included for extreme values.

   d. In 1993 the POR will be 1983 through 1992. All available data through 1992 will be used for extreme values.

Each standard POR (10 years) summary should be retained by individual stations along with the SMOS prepared in 1973. The retention of these summaries will provide the most comprehensive climatological file for your station.

DESCRIPTION: Preceding each section is a brief description of the data comprising each part of the summary and the manner of presentation. Tabulations are prepared from 3-hourly and daily observations recorded by stations operated by the U.S. Navy and U.S. Marine Corps. 3-hourly observations are defined as these record or record-special observations recorded at scheduled 3-hourly intervals. Daily observations are selected from all data recorded on reporting forms and combined into Summary of the Day observations (prepared from record-special, local, summary of the day, remarks, etc.).

COMMENT: All observations summarized in this tabulation have been computer edited for consistency and reasonableness prior to, or during, the processing stage. Efforts to improve the quality of the data after summarization are expensive, i.e., the improvement might consist of the elimination of one suspect or erroneous value. The cost of preparing "perfect" copy can be prohibitive due to the handwork involved. Suspect cases will occur infrequently, but users should not disregard extreme values completely as some could be valid. Questionable values will most likely be single occurrences shown by a percentage frequency of ".0". (This value indicates a percent less than ".05," which, in most cases, reflects a single observation.) Since most stations summarized now have in excess of 10,000 3-hourly observations, the occurrence of an occasional spurious value should not in itself be considered significant. Every effort is made by this office to maintain a high degree of accuracy and reliability in these tables, and the Naval Weather Service Detachment (NWSD), Asheville, N. C. welcomes your comment and criticisms.

STATION NO OR SUMMARY	STATION NAME	LATITUDE	LONGITUDE	STATION ELEV (FT)	CALL SIGN	WMO NUMBER
11630	Roosevelt Roads, P.R.	18°15'N	65°38'W	39	MJNR	78535

STATION LOCATION AND INSTRUMENTATION HISTORY

NUMBER OF BARO LOCATION	GEOGRAPHICAL LOCATION & NAME	TYPE OF STATION	AT THIS LOCATION FROM	AT THIS LOCATION TO	LATITUDE	LONGITUDE	ELEVATION ABOVE MSL FEET	ELEVATION ABOVE MSL TYPE BAROMETER	OBS PER DAY
1.	Unknown	Navy			18°15'N	65°38'W	66.7	Unknown	
2.	Aerological Office	"		1959	"	"	33	Mercurial	
3.	Meteorological office ops bldg	"	1959	1963	"	"	37	"	
4.	" " " "	"	1963	1964	"	"	33	"	
5.	South bulkhead of met. office	"	1964	1977	"	"	36	"	
6.	Central partition of met office	"	1977		"	"	36	"	
1a.	AN/GMQ-14A console	"	1965	1975	"	"	38	Aneroid	
2a.	AN/GMQ-29 auto met station	"	1975		"	"	38	"	

NUMBER OF LOCATION	DATE OF CHANGE	SURFACE WIND EQUIPMENT INFORMATION: LOCATION	TYPE OF TRANSMITTER	TYPE OF RECORDER	HT ABOVE GROUND	REMARKS, ADDITIONAL EQUIPMENT, OR REASON FOR CHANGE
1.		Control tower	PMQ-3		90' MSL	1. Barograph (marine)
2.	Prior 1960	Roof of ops tower	Unknown		87' MSL	2. Auto met station (AN/GMQ-29)
						3. Ceiling light (ML-121-D)
3.	1960	300'SE of the edge of runway 06-24 near east end of airfield	AN/UMQ-5	RD-108B	Unknown	4. Theodolite (Aero 1937 USN)
						5. Radar (FPS-106)
4.	1963	Extended mast	"	"	28' MSL	
5.	1971	450'E of operations building	"	"	41' MSL	

NWSD, Federal Building
Asheville, NC

NWSD, Federal Building

Asheville, N. C.

PART C SURFACE WINDS

Presented in this part are various tabulations of surface winds as follows:

1. Extreme Values - Peak Gusts: Derived from daily observations and presented by individual year and month for the entire period of record available. Speeds are presented in knots, while directions are given in 16 compass points from the beginning of record through 1963, and in tens of degrees starting in January 1964. When 90% or more of the daily observations of peak gust wind data are available for a month, the extreme is selected and printed. These values are then used to compute means and standard deviations for the entire period. Every month of a year must have valid observations present before the ALL MONTHS value is selected for that year. Means and standard deviations are computed when four or more values are present for any column. A supplementary list of Peak Gusts by year-month with < 90% observations reported is also provided.

   NOTE: According to Circular N specifications, "peak gust data are recorded only at stations with continuous instantaneous wind-speed recorders."

2. Bivariate percentage frequency tabulations: Derived from 3-hourly observations, these tabulations are a percentage frequency of wind directions to 16 compass points and calm by wind speeds (knots) in increments of Beaufort classifications. Percentages are shown by both direction and speed, and in addition the mean wind speed for each direction.

   A separate category is provided on the form for variable winds, which are reported in some data sources. In these data where light and variable winds are reported with no directions but with speeds given, the speeds will be summarized in the appropriate groups opposite the column headed VARBL.

   a. Three tables are prepared for all surface winds included, and for all years combined as follows:

      (1) Annual - all hours combined

      (2) By month - all hours combined

      (3) By month - by standard 3-hour groups

   b. A separate annual table is also presented for surface winds meeting the following ceiling and visibility conditions: INSTRUMENT CLASS: Ceiling 200 through 1400 feet inclusive with visibility equal to or greater than 1/2 mile, and/or visibility 1/2 through 2-1/2 miles inclusive with ceiling equal to or greater than 200 feet.

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	JAN

CLASS: ALL WEATHER
HOURS (L.S.T.): ALL
CONDITION:

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.3	.9	.4									1.5	4.2
NNE	.2	2.1	2.3	.2								4.8	6.7
NE	1.6	5.1	9.4	3.1								19.0	7.7
ENE	2.5	6.8	13.9	8.1								31.3	8.3
E	1.9	6.3	7.9	3.0	.2							19.3	7.5
ESE	1.5	1.0	1.0	.4								4.0	5.5
SE	.2	.8	.4	.2								1.6	6.0
SSE	.1	.3	.3	.1								.8	6.7
S	.3	.7	.8	.1								1.9	6.1
SSW	.1	.2	.2									.5	6.3
SW	.5	.2	.2	.1								1.0	4.8
WSW	.1	.1										.2	3.0
W	.2											.2	1.5
WNW	.2	.2										.4	2.6
NW	.6	.1										.6	2.1
NNW	.5	.2										.6	2.1
VARBL													
CALM												12.3	
	11.1	24.3	36.9	15.2	.2							100.0	6.5

TOTAL NUMBER OF OBSERVATIONS 1240

DIRNAVOCEANMET SMOS

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

11630 — STATION
ROOSEVELT ROADS, PUERTO RICO — STATION NAME
73-77 — YEARS
FEB — MONTH

ALL WEATHER — CLASS
ALL — HOURS (L.S.T.)

CONDITION

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.4	.6	.5	.1								1.7	5.4
NNE	.4	2.0	2.3	.1								4.8	6.6
NE	.9	3.2	6.7	.9								11.7	7.3
ENE	1.4	6.3	12.1	3.1	.1							23.0	7.6
E	3.0	8.6	12.9	4.0								28.5	7.2
ESE	1.4	1.6	2.9	1.2								7.1	7.2
SE	.7	1.2	.6									2.5	5.0
SSE	.2	.6	.6									1.4	6.2
S	.2	.6	1.0	.1								1.9	7.1
SSW	.7	.8	.1									1.6	3.9
SW	.6	.4										1.0	2.9
WSW			.1	.1								.2	11.0
W	.2	.2										.4	4.0
WNW	.3											.3	1.7
NW	.6	.6										1.2	3.4
NNW	.7	.5	.2	.1								1.5	4.3
VARBL													
CALM												11.3	
	11.8	27.1	40.1	9.6	.1							100.0	6.2

TOTAL NUMBER OF OBSERVATIONS 1128

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	MAR

CLASS	HOURS (L.S.T.)
ALL WEATHER	ALL

CONDITION

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.8	.7	.4									1.9	4.5
NNE	.3	1.0	.7	.1								2.1	6.2
NE	1.0	4.8	6.3	.9								13.0	7.0
ENE	1.0	5.8	13.1	2.8								22.7	7.8
E	2.7	9.7	15.6	7.5	.2							35.7	7.9
ESE	.6	1.6	2.4	1.1								5.8	7.7
SE	.8	1.0	.3	.1								2.2	4.6
SSE	.1	.6	1.0	.1								1.8	6.7
S	.2	.5	1.0	.5								2.1	8.4
SSW	.2	.1	.1									.4	4.0
SW	.6	.5										1.1	3.0
WSW	.2	.1										.3	2.8
W	.1											.1	2.0
WNW		.1										.1	4.0
NW	.2											.2	2.7
NNW	.2	.2										.4	3.0
VARBL													
CALM												10.0	
	9.2	20.6	41.0	13.1	.2							100.0	6.6

TOTAL NUMBER OF OBSERVATIONS 1240

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	APR

CLASS	HOURS (L.S.T.)
ALL WEATHER	ALL

CONDITION

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	1.1	.5	.5	.1								2.2	4.8
NNE	.1	1.2	1.1									2.3	6.5
NE	.8	3.8	5.7	1.3								11.5	7.4
ENE	.8	6.3	11.9	3.6								22.5	8.0
E	2.3	8.8	12.5	3.3								26.9	7.3
ESE	1.5	1.6	2.8	1.2								7.0	7.0
SE	.8	1.3	.7	.1	.1							2.9	5.4
SSE	.7	.8	1.8	.3								3.6	7.1
S	.5	.9	2.0	.8								4.3	7.8
SSW	.2	.4	.2	.1								.8	6.0
SW	.6	.2										.8	3.4
WSW	.2	.2										.3	3.0
W	.1											.1	1.0
WNW		.1										.1	4.0
NW	1.1	.4	.1									1.6	2.8
NNW	1.4	.8	.7									2.8	4.1
VARBL													
CALM												10.2	
	12.1	27.1	39.9	10.6	.1							100.0	6.4

TOTAL NUMBER OF OBSERVATIONS 1198

SURFACE WINDS

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	MAY

CLASS	HOURS (L.S.T.)
ALL WEATHER	ALL

CONDITION

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.5	.6	.4									1.5	5.1
NNE	.3	.6	.7	.1								1.7	6.2
NE	.8	1.8	1.3	.1								4.0	5.4
ENE	1.6	4.5	5.0	.9	.1							12.1	6.5
E	4.2	15.4	17.6	4.4								41.6	7.0
ESE	1.8	4.7	5.7	2.2								14.4	7.2
SE	1.3	1.9	1.9	.3								5.5	6.8
SSE	.9	1.2	1.9	1.0								5.1	7.3
S	.3	1.4	2.6	.4								4.7	7.3
SSW	.2	.3										.5	3.3
SW	.2	.2										.3	3.3
WSW	.1											.1	2.0
W													
WNW	.1											.1	1.0
NW	.2											.2	2.7
NNW	.7	.2	.1									1.0	3.6
VARBL													
CALM												7.3	
	13.1	32.8	37.3	9.4	.1							100.0	6.2

TOTAL NUMBER OF OBSERVATIONS 1240

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

11630 — STATION
ROOSEVELT ROADS, PUERTO RICO — STATION NAME
73-77 — YEARS
JUN — MONTH
ALL WEATHER — CLASS
ALL — HOURS (L.S.T.)
CONDITION

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.1	.1	.1									.2	4.7
NNE	.3	.2	.2									.8	4.5
NE	.4	1.7	1.7	.4								4.2	7.0
ENE	1.2	5.2	10.2	1.1								17.7	7.2
E	4.3	18.1	22.1	5.5								50.0	7.1
ESE	1.4	4.2	6.2	3.1								14.9	7.8
SE	.8	1.4	1.3	.2								3.7	5.8
SSE	.7	1.0	.6	.2								2.5	5.9
S	.2	.7	.9	.2								2.0	6.8
SSW		.1	.1									.2	7.0
SW													
WSW		.2										.2	5.0
W													
WNW	.1	.1										.2	4.0
NW													
NNW	.1											.1	2.0
VARBL													
CALM												3.3	
	9.7	33.0	43.4	10.6								100.0	6.8

TOTAL NUMBER OF OBSERVATIONS 1200

DIRNAVOCEANMET SMOS

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	JUL

CLASS	HOURS (L.S.T.)
ALL WEATHER	ALL

CONDITION

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥ 56	%	MEAN WIND SPEED
N	.2	.2										.3	3.3
NNE	.3	.4	.2	.1								1.0	4.6
NE	1.4	2.5	4.3	.3								8.3	6.5
ENE	2.2	11.3	12.7	1.3								27.5	6.6
E	4.9	15.9	20.8	3.2								44.8	6.9
ESE	.5	2.2	4.0	1.1								7.8	7.5
SE	.5	.5	.7									1.7	5.8
SSE	.3	.4	.2	.2								1.1	5.6
S	.2	.3	.5									1.0	6.4
SSW	.1	.2	.1									.4	5.4
SW	.1											.1	3.0
WSW			.1									.1	7.0
W	.1	.1										.2	3.0
WNW	.2											.2	1.5
NW	.1											.1	2.0
NNW	.4	.1										.5	2.7
VARBL													
CALM												5.1	
	11.4	34.1	43.5	6.0								100.0	6.4

TOTAL NUMBER OF OBSERVATIONS 1224

DIRNAVOCEANMET SMOS

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	AUG

CLASS	HOURS (L.S.T.)
ALL WEATHER	ALL

CONDITION

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.2	.2										.4	2.8
NNE	.8	.9	.3	.1								2.1	4.7
NE	1.0	3.3	4.3	.3								9.0	6.5
ENE	1.9	9.5	11.6	1.6	.1							24.8	6.9
E	4.8	12.7	17.7	3.6								38.7	6.8
ESE	1.4	3.0	4.0	.6								9.0	6.7
SE	1.0	1.0	.9	.1								2.9	8.1
SSE	.1	.4	.4									.9	6.1
S	.2	.6	.3									1.1	6.4
SSW	.1	.2	.2									.5	5.8
SW	.3											.3	2.0
WSW	.1	.1										.2	3.5
W		.2										.2	5.0
WNW	.2	.1										.2	2.7
NW	.2											.2	2.0
NNW	.4											.4	1.8
VARBL													
CALM												9.0	
	12.7	32.2	39.8	6.1	.1							100.0	6.0

TOTAL NUMBER OF OBSERVATIONS 1240

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	SEP

CLASS	HOURS (L.S.T.)
ALL WEATHER	ALL

CONDITION

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.5	.3	.2									1.1	5.6
NNE	1.0	1.2	1.0	.3								3.6	5.6
NE	2.1	4.7	3.4	.5								10.7	5.8
ENE	2.6	6.7	6.9	.6								16.8	5.8
E	5.6	9.8	7.7	1.1								24.2	5.7
ESE	2.1	2.9	2.6	.5								8.1	5.8
SE	1.3	1.8	1.3	.4								4.6	5.1
SSE	.5	1.7	1.2	.4	.1							3.9	6.4
S	.6	1.5	.7	.4		.1						3.1	6.1
SSW	.7	.5	.6	.1								1.8	5.0
SW	.3	.4	.2									.9	4.2
WSW	.6	.2										.6	3.3
W	.2											.2	2.7
WNW	.5											.5	1.7
NW	.6	.1										.5	2.3
NNW	1.0											1.0	2.2
VARBL													
CALM												19.1	
	19.6	33.8	25.7	3.5	.1	.1						100.0	4.5

TOTAL NUMBER OF OBSERVATIONS 1200

DIRNAVOCEANMET SMOS

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	OCT

CLASS: ALL WEATHER   HOURS (L.S.T.): ALL

CONDITION:

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	1,6	,3	,1									2,0	2,7
NNE	1,4	1,7	,6	,1								3,8	4,6
NE	2,4	5,0	1,4									8,8	4,8
ENE	3,1	8,5	6,6	,2		,1						18,5	5,8
E	4,7	11,0	8,5	1,3	,1							25,6	6,1
ESE	1,4	2,7	1,8	,1	,1							6,0	5,6
SE	1,3	1,7	1,0	,1								4,1	5,0
SSE	,2	2,0	1,0									3,1	5,8
S	,7	1,0	1,0	,1								2,8	5,7
SSW	1,0	,7	,6									2,3	4,4
SW	1,6	,8	,2									2,7	3,7
WSW	,3	,2	,1									,6	3,8
W	,2	,2										,3	3,3
WNW	,1	,1										,2	2,5
NW	,2											,2	2,0
NNW	,3	,2										,6	2,5
VARBL													
CALM												18,1	
	20,8	36,0	22,9	1,9	,2	,1						100,0	4,4

TOTAL NUMBER OF OBSERVATIONS 1240

DIRNAVOCEANMET SMOS

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	NOV

CLASS	HOURS (L.S.T.)
ALL WEATHER	ALL

CONDITION

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	1,2	,3										1,5	2,9
NNE	,7	1,3	1,6	,3								3,9	6,6
NE	1,2	4,7	5,7	,6								12,2	6,7
ENE	2,9	7,2	9,2	,3								19,7	6,3
E	4,2	9,9	9,7	,8								24,7	6,1
ESE	,9	1,7	1,2	,2								4,2	5,7
SE	,8	1,4	,4	,1								2,7	4,5
SSE	,7	,8	,2									1,7	4,4
S	1,1	1,1	,7	,1								3,0	4,9
SSW	,7	,6	,3									1,6	4,5
SW	,3	,2	,1									,6	3,7
WSW	,7	,2										,8	2,7
W	,2											,2	3,0
WNW	,1	,2										,2	3,0
NW	,4	,1										,5	2,2
NNW	,7	,2										,9	2,6
VARBL													
CALM												21,5	
	16,7	30,1	29,3	2,3								100,0	4,6

TOTAL NUMBER OF OBSERVATIONS 1200

DIRNAVOCEANMET SMOS

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	DEC

CLASS: ALL WEATHER HOURS (L.S.T.): ALL

CONDITION:

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	1.7	2.2	1.1	.2	.1							5.2	5.3
NNE	.6	2.9	4.1	.5								8.1	6.9
NE	1.5	5.3	7.7	1.6	.1							16.2	7.5
ENE	2.4	6.2	9.4	4.3								22.3	7.6
E	3.3	8.3	8.4	1.0								21.0	6.2
ESE	.5	1.5	2.2	.2								4.4	6.5
SE	.6	.7	.6	.1								1.9	5.2
SSE	.2	.5	.1									.8	4.4
S	.3	1.0	1.1									2.4	6.2
SSW	.1	.1	.2									.3	5.5
SW	.2	.2										.4	3.4
WSW		.2										.2	4.0
W		.1										.1	5.0
WNW	.1	.4										.5	4.0
NW	.6	.3										.9	2.8
NNW	.9	.7	.1									1.7	3.8
VARBL													
CALM												13.6	
	13.0	30.6	34.9	7.7	.2							100.0	5.7

TOTAL NUMBER OF OBSERVATIONS 1240

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	ALL

CLASS: ALL WEATHER

HOURS (L.S.T.): ALL

CONDITION:

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.8	.3	.3	.0	.0							1.6	4.4
NNE	.5	1.3	1.3	.2								3.2	6.2
NE	1.2	3.8	4.8	.8	.0							10.7	6.8
ENE	2.0	7.2	10.1	2.3	.0	.0						21.6	7.1
E	3.9	11.2	13.5	3.2	.0							31.8	6.9
ESE	1.2	2.4	3.1	1.0	.0							7.7	6.9
SE	.8	1.2	.8	.1	.0							3.0	5.3
SSE	.4	.9	.8	.2	.0							2.2	6.3
S	.4	.9	1.1	.2		.0						2.5	6.6
SSW	.3	.3	.2	.0								.9	4.8
SW	.3	.2	.1	.0								.6	3.6
WSW	.2	.1	.0	.0								.3	3.7
W	.1	.1										.2	3.2
WNW	.1	.1										.2	2.7
NW	.4	.1	.0									.5	2.7
NNW	.6	.3	.1	.0								1.0	3.4
VARBL													
CALM												11.7	
	13.5	30.7	36.0	8.0	.1	.0						100.0	5.9

TOTAL NUMBER OF OBSERVATIONS 14590

NAVAL WEATHER SERVICE
DETACHMENT
ASHEVILLE, NC

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

STATION	STATION NAME	YEARS	MONTH
11630	ROOSEVELT ROADS, PUERTO RICO	73-77	ALL

CLASS: INSTRUMENT

HOURS (L.S.T.): ALL

CONDITION: CIG 200 TO 1400 FT W/VSBY 1/2 MI OR MORE, AND/OR VSBY 1/2 TO 2-1/2 MI W/CIG 200 FT OR MORE

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	2.7	1.3	1.3									5.4	4.5
NNE	.7	1.3	4.0	.7								6.7	7.4
NE	1.3	2.0	2.0	1.3								6.7	7.2
ENE	.7	4.0	2.0	4.0		.7						11.4	9.8
E	3.4	4.0	7.4	5.4								20.1	8.0
ESE	.7	2.0	2.7	2.0								7.4	9.2
SE	.7	2.0	2.0									4.7	6.4
SSE	.7	1.3	.7									2.7	4.5
S	.7	.7	2.0	1.3								4.7	8.0
SSW		1.3	1.3	.7								3.4	7.0
SW		.7	1.3									2.0	8.0
WSW	.7	2.0										2.7	4.0
W		2.0										2.0	6.0
WNW	.7	1.3										2.0	3.3
NW	1.3	.7										2.0	2.7
NNW		1.3										1.3	5.0
VARBL													
CALM												14.8	
	14.1	28.2	26.8	15.4		.7						100.0	6.2

TOTAL NUMBER OF OBSERVATIONS 149

SECTION C

WASTE CHARACTERISTICS

C-1 CHEMICAL AND PHYSICAL ANALYSES OF WASTE [40 CFR 270.14(b)(2)]

INTRODUCTION

One of the reasons this facility is considered a miscellaneous unit is the unique nature of the waste treated. Unlike drums of spent solvent, these wastes are packaged in devices such as bombs, grenades, rockets and flares. Further, these items have a long history (prior to RCRA regulations) of being tracked from cradle-to-grave for safety purposes.

An extensive series of standard operating procedures, technical manuals, technical bulletins, and field publications provide instruction on the proper methods and techniques of treating explosive ordnance. These include NAVSEA OP-5 (*Ammunition and Explosives Ashore Safety Regulations for Handling, Storing, Production, Renovation and Shipping*) and the 60-series publications. NAVSEA OP-5 Chapter 13 contains general criteria for both open burning and open detonation disposal methods. EOD utilizes OP-5 procedures in conducting OB/OD operations; however, due to the unique aspects of each operation, field decisions based on field conditions and the technical expertise of the EOD personnel are also made. NAVSEA OP-5 is described in detail in Section D, and the chapter pertaining to ordnance disposal is included in Appendix D-2. The 60-series publications are a collection of over 1,700 documents providing detailed handling and disposition instructions for individual types of ordnance. Ordnance specific technical manuals (TMs) and field manuals (FMs) also provide information on ordnance disposal.

Through their extensive training, EOD Technicians are capable of identifying ordnance through many means. First, all explosive ordnance is labeled with a specific military number. From this number, the ordnance can be identified. Once the ordnance has been identified, the type of explosives, propellants or pyrotechnics in the ordnance can be identified.

One possible exception to this is the ash generated during open burning. While this ash will almost certainly no longer have the hazardous characteristic of reactivity, it may have the hazardous characteristic of toxicity as defined by the TCLP analytical procedure. Previous experience indicates that the ash is not a hazardous waste. However, it will be drummed and transported to the mainland as a potential hazardous waste. The ash will be stored in the Roosevelt Roads hazardous waste container storage facility until it is sampled and analyzed to determine if it meets the definition of a hazardous waste. If the ash should meet this definition, it will be declared a hazardous waste at that time and will be stored, treated and disposed of per all applicable federal and Puerto Rican hazardous waste regulations.

DESCRIPTION OF ORDNANCE

Explosives

Explosives fall into one of the following two categories:

- Detonating or high explosive materials:

  (a) Primary, or initiating explosives (detonators), such as lead azide, mercury fulminate, lead styphnate (lead trinitroresorcinate).

  (b) Secondary explosives such as TNT-AN, Tetryl, PETN, RDX, TNT, ammonium picrate, picric acid, DNT (Dinitro-toluene).

- Deflagration or low explosives such as smokeless powder (colloided cellulose nitrate), black powder, nitrocotton.

Primary or initiating high explosives are quite sensitive materials which can be made to explode by the application of fire or by means of a blow. They are very dangerous to handle and are used in comparatively small quantities to start the explosion of larger quantities of less sensitive explosives.

Secondary high explosives are materials which are quite insensitive to both mechanical shock and flame but which explode with great violence when set off by explosive shock, such as that obtained by detonating a small amount of initiating explosive in contact with the high explosive. Decomposition proceeds by means of detonation, which is rapid chemical destruction progressing directly through the mass of the explosive. Detonation is thought to be a chain reaction and proceeds at rates frequently as high as 6,000 m/s. It is this high rate of energy release, rather than the energy given off that makes a product an explosive. Nitroglycerin has only one-eighth the energy of gasoline. On the other hand, most high explosives, when unconfined or unshocked, will merely burn if ignited.

Low explosives, or propellants, differ from high explosives in their mode of decomposition; they only burn. Burning is a phenomenon that proceeds not through the body of the material, but through layers parallel to the surface. It is quite slow in its action, comparatively speaking, rarely exceeding 0.25 m/s. The action of low explosives is, therefore, less shattering. Low explosives evolve large volumes of gas on combustion in a definite and controllable manner.

Possibly the most powerful nonatomic military explosives are cast aluminized mixtures such as Torpex and HBX (RDX, TNT, aluminum and wax). Because military requirements are extremely strict, only a few explosives have survived competitive testing.

Projectiles

A high artillery shell is depicted in Figure C-1. Such a shell consists of thin brass or steel cartridge case holding the primer, igniter, and propellant charge. This case is designed to fit smoothly into the gun and, on explosion, to expand, scaling the breech of the gun so that the escape of gases from the burning of the propellant charge is prevented, thus allowing the full effect of the propellant to be exerted on the projectile (destructive half of the shell).

The primer contains a small amount of primary explosive or sensitive mixture (e.g., $KCLO_3$ + $Pb(CNS)_2$ + Sb_2S_3 + TNT + ground glass). This mixture explodes under the impact of the firing pin and produces a flame which ignites the black powder charge in the igniter, in turn igniting the propellant charge of smokeless powder. The burning of the smokeless powder causes the rapid emission of heated gas, which ejects the propellant from the gun. At the target, upon impact or upon functioning of the time fuse mechanism, a small quantity of primer (detonator) is set off; this causes explosion of the booster, an explosive of intermediate sensitivity (between that of a primary explosive and the bursting charge), which picks up the explosive wave from the primary explosive, amplifies it, and ensures complete detonation of the bursting charge. The bursting charge, or high explosive, is usually TNT alone or mixed with ammonium nitrate, RDX, PETN, and ammonium nitrate.

Smoke Producing Ordnance

Various chemicals have been used to produce smokes or fogs primarily designed to conceal the movements of troop or installations from enemy observations. Screening smokes are basically of two compositions: (1) dispersion of solid particles in air, which correspond to true smoke, and (2) dispersion of minute liquid droplets, which resemble natural fogs or mists. One of the important innovations of World War II was the use of smokes not dependent on waste but prepared by atomization of high boiling fractions of petroleum. Much of the hiding effect of all smokes is due to their ability to scatter light waves by reflection.

This is more effective than obstructing. Smokes may be dispersed by various methods including mechanical, thermal, and chemical.

White phosphorus is loaded directly into shells, bombs, and grenades in the molten state. The material is dissipated by the force of the explosion and immediately burns to P_2O_5. In terms of pounds of smoke producing agent, this is the most efficient obscuring smoke. The smoke causes coughing and acid burns. These particles also have some incendiary effect. It has been improved by the development of plasticized white phosphorous.

Hexachlorethane is employed in mixtures with finely powdered aluminum and zinc oxide which are started by a fuse. The burning power here is that of phosphorous. The $ZnCl_2$, which is hygroscopic, attracts moisture to form a fog, the finely divided Al_2O_3 deflects the light rays

Figure C-1 Typical High Explosive Artillery Shell and the carbon colors the cloud gray. These mixtures are used in shells, grenades, and floating smoke pots and are known as volatile hygroscopic chloride.

A mixture of sulfuric trioxide and chlorosulfonic acid is used which hydrolyzes in air to produce an acidic mixture. This blend of chemicals is used by low flying airplanes equipped with spray tanks and replaces the more costly titanium tetrachloride. The resulting fumes are highly acidic and cannot be used by troops. The screening power of the smoke due to the hydroscopic action is not nearly as effective as that of phosphorous. This compound is also more difficult to store and handle.

Colored smokes are produced by burning a pyrotechnic mixture of fuel and various colored organic dyes. Anthraquinone dyes provide superior characteristics when dispersed into the air, where they are act as aerosols of brilliant hue. They are used for signaling purposes.

Pyrotechnics

Pyrotechnic compositions engage in oxidation-reduction reactions that resemble that of propellants and explosives, but generally produce little or no gas. They are heterogeneous mixtures of finely powdered metal, metal alloy, or organic fuel and inorganic oxidizers. Such compositions are commonly used for flares, signals, tracers, incendiaries, delays, igniters, heating mixtures, and in devices where the formation of much gas is unacceptable either because the gas pressure causes unwanted changes in the reaction rate or the system is not designed to withstand the pressure without rupturing. Although pyrotechnic compositions are composed of inert ingredients, their accidental initiation during the manufacturing process may be accomplished by the same catastrophic consequences that attend explosive detonations. Mixtures of finely divided oxidizers and metals are sensitive to initiation by friction or by spark.

Propellants

Rocket propulsion fuel systems derive their energy from chemical sources. Propellants are low explosives and carry their own oxidant or other reactant necessary to cause the planned reaction. The thrust of the escaping hot gases pushes the device forward, according to the principle that forces act equally in opposite directions. Propellant fuels are presented under liquid and solid, or castable. Actually there is a great variety of choices in which a combination of energy sources and conversion mechanisms are used for the design of efficient propulsion systems.

Solid propellants are simple in design and more easily handled than liquid propellants. Originally solid propellants were classified in two groups: (1) heterogeneous or composite propellants (oxidizer and reducer present in two distinct phases), and (2) homogeneous, or double based (oxidizer and reducer present in a single distinct phase, e.g., nitrocellulose dissolved in nitroglycerin). Small percentages of additives are used to control the physical and chemical properties of the solid propellant. Composite propellants commonly use ammonium perchlorate to supply the oxygen required for the reaction. The most common gaseous products of the oxidation-reduction reactions are hydrogen, water, carbon monoxide, carbon dioxide, and nitrogen.

Propellants generally operate at low pressures up to about 2900 psi in rockets and up to about 100,000 psi in high performance guns. The process is characterized by a reaction front that moves in a direction normal to the exposed surface of the grain, proceeding from the outside to within in laminar layers. The rate of burning depends on the intrinsic rate of decomposition of the propellant and the rate of heat transfer from the hot gases above the propellant surface.

A more comprehensive evaluation of all conventional military munitions and explosive and their compositions is provided in Appendix C-1. The information in Appendix C-1 demonstrates both the complexity of the composition of explosive ordnance and the completeness of the military's knowledge concerning the ordnance by the military.

CHEMICAL AND PHYSICAL ANALYSES

Basis for Designation

All hazardous waste treated at Vieques is reactive (D003). Some primary explosives may also be toxic as measured by TCLP analyses. Table C-1 lists these compounds and their hazardous waste ID number. Treatment should render all ash as non-reactive, but each filled drum will be treated as though it is reactive and toxic until sampling and analysis can be completed.

Table C-1
TCLP Toxic Explosive Ordnance

Name	Hazardous Waste Number
Lead Azide	D008
Mercury Fulminate	D009
Lead Styphynate	D008
Lead Mononitroesorcinate	D008
Barium Nitrate	D005

Hazardous Constituents

In addition to being reactive and TCLP toxic, the waste ordnance may contain varying amounts of hazardous constituents as defined in 40 CFR 261 Appendix VII. Although EOD currently disposes of only those items listed in Table C-2, they must have the permitted capability to treat

Table C-2
Explosives Currently Treated at AFWTF

Explosive	Method of Treatment
Black Powder	Open Burning
TNT	Open Detonation
Explosive D	Open Detonation
PETN	Open Detonation
Tetryl	Open Detonation
RDX Compositions: A, B, B-2, B-3, B-4, C-1, C-2, C-3, C-4	Open Detonation
Cyclotols	Open Detonation
HMX	Open Detonation
Octols	Open Detonation
HBX	Open Detonation
H6	Open Detonation
Tritonal	Open Detonation
DBX	Open Detonation
Torpex	Open Detonation
Comp D-2	Open Detonation
PBX	Open Detonation
Lead Azide	Open Detonation
Lead Styphnate	Open Detonation
Mercury Fulminate	Open Detonation
Tetracene	Open Detonation
DDNP	Open Detonation
Smokeless Powder	Open Burning
Solid Propellant	Open Detonation
Pyrotechnics	Open Burning

the entire range of ordnance described in Appendix C-1. Therefore, a full list of potential hazardous constituents is given in Appendix C-2. Appendix C-3 has been included which identifies the chemical composition of explosives that are treated through open detonation and to a lesser extent those that are treated through open burning. Appendix C-8 contains physical properties of PEP materials demilitarized at this site which, in conjunction with Appendix C-3, further demonstrate that OB/OD will successfully treat these wastes.

The Department of Defense has performed additional studies into the effectiveness of open detonation in terms of effectiveness and impact upon human health and the environment. The most recent has been performed by the U.S. Army Armament, Munitions and Chemical Command under both laboratory and field conditions. The final reports, including all conclusions and recommendations, of this testing program are discussed in Section L of this document; the reports are included as Appendix L-11. The reports suggest that the bulk explosives and propellants examined during the field testing will produce and release acceptable levels of emittants to the environment by surface OB/OD methods. However, further item- and site-specific testing is needed to provide data to support risk assessments. Only after these risk assessments are completed can a definitive statement be made concerning the effect (if any) OB/OD operation may have on human health and the environment. However, based upon the testing performed so far, OB/OD thermal treatment operations appear to be an environmentally safe, as well as cost effective, means of treatment. Although further testing is required, OB/OD should continue to be used as an integral part of a balanced DoD total demilitarization/treatment program.

WASTE GENERATION

Cause

Ordnance is classified per ammunition condition codes which identify the material in terms of readiness for issue and use. Fourteen individual codes exist, ranging from Code A to P. Code H is the classification for ordnance that is considered unserviceable and uneconomical to repair. Navy ordnance may be classified as unserviceable because of several reasons, such as:

- The age of the item exceeds its shelf life.
- The item appears to be damaged.
- The item shows evidence of deterioration such as rust.
- The item has been declared surplus.

There are two means by which ordnance is classified as Code H:

- Notice of Ammunition Reclassification.
- Field Returns.

Source

Naval Station Roosevelt Roads is located on the eastern coast of Puerto Rico. The Naval Ammunition Facility is located on the west side of Vieques Island. NAF, which is operated by the Weapons Department, is in charge of procuring, storing and issuing all ordnance authorized by Naval Station Roosevelt Roads for support of Atlantic Fleet units. When an ordnance is no longer adequate for its intended purpose, the Weapons Department will receive a Notice of Ammunition Reclassification (NAR).

Notice of Ammunition Reclassification

Malfunctions and deficiencies by field units may identify ordnance items which will no longer function in accordance with original design. This determination may also be made during quality evaluation and testing, or by exceeding the allowable shelf life of the ordnance. The use of these items must therefore be limited, restricted, or curtailed. In these instances, the Navy Ships Parts Control Center (SPCC) in Mechanicsburg, Pennsylvania or the Naval Weapons Station Crane, Indiana issues an NAR to reclassify the ordnance item. NARs are received by all major Naval commands in message format. NARs are listed in numerical order during a calendar year. At the end of each calendar year, all NARs are consolidated into a single volume.

The Naval Station (NAVSTA) Weapons Department is responsible for dissemination of all NARs to tenant commands having a storage capacity. The officer in charge of each command is responsible for the necessary action required by the NAR and for contacting those units that may have been issued the suspect material prior to its reclassification.

If the Weapons Department or any tenant commands finds any ordnance subject to a NAR in their inventory, they request disposition from the SPCC.

Field Returns

Field returns consist of items which cannot be reissued due to physical damage, missing components, or lack of identification (mixed lots, lost identification numbers). If these items cannot be readily restored or identified, the Weapons Department requests a disposition determination from Mechanicsburg or Crane. Disposition instructions may involve reworking, disposal, or transfer of the materials to another facility for alternate usage. If instructed to perform local disposal, Weapons Department will reclassify the item(s) as unserviceable and coordinate with EOD for disposition.

For small types or lots of ordnance (worth less than $1,000), Weapons Department is authorized to reclassify ordnance as unserviceable. This decision is based upon general information within Supply Bulletins (SBs), information from technical manuals (TMs), and NAVAIRSYSCOM publications for each individual category of ordnance.

Disposition

SPCC determines the appropriate method of disposition ordnance which is reclassified as unserviceable (Code H). Such disposition is achieved through reworking, disposal, or transfer to another facility for alternate usage. No significant reworking is performed at NAVSTA; all such activities occur offsite at either Mechanicsburg, Pennsylvania or Crane, Indiana. The decision to rework is dependent upon the availability of a rework facility as well as the type of ordnance itself. Offsite disposal at WPNSTA Yorktown and use in training of EOD personnel are also options.

When a determination to dispose the material locally is made, Weapons Department prepares the initial paperwork as per Form 1348-1. EOD is then notified and schedules a day for treatment in accordance with NAVSEA OP-5. The method of treatment, open burning versus open detonation, is also determined using this manual.

When ordnance is reclassified as Code H and local disposal is determined to be the appropriate means of disposition, the ordnance is administratively transferred into the Demil Account (Special Defense Property Disposal Account — SDPDA); NAVSTA Weapons Department manages the administration of the Demil account for the facility.

Local disposition is currently achieved through open burning/open detonation. To the extent possible, available waste ordnance is utilized in the training of EOD personnel. AFWTF currently possesses interim status for these OB/OD operations. No unserviceable ordnance from offsite facilities are treated at the AFWTF facility.

Within the jurisdiction of NAVSTA, Code H ordnance designated for OB/OD disposition is transferred to separate magazines on NAVSTA Roosevelt Roads. These items are transferred to Vieques Island as soon as practicable afterward. Segregated magazines are maintained on the NAF for storage of ordnance items awaiting disposition.

EOD and Weapons Department personnel conduct all transportation of waste ordnance. Such ordnance is transported by truck from the storage magazines on NAVSTA to the NAVSTA piers. From there, the ordnance is loaded onto YFU craft and transported to the NAF (Mosquito Pier) on Vieques Island. It is then transported by truck to the designated storage magazines and unloaded. During semiannual range clearance and refurbishment operations, one day is scheduled for waste ordnance disposal operations. Waste ordnance is then transported by truck from the magazines to Mosquito Pier where it is loaded onto YFU craft for movement to the AIA. Upon arrival at the AIA, the materials are transferred to the open burning and open detonation areas by truck. Material is held at the AIA for a maximum of 12 hours prior to treatment. On the day of treatment, it takes approximately four hours to place and prepare the ordnance and to evacuate personnel to OP-1 for safety reasons.

EOD and Weapons Department load and unload all vehicles. Vehicles are requisitioned from other departments for such usage and all vehicles which transport ordnance are inspected to ensure compliance with NAVSEA OP 5 VOL I and NAVSEA OP 2239 (Explosives Drivers Handbook). EOD and Weapons Department drivers and authorized personnel detailed to draw and/or transport Class V material are instructed in hazards pertaining to such material. EOD personnel conduct all waste ordnance shipments from the NAVSTA magazine area to the AIA, including shipments to all intermediate destinations. The EOD team provides safety/emergency response equipment for all transportation evolutions.

Generation Point

On the day that treatment is scheduled, EOD and Weapons Department personnel transport the ordnance to the Air Impact Area. Upon receipt of the ordnance at the facility, Form 1348-1 is signed by EOD. Possession is thereby transferred from the Weapons Department to EOD. By an agreement reached between the Environmental Protection Agency and the Department of Defense, the ordnance becomes waste only at that point.

C-2 ORGANIZATIONAL RESPONSIBILITIES

NAVSTA Weapons Department

All Naval ammunition and explosive ordnance for Naval Station Roosevelt Roads and NAF Vieques is maintained by the Weapons Department. Serviceable ordnance is stored at permanent magazine storage sites suitable for long-term storage both at NAVSTA and at the NAF on Vieques Island. Ordnance classified as unserviceable is primarily accumulated at NAF; smaller quantities are accumulated on NAVSTA.

Explosives Ordnance Disposal (EOD)

EOD Mobile Unit Two is stationed at NAVSTA. The mission of the EOD unit is to provide the capability to neutralize hazards associated with ordnance which are beyond the capabilities of other specialties and which present a threat to operations, installations, personnel or material. Additionally, the EOD mission includes rendering assistance to other armed forces and civilian law enforcement authorities for explosives ordnance disposal support, providing escorts to personnel entering the AIA, conducting unserviceable ordnance disposal operations, providing support during range sweeps of the AIA, transportation of unserviceable ordnance, etc.

Atlantic Fleet Weapons Training Facility (AFWTF)

AFWTF controls and schedules all activities within the AIA. AFWTF Range Control is contacted to schedule retrograde disposal and training operations on the AIA impact range. Range Control has no direct control or authority over such operations; however, Range Control personnel are trained and on stand-by in the event of an incident during treatment which would require activation of the facility contingency plan (Section G).

C-3 WASTE ANALYSIS PLAN [40 CFR 270.14(b)(3)]

Analysis Parameters and Rationale

Since there is a safety hazard posed by the handling and testing of wastes containing relatively high levels of explosives, explosives and explosive-contaminated wastes are assumed to be reactive in lieu of testing. However, the ash resulting from the treatment of these hazardous wastes may require tests to determine other hazardous waste characteristics.

The possible characteristics of the ash resulting from the thermal treatment of open burning waste explosive materials are: (1) reactivity and (2) TCLP toxicity for barium, cadmium, chromium, lead and mercury.

The ash will be tested for reactivity and TCLP toxicity. The potential heavy metal contaminants will vary with the type and chemical composition of the burned explosives. Therefore, TCLP toxicity tests for barium, chromium, and lead must be performed. Although the barium content of analyses is generally low, barium is a component of some explosives.

The chemical composition of waste munitions and munition components is known and the munitions are also known to be reactive. Therefore, no laboratory analyses are needed to determine physical or chemical characteristics.

AFWTF Vieques also intends to utilize the results of the U.S. Army Armament, Munitions and Chemical Command (AMCCOM) OB/OD Emissions and Residues Characterization Study as a means of evaluating effectiveness of treatment. The Army study has been conducted over the last several years; the final report is expected to be released in the near future. The study provides data available for the majority of explosive materials treated at AFWTF Vieques through OB/OD, and addresses air emissions, chemical and energy conversion, and residues. It is felt that the results of this study will provide a more reliable evaluation of treatment efficiency than local testing could provide. The draft of the AMCCOM report has been issued; a copy of the conclusions section of this report is included in Appendix C-6. Also, the draft U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) document, provided in Appendix C-7, provides a more detailed description of this study.

The open burning and open detonation of explosive hazardous materials will release constituents to the atmosphere that must be considered. The primary pollutants of concern are those for which ambient air quality standards have been established via the Clean Air Act. The following pollutants need to be considered: carbon monoxide, nitrogen oxides, sulfur oxides, and hydrocarbons. The approximate quantities of these emission products will be further discussed in Section L entitled Environmental Performance Standards. Through computer modeling, the U. S. Navy has generated tables of the expected chemical by-products which may result from open burning and open detonation exercises. These tables are included as Appendix C-4.

No open burning has been conducted since 1987; as a result, no ash has been generated from which samples could be obtained for analysis. When open burning operations are recommenced, samples will be obtained and analyzed per the Waste Analysis Plan. Soil samples were obtained in 1990 from both the OB and OD units. The results of these activities are discussed in Section L.

Testing Methods

Two test methods have been developed by the U.S. Bureau of Mines for evaluating wastes for the characteristic of reactivity. They are the *Deflagration to Detonation Transition Test* and the *GAP Test*. No EPA approved procedure for detonation reactivity exists at this time. Descriptions of the tests methods are given in Appendix C-3.

As mentioned before, waste explosive materials are not sampled or analyzed. Any residual ash that may be generated through treatment operations shall be tested for TCLP toxicity, barium, chromium, and lead according to the following EPA test methods: Method 1310, Method 7420/7421, Method 7190/7191, and Method 7080/7081 respectively.

Sampling Methods

Any residual ash remaining after burning operations shall be removed from the burning tray and placed in a 55-gallon drum to await sampling and analysis. The color of the ash usually ranges from white to black. In terms of texture, the ash residues appear in a variety of forms from light flakes to solid char and often will be seen in crumbly granular *cake*. Metal parts may also be found in the residual ash.

A Thief Sampler shall be used to sample containers of ash. The procedures for the successful operation of the Thief Sampler and proper sample collection are described below.

Before Sampling:

1. Choose the stainless steel or brass Thief Sampler for the sampling of the residual ash.

2. Make sure that the sampler is working properly by rotating the end of the device and ensuring that all moving parts are free moving and operational.

3. Ensure that the sampler has been thoroughly cleaned and decontaminated.

4. Wear all applicable and appropriate protective clothing and observe required sampling precautions.

During Sampling:

1. Ensure that the Thief Sampler is in the closed position before any sampling is performed.

2. Slowly lower the Thief Sampler into the barrel of waste ash until it reaches the bottom of the barrel.

3. Slowly rotate the top of the handle in a clockwise fashion to open the Thief Sampler. Shake sampler slightly to allow the ash to fall into the sampler.

4. Close the Thief Sampler by rotating the top of the handle in a counter-clockwise fashion to secure the sample.

5. Slowly retrieve the Thief Sampler from the barrel with one hand while wiping the sampler with a disposable cloth or rag with the other hand.

6. Carefully discharge all of the sample into a suitable sample container by slowly opening the sampler. This is done by again rotating the upper handle in a clockwise fashion.

After Sampling:

1. Cap the sample container; attach and seal; record in field logbook; and complete the sample analysis request sheet.

2. Disassemble the sampler, if appropriate, and perform decontamination operations with an appropriate cleaning solution, or store the contaminated parts in a plastic tube for subsequent cleaning. Store used rags in a plastic bag for subsequent disposal.

3. Only all-cargo aircraft, trucks, UPS, or other approved nonpassenger vehicles will be used to ship hazardous waste samples to laboratories. EPA procedures (SW-846) for sample preservation must be followed and EPA and DOT regulations for transportation hazardous materials/wastes must be met. Laboratories must certify that their procedures are EPA-approved and, in that certification, reference either 40 CFR 261 or Test Methods Manual SW-846.

The Bureau of Mines test protocol for reactivity includes the *Gap Test* and the *Deflagration to Deflagration Transition Test*. These two tests, to be performed in three replicates for reproducibility, call for a total volume of approximately two gallons of residue. All samples taken form the drums will be mixed to form one composite sample.

Frequency of Analysis

Ash shall be collected and containerized after each burning episode. Actual frequency varies with burning operations. However, sampling and analysis shall be performed on each drum of waste generated.

C-4 ADDITIONAL REQUIREMENTS FOR WASTE TO BE DISPOSED OF OFFSITE [40 CFR 268]

All hazardous wastes shipped to offsite landfills will meet the requirements of 40 CFR 268. All liquid hazardous wastes are now prohibited from land disposal unless treated to published standards in 40 CFR 268. Ash disposal will conform to these regulations.

C-5 ADDITIONAL REQUIREMENTS FOR WASTES GENERATED OFFSITE [40 CFR 264.13(c)]

The material received from offsite does not become hazardous waste until it is delivered to the OB/OD facility. The material will be identified by visual inspection and container markings since sampling and analysis is either impossible or dangerous to human health.

C-6 IGNITABLE, REACTIVE AND INCOMPATIBLE WASTES [40 CFR 270.14(b)(9)]

MANAGEMENT OF IGNITABLE AND REACTIVE WASTES

All hazardous materials handled at the demolition range shall be assumed to be reactive due to inherent physical and chemical characteristics. As such, personnel must take appropriate precautions to prevent reactions which:

1. Generate extreme heat or pressure, fire or explosions, or violent relations.

2. Produce uncontrolled toxic mists, fumes, dusts, or gases in sufficient quantities to threaten human health or the environment.

3. Produce uncontrolled flammable fumes or gases in sufficient quantities to pose a risk of fire or explosion.

4. Damage the structural integrity of the device or facility.

5. Through other like means threaten human health or the environment.

Safety Guidelines

The means to accomplish the aforementioned criteria are provided through the establishment of safety guidelines stated in NAVSEA OP-5. The safety guidelines include, but are not limited to, the following:

1. *No Smoking* signs shall be posted at the demolition range.

2. Ignition sources shall be prohibited at the demolition range.

3. Spark producing equipment and tools shall be prohibited from use near explosive materials unless specifically authorized.

4. Incompatible materials shall not be treated or stored in the same locations.

5. Supervisory personnel shall perform inspections of hand tools and mechanical devices to ensure that they have not become unsafe for use as designated either to the item or to the operator.

6. Motor vehicles used to transport waste explosives, ammunition, or other material to the destruction site shall meet the requirements of NAVSEA OP-5.

7. Thermal treatment operations shall not be conducted during electrical storms.

Compatibility of Waste and Container

Explosive hazardous wastes shall only be stored in the original containment device or in containers approved by the U.S. Navy/DOD. Residual ash shall be stored in containers that are compatible with the ash. If there is any indication that the ash and container may not be compatible with each other, a polyethylene liner may be used for the waste drum. To ensure that adverse reactions do not occur.

APPENDIX C-1

CONVENTIONAL MILITARY MUNITIONS

APPENDIX C-1

CONVENTIONAL MILITARY MUNITIONS

A. BLACK POWDER

A.1 General Description

Black powder is a low explosive, composed essentially of a mixture of potassium nitrate or sodium nitrate, charcoal, and sulphur. The proportions of ingredients are approximately 75 percent nitrate, 15 percent charcoal, and 10 percent sulphur. The Navy uses it in the form of grains or granules of varying sizes and degree of fineness, depending on its specific purpose or function. The grains are usually glazed and graphited to improve the power's resistance to moisture and to give it a low coefficient of friction so that the grains will slide one upon the other for more compact loading. Black powder, originally called gun powder, is the oldest of the explosive and one of the most dangerous.

A.2 Classes and Uses

The various classes of black powder and the primary uses of each are described below.

A.2.a. Black Powder (Potassium Nitrate)

Black powder with a potassium nitrate base is divided into the following classes:

Class 1.	Used in JATO and rocket igniters, artillery primers and igniter pads.
Class 2.	Used in JATO and rocket igniters, primers, and propelling charges for line-throwing rockets and cartridges.
Class 3.	Used in JATO and rocket igniters, expelling charges for base ejection shells, and pyrotechnic items.
Class 4 and 5.	Used in JATO and rocket igniters, relay pellets, igniting charges for illuminating pyrotechnics, charges in target practice shells, expelling charges for base ejection shells, and igniter charges in primer detonators, fuse delay elements, and tracer igniters.
Class 6 and 7.	Used in JATO and rocket igniters, relay pellets, and delay and igniter charges in primer detonators, delay elements, practice hand grenade fuzes, and Navy squibs.
Class 8.	Used in propellant charges for rocket signals.

A.2.b. Black Powder (Sodium Nitrate)

Black powder with a sodium nitrate base is divided into the following classes:

Class A. Used in saluting charges.

Class B. Used in practice bombs.

Class C. Used in torpedo impulse charges.

B. HIGH EXPLOSIVES

B.1 General Description

The various types of high explosives which are commonly used and stored by the Navy are described in the following paragraphs:

B.1.a. Trinitrotoluene (TNT)

TNT is a light brown or white colored material whose appearance varies with the degree of purity. It is insoluble in water but soluble in ether, acetone, alcohol, and similar solvents. Although TNT is less sensitive to friction and impact than many other explosives, it can be detonated by moderate force when confined between metal surfaces such as on threads of bolts. In thin, unconfined layers it usually burns without explosion. Burning or rapid heating under confinement may cause detonation. TNT is stable and does not form sensitive compounds with metals. It will, however, become very sensitive in the presence of alkalies. TNT exhibits well recognized toxic properties.

B.1.b. Cyclotrimethylene trinitramine (RDX)

RDX is a white crystalline solid usually used in mixtures with other explosives, oils, or waxes and is rarely used alone. It has a high degree of stability in storage and is considered the most powerful and brisant of the military high explosives.

B.1.c. Amatol

Amatol is not a manufactured product but is a mixture of molten TNT and ammonium nitrate which is made at the time of loading. The most generally used amatol consists of 50% TNT and 50% ammonium nitrate. Amatols containing up to 80% ammonium nitrate have been used.

Ammonium nitrate is a crystalline powder varying from almost white to brown. It usually cannot be detonated by heat or friction but may be exploded by a sufficiently heavy initiation by booster explosives. It may be exploded by relatively light initiation if it has been sensitized by certain impurities, including many carbaceous materials. Ammonium nitrate is not flammable at normal temperatures. In fires involving large quantities of ammonium nitrate, the material becomes an explosive hazard which is accentuated by conditions of partial confinement and build up of a certain degree of pressure in the gases of decomposition. When ammonium nitrate is in contact with copper bearing metals, it may form sensitive compounds.

B.1.d Explosive D

Explosive D (ammonium picrate) is a high explosive usually derived by nitration of phenol followed by ammonification of the picric acid which is produced. In bulk density, explosive D appears in the form of finely divided crystals. Explosive D stains human hair and skin yellow, due to the yellow dye content in the picric acid. If not entirely free of traces of unammoniated picric acid, explosive D will react with certain metals such as lead, potassium, copper, and iron to form sensitive compounds and must, therefore, be protected from direct contact with these metals.

B.1.e. Picratol

Picratol is a castable mixture consisting of 52% explosive D and 48% TNT which is made by heating TNT to about 90o C in a steam-jacket melt kettle. The explosive D is added slowly, without preheating, and the mixture is agitated until it is uniform in composition.

B.1.f. Pentaerythritol (PETN)

PETN is more sensitive than either tetryl or RDX. In its pure form, PETN is a white crystalline material, but it may be light gray in color due to impurities. It must be shipped wet with not less than 40 percent by weight of water in metal barrels or drums or wooden barrels or kegs in which the material is packed in cloth or rubber bags. It is extremely sensitive to initiation and as such is considered an initiating agent.

B.1.g. Pentolite

Pentolite is a castable mixture of PETN and TNT usually in a 50/50 proportion. Pentolite may have a tendency to separate into its ingredients and, consequently, it should be handled as carefully as PETN.

B.1.h. N-tetranitro-N-methylaniline (Tetryl)

Tetryl is a fine yellow crystalline material which is insoluble in waster but soluble in acetone, benzene, and other similar solvents. It is toxic when taken internally or by skin contact and special precautions are necessary to protect personnel. It is stable at all temperatures normally encountered in storage.

B.1.i. Tetrytol

Tetrytol is a castable mixture of tetryl and TNT usually in the proportion of 70% tetryl and 30% TNT. It is used to obtain a tetryl mixture that may be cast for boosters and demolition charges.

B.1.j. Nitroguanidine

Nitroguanidine is a powerful high explosive which, when incorporated in propellants in appreciable quantities, results in a propellant that burns in a gun with temperatures so cool that little muzzle flash is produced.

B.1.k. RDX Composition

RDX compositions are mixtures of RDX, other explosive ingredients, and desensitizers or plasticizers. Three RDX compositions are described below:

1. **Composition A** — During World War II the British introduced an explosive composition consisting of 91% RDX and 9% beeswax. This was designated as Composition A. When the United States standardized Composition A, the beeswax was replaced with wax derived from petroleum. Subsequent changes in the method of adding the desensitizer led to designation of the explosive as Composition A-2. More recently the composition has been designated as Composition A-3 because of later changes in the granulation of RDX and the method of manufacture. The wax is applied to coat the particles of RDX and act as a binding agent when the composition is pressed. Compositions A-4 and A-5 consisting of 97.0 and 98.5% RDX, respectively, with desensitizer added, have been developed but these explosives are not widely used.

2. **Composition B** — This consists of castable mixtures of RDX and TNT; in some instances desensitizing agents are added to the mixture. The following are formulations of Composition B:

   Composition B — 60% RDX and 40% TNT with 1% wax added.

   Composition B-2 — 60% RDX and 40% TNT

   Composition B-3 — Percentages of RDX and TNT vary but no desensitizer is added.

   Composition B-4 — 60% RDX, 39.5% TNT, and .5% Calcium Silicate.

   Composition B, Desensitized — There are two formulations of desensitized Composition B — (1) 60% RDX and 40% TNT with 5% wax and 2% Vinylseal added, and (2) 55.2% RDX, 40% TNT, 1.2% Vistanex, and 3.6% Albacer Wax.

3. **Composition C** — The Composition C explosives are plastic demolition explosives consisting of RDX, other explosives, plasticizers, and so forth. The following are formulations of Composition C:

Composition C-1	88.3% RDX and 11.7% nonexplosive oily plasticizer containing 0.6% lecithin.
Composition C-2	78.7% RDX, 5.0% TNT, 12% DNT, 2.7% MNT, 0.6% NC, 1.0% Solvent.
Composition C-3	77% RDX, 3% tetryl, 4% TNT, 10% DNT, 5% MNT, and 1% NC.
Composition C-4	91% RDX, 2.1% Plyisobutylene, 1.6% Motor Oil, and 5.3% Sebacate.

Note: Although C-3 and C-4 are the only formulations presently being used, C-1 and C-2 may still be encountered.

B.1.l Cyclotols

The cyclotols were developed by the British between World Wars I and II and standardized in the United States early in World War II. Cyclotol is prepared by adding water-wet RDX to molten TNT in a steam-jacketed kettle at a temperature of 100°C. Some water is poured off and the heating and stirring are continued until all moisture is evaporated. The composition is cooled to a satisfactory pouring temperature. It is cast directly into ammunition components or in the form of chips when the cyclotol is to be stored for use later. There are three formulations of cyclotol being used, 75/25, 70/30, and 65/35 with the first number being the percent of RDX and the second number being the percent of TNT. Cyclotols used at NAVSEASYSCOM installations are procured commercially. Cyclotols are used for loading shaped-charge bombs, special fragmentation projectiles, and grenades.

B.1.m. Cyclotetramethylene tetranitromine (HMX)

HMX was discovered as an impurity in the nitration of hexamethylene tetramine to form RDX. Its sensitivity is about the same as RDX. Although it is almost as powerful as RDX, it is seldom used alone in military applications but is mixed with a compound such as TNT. NAVSEASYSCOM uses HMX as an ingredient in plastic bonded explosives.

B.1.n. Octols

The Octols, which were developed by the United States, are prepared by slowly adding water-wet HMX to molten TNT in a steam-jacketed kettle at a temperature of 100o C. The mixture is heated and cooled to a satisfactory pouring temperature and cast directly into ammunition components or prepared in the form of chips when the octol is to be stored for use later. There are two formulations of octol being used, 75/25 and 70/30, with the first number being the percent of HMX and the second number the percent of TNT. Octols used at NAVSEASYSCOM installations for loading HE projectiles and bombs are procured commercially.

B.1.o. Aluminized Explosives

Aluminum is added to explosives to increase its explosive power. Some recent studies to determine the optimum amount of aluminum for the TNT/aluminum mixture have shown that the blast effect reaches the maximum when the aluminum content is 30%. The brisance, as measured by the sand test, passes through a maximum of about 17% aluminum. The rate of detonation of cast charges is continuously decreased by addition of aluminum up to 40%. For all practical purposes, the addition of 18% to 20% of aluminum to TNT produces maximum performance of the TNT.

Six aluminized explosives are described in the following sections:

1. **HBX** HBX-1 and HBX-3 are binary explosives which were developed by the United States during World War II. The relatively insensitive mixtures were made by adding 5% desensitized to Torpex II for High Blast Explosive applications. They are castable mixtures of RDX, TNT, powdered aluminum, D-2 wax, and calcium chloride. The exact formulations are:

	Percent HBX-1	Percent HBX-3
RDX	40	31
TNT	38	29
Powdered Aluminum	17	35
D-2 Wax	5	5
Calcium Chloride (added)	0.5	0.5
Loading Density	1.69	1.69

HBX can be made by adding the calculated amount of TNT to Composition B to obtain the desired proportion of RDX/TNT. After the TNT/Comp B is melted, the appropriate amounts of the other ingredients are added to complete the mixture. HBX is used in guided missile warheads and underwater ordnance.

2. **H6** This is a binary explosive developed by the United States. It is a castable mixture consisting of 45% RDX, 30% TNT, 20% Powdered Aluminum, and 5% D-2 Wax with 0.5% Calcium Chloride added. It is prepared by adding the powdered aluminum, D-2 Wax, and calcium chloride to previously melted Composition B. It is stable in storage, is more bristant that TNT, and is normally cast at a density of 1.74. H6 is used as a bursting charge in general purpose bombs, guided missile warheads, and underwater ordnance.

3. **Tritonal** This is a binary explosive developed by the United States during World War II. It is a castable mixture consisting of 80% TNT and 20% powdered aluminum. It is prepared by adding the TNT and aluminum separately to a steam-jacketed melt kettle equipped with an agitator. Heating is continued until the TNT is molten and the mixture is at the right viscosity for pouring (about 85°C). Tritonal is used as the bursting charge for general purpose bombs.

4. **Minol-2** This is also a binary explosive developed by the British during World War II. It is a castable mixture consisting of 40% TNT, 40% Ammonium Nitrate, and 20% Powdered Aluminum. It is prepared by adding ammonium nitrate and powdered aluminum to TNT that has been previously melted and which is maintained at a temperature of 90°C. It is comparable to TNT and Tritonal in sensitivity to initiation but is more sensitive to shock and less brisant. It is unstable in the presence of moisture since the ammonium nitrate and aluminum react with each other. It is normally cast at a density of 1.68. Minol-2 is used as a bursting charge where TNT is in short supply.

5. **DBX** This is known as Depth Bomb Explosive. It is a binary explosive developed by the United States and Great Britain during World War II. It is a castable mixture consisting of 40% TNT, 21% RDX,21% ammonium nitrate, and 18% powdered aluminum. It can be prepared by adding 21% ammonium nitrate and 18% aluminum to 19% TNT which has been previously melted at about 100°C. It is normally cast at a density of between 1.61 and 1.69 and is used as a bursting charge in depth charges.

6. **Torpex** This is a binary explosive developed by the British during World War II. It is a castable mixture consisting of 42% RDX, 40% TNT, and 18% powdered aluminum. Waxed Torpex-2 and Torpex-3 with wax and calcium chloride were subsequently developed. Torpex mixtures have been declared obsolete and are no longer used due to their sensitivity.

B.1.p. Composition D-2

This is a desensitizing wax used in many of the high explosive mixtures which have been discussed in this section. Composition D-2 contains 84% paraffin and other waxes, 14% nitrocellulose, and 2% lecithin.

B.1.q. Plastic Bonded Explosives

Plastic bonded explosives are conventional high explosives which contain a plastic bonding agent such as nylon. They will stand higher temperatures than conventional high explosives and not be affected. They can be either press or cast-loaded depending on the type composition. Plastic bonded explosives used by the Navy are identified as PBX-N series.

B.1.r Picric Acid

Picric acid is a nitrated product of phenol. With or without the addition of various materials intended to lower its melting point, it has been used as a military high explosive, to a greater or lesser extent, by almost all countries. The chemical name for picric acid is trinitrophenol.

C. INITIATING EXPLOSIVES

C.1 General Description

Complete detonation is accomplished by adding an initiating device to the explosive. Detonating substances used for this purpose are initiating mixtures consisting of an initiating explosive (also known as a primary explosive), such as lead azide or lead styphnate, thoroughly mixed with other materials. These mixtures will detonate by the application of impact, friction, heat or electrical current and will impart a percussion blow suitable to detonate a high explosive. Initiating explosives detonate, whether they are confined or not. They differ considerably in sensitivity to heat, and the amount of heat they give off, and in brisance.

C.2 Types of Initiating Explosives

Types of initiating explosives commonly stored and used by the Navy are described in the following sections.

C.2.a Lead Azide

Lead azide is a crystalline, cream-colored compound which is practically insoluble in water. When lead azide is stored in water, however, care must be taken to assure that the water is free of bacteria forming impurities which may react with the dextrinated lead azide to form a gas. Lead azide shall not be exposed to copper, zinc, or alloys containing such metals because of the possible formation of other azides which are more sensitive than the original lead azide.

C.2.b Lead Styphnate

There are two forms of lead styphnate--that which appears as six-sided monohydrate crystals and that which appears as small rectangular crystals. Its color varies from yellow to brown. Lead styphnate is particularly sensitive to fire and the discharge of static electricity and, when dry, can be readily detonated by static discharges from the human body. The longer and narrower the crystals, the more susceptible the material is to static electricity. Lead styphnate does not react with metals and it is less sensitive to shock and friction than mercury fulminate or lead azide. Lead styphnate is only slightly soluble in water and methyl alcohol and may be neutralized by a solution of sodium carbonate.

C.2.c Mercury Fulminate

Mercury fulminate is white when pure, but ordinarily it has a faint brownish yellow or grayish tint. It is a heavy, practically nonhygroscopic, crystalline solid. When dry it is very sensitive to heat, friction, spark, flame, and shock. Mercury fulminate either wet or dry shall not come in contact with certain materials such as aluminum, magnesium, zinc, brass, or bronze.

C.2.d Tetracene

Tetracene is a colorless or pale yellow material. It is soluble in strong hydrochloric acid but practically insoluble in alcohol, water, benzene, ether, and carbon tetrachloride. It explodes readily from flame and produces a large volume of black smoke. It is lightly more sensitive to impact than mercury fulminate. Tetracene has the disadvantage of becoming easily dead-pressed.

C.2.e Diazodinitrophenol (DDNP)

DDNP is a yellowish brown powder which is soluble in acetic acid, and most of the solvents, but insoluble in water. A solution of cold sodium hydroxide may be used to destroy it. It is desensitized by immersion in water and does not react with water at normal temperatures. It is less sensitive to impact but more powerful than mercury fulminate or lead azide.

D. SMOKELESS POWDER

D.1 General Description

Smokeless powder is produced in many different types. Originally it was developed as a propellant for gun ammunition, and this remains a principle use today. In late years special types have developed as propellants for rockets and missiles. Smokeless powder is a hard, plastic substance, the color and appearance of which may vary from chalk white through pale yellow and translucent to black and completely opaque. Recently developed types are almost white and opaque.

D.2 Types by Characteristic of Base

Smokeless powder generally is considered to be of three types: single-base, double-base, and multibase. In single-base powder, nitrocellulose is the only explosive ingredient. Double-base powder contains both nitrocellulose and nitroglycerine as explosive ingredients. One multibase powder is cordite propellant which contains nitrocellulose, nitroglycerine, and nitroguanidine.

D.3 Types by Index Designation

Index numbers are given serially to powder that has been manufactured and proofed. The numbers aid in the identification of each index and also give an approximate indication as to the age of the powder. Each index of powder is assigned an index number consisting of a group of letters which designate the type of powder and a number which indicates the sequence of manufacture. Following are the index designation letters and their meanings. The letters SP refer to smokeless powder not containing stabilizers as distinguished from the earlier propellants, black powders, and brown powders (BP). SPR indicates a type of powder to which rosaniline dye was added to give it a violet color and to indicate that its stability was acceptable until the color changed to red by formation of decomposition acids within the grain. This procedure was not successful and the powder is no longer used. The letters D and C indicate the stabilizer diphenylamine and centralite, respectively.

D.3.a SPD

Smokeless powder stabilized by addition of diphenylamine. All powder since index 883 has been stabilized. This is standard "pyro" composition powder.

D.3.b SPDW

Reworked powder made from ground stabilized SPD smokeless powder and regranulated.

D.3.c SPDB

A blend of stabilized SPD smokeless powder. The blend was originally devised to provide an index of ample size for a ship's service allowance but the letters are now assigned to a lot made to utilize small remnants for service or target practice purposes. A blend of large-web and small-web powder may be made to produce an equivalent intermediate web to satisfy desired ballistics.

D.3.d SPDN

Nonhygroscopic powder stabilized with diphenylamine and with the further addition of certain nonvolatile solvents to reduce hygroscopicity and increase service life. This type of designation is also used for blends of nonhygroscopic stabilized smokeless powder.

D.3.e SPDF

Flashless powder; SPD powder made flashless by incorporation in the grains during manufacture of certain compounds which reduce muzzle flash.

D.3.f SPCG (Cordite N)

A flashless, cool burning multibase powder of the Cordite (N) type, containing centralite as a stabilizer and plasticizer. SPCG contains nitrocellulose, nitroglycerine, and nitroguanidine. SPCG is opaque, chalk white in color and becomes slightly yellow with age.

D.3.g Ballisite

Ballisite is a double base smokeless powder which is used as the propelling charge for mortar ammunition and for some shotgun shells. It is used in greater measure as the propellant for rocket motors and as boosters and sustainers for guided missiles.

D.3.h Nitrocellulose

Nitrocellulose includes various types of nitrated cotton or wood pulp depending on the nitrogen content. Nitrocellulose when dry is extremely sensitive to shock and friction and readily accumulates static charges. It is highly flammable and explosive and burns rapidly but produces very little smoke and leaves no residue. When impure, it is subject to spontaneous ignition.

E. SOLID PROPELLANTS

E.1 General Description

Cast propellants are used normally in missiles and rockets of five-inch diameter and larger. Cast propellant grains are produced from both single-base and double-base casting powders. These casting powders are in granulation similar to small-arms powders but each has its own composition as follows:

E.1.a Single-Base Powder

In single-base powder, nitrocellulose forms the principal explosive ingredient. The nitrocellulose is transformed by a solvent into a colloid for granulation. Modifiers and stabilizers are included to obtain suitable form, desired burning characteristics, and stability. Single-base powder produces a larger volume of gas but less heat than double-base powder.

E.1.b Double-Base Powder

In characteristic double-base powder, nitroglycerine and nitrocellulose are the principal explosive ingredients. The nitrocellulose is transformed by the nitroglycerine and other added ingredients into a colloid for granulation.

F. GUN AMMUNITION

F.1 Projectiles

Projectiles are of various types and may be base fuzed, nose fuzed, or both. Commonly designated types are described in the following sections.

F.1.a Loaded Projectiles

These consist of all types of projectiles, 20-mm and larger caliber, which contain special materials or any of the following:

1. Explosive in any form or quantity as a filler.

2. Pyrotechnic composition for illuminating, screening, signaling, or incendiary purposes.

3. Smoke-making composition.

4. Chaff load with expelling charge.

5. Anti-personnel grenades with ejection charge.

6. Fuse containing explosives.

F.1.b Blind Loaded and Plugged (BL&P) Projectiles

These are loaded with an inert filler and closed with plugs or dummy fuzes.

F.1.c Blind Loaded with Tracer (BL&T) Projectiles

These have an inert load, but a tracer is inserted in a hole in the base of the projectile.

F.1.d Solid Projectiles

These consist of solid metal without cavity.

F.1.e Empty Projectiles

These are projectiles having cavities which are capable of being closed and which do not contain explosive, inert, or other kinds of fillers. This type does not include slugs, proof-shot, or solid target projectiles or unfused illuminating projectiles which contain illuminating elements. The latter types of projectilies are regarded as loaded projectilies.

F.1.f Rocket Assisted Projectile (RAP)

The RAP projectile has been developed for 5"/38, 5"/54 and 155-mm guns to provide additional range without redesign of the existing weapons. The projectile consists of a solid-propellant rocket motor with a delayed ignition element, an explosive filled warhead, and either a controlled VT or a point detonation fuse.

F.2 Fixed Ammunition

Fixed ammunition includes all recoiless rifle and gun ammunition, larger than .60 caliber, in which the projectile and primer are firmly secured in a cartridge case containing the propelling charge so that the round is loaded into the gun as a unit in one operation. Examples of fixed ammunition are 20-mm, 30-mm, 40-mm, 76-mm, and 3"/50 cartridges.

F.3 Artillery Ammunition

Artillery ammunition is divided into four general types. They include fixed artillery ammunition, semifixed artillery ammunition, separate loading artillery ammunition, and separated artillery ammunition. Each of the four types are discussed in the following sections.

F.3.a Fixed Artillery Ammunition

In this type the round is fixed, that is, not adjustable. It is loaded into the weapon in one operation and the primer is fitted into the base of the cartridge.

F.3.b Semifixed Artillery Ammunition

A round of semifixed artillery ammunition is characterized by the loose fir of the cartridge munition, it is loaded into the weapon in on operation. The propelling charge is divided into sections, each consisting of propellant powder in a bag. To adjust the propelling charge, the projectile is lifted from the cartridge case, and the projectile is reassembled in the cartridge case. As in fixed ammunition, the primer is assembled in the base of the cartridge case. In certain rounds for the 105-mm howitzer, even though the charge is fixed, the cartridge case is a free fit over the projectile to facilitate packing for shipment.

F.3.c Separate Loading Artillery Ammunition

Separate loading artillery ammunition requires two or more operations to be loaded into the weapon. The propellant, primer, and projectile are loaded in separate operations. The propellant is contained in cartridge bags and may be in one section but usually is divided into two or more sections with each section assembled in a bag.

F.3.d Separated Artillery Ammunition

In this type, the propelling charge is contained in a primed cartridge case, but the projectile can be fitted into the cartridge. The propelling charge and the projectile are loaded into the gun in one operation.

G. BOMB TYPE AMMUNITION

Typical bomb-type ammunition which may be treated at the open burning/open detonation unit include aircraft bombs, underwater mines (submarine, surface vessel, and aircraft launched), destructors, depth charges, torpedo warheads, and other thin walled containers which are loaded with relatively large bursting charges of cast explosives.

G.1 TNT Exudate

Bomb type ammunition containing cast TNT is known to exude, at times, a sticky, viscous liquid which varies from pale yellow to brown in color. This TNT exudate is found most frequently in old ammunition stocks whose TNT charges contain relatively large quantities of impurities as compared to stocks produced in late years. Its production is accelerated with increase temperature. TNT exudate mixed with a combustible material, such as wood chips, sawdust, or cotton waste, will form a low explosive which is highly flammable and ignites easily from a small flame. It can be exploded in a manner similar to a low grade of dynamite, but the main danger is its fire hazard.

H. ROCKET TYPE AMMUNITION

H.1 Guided Missiles

A guided missile is an unmanned self-propelled vehicle with or without a warhead, designed to move in a trajectory or flight path all or partially above the earth's surface, whose trajectory or course while in flight is capable of being controlled remotely by homing systems or by inertial or programmed guidance from within.

H.2 Rockets

A rocket consists essentially of an inert, chaff loaded, incendiary or explosive loaded warhead, a motor, and a flight stabilizer. The warhead usually contains an explosive filler and a fuse which produces the desired effect at the target. The motor contains the propellant.

The stabilizer for a fin-stabilized rocket consists of fins attached to the motor. For a spin-stabilized rocket, it consists of multiple canted nozzles.

H.3 Jet Assisted Take-Off (JATO) Units

JATO units are cylindrical motors, similar to rocket motors. They use a propellant of the double-base type where in the individual grains are cast or extruded in a variety of configurations. They use electrically fired igniters. They vary in size from those designated to assist large multi-engine planes on take-off to those designated to assist the launching of small target drones. In the large JATO units propellant weight may approximate 150 pounds, while the small units used to launch drones may have about 9.5 pounds.

I. MISCELLANEOUS EXPLOSIVES

Fuzes, primers, and detonators are included in the collective term, "explosive initiating devices." Explosive initiating devices, boosters, and tracers are components designed for assembly and use with larger ammunition components such as projectiles, bombs, and ammunition charges.

J. LANDING FORCE AMMUNITION

J.1 Grenades

Grenades are either explosive or chemical and are intended for use at relatively short range. They are very effective for augmenting primary weapons. They are also very effective in the form of smoke and tear gas grenades for dispersing crowds. There are two basic types of grenades: hand grenades designed to be thrown by hand, and rifle grenades designed to be projected by rifle or other launcher. Hand grenades are of four types: explosive (fragmentation and offensive) grenades, chemical grenades, practice grenades, and training grenades. Practice grenades contain a charge of black powder while the training grenades are inert. All hand grenades except training grenades are fitted with a delay action fuse.

J.2 Land Mines

There are two main types of land mines: antitank (AT), for use against armored cars and tanks, and antipersonnel (AP), for use against personnel. They are further classified as service, practice, or dummy.

J.2.a Antitank (AT) Mines

Antitank mines consist of a high explosive charge designed to be laid on, below, or planted flush with the ground. The mine is detonated by a mechanical or chemical device when actuated by the weight of the vehicle. Antitank mines may be of metallic construction or, to counteract the use of magnetic mine detectors, the material may be plastic, ceramic, hard paper, or other nonmetallic material.

J.2.b Antipersonnel (AP) Mines

Antipersonnel mines consist of a high explosive charge designed to be used as booby traps, on or in-ground laying, or ambush. Types include bounding, bounding-fragmentation, blast and directional. A complete mine consists of the mine itself, the firing device, and any accessories such as trip wires.

J.3 Mortar Ammunition

The types of mortar ammunition are: high explosive, smoke, illuminating, antipersonnel, practice, and training. The complete round is loaded into the mortar as a unit. It consists of a shell body, a fin assembly, an ignition cartridge, and a primer. The propellant charge is adjustable and consists of a number of propellant increments, usually sealed in individual bags. The propellant increments are attached to the fin shaft or within the fin blades. The ignition cartridge is inserted in the perforated base end of the fin shaft; the primer is screwed into the shaft after the ignition cartridge has been inserted.

J.4 Ground Type Rockets

Ground type rockets are procured by the Navy and Marine Corps chiefly from Army source for use by Naval landing forces ashore. They may be fitted with high explosives, chemical, practice, or target rocket warheads. High explosive is employed for antitank use. Both high explosive and chemical warheads are employed for barrage use.

K. PYROTECHNICS

Pyrotechnics are mixtures of oxidizing agents and combustibles to which materials such as agents for coloring flames or smokes, flame brighteners, deterrents, binders, stabilizers, and accelerators may be added for a particular purpose. Pyrotechnics consist of fireworks adapted to military purposes and are divided into signaling, simulators, smoke screening, incendiary and illuminating types.

L. INERTING MATERIALS

L.1 Inert Ammunition Components

Inert ammunition components are the essential materials which, when assembled together and loaded, comprise finished rounds. The proper functioning and, to a large extent, the safety in storage and use of ammunition is dependent upon the condition and suitability of the respective ammunition components.

L.2 Drill Ammunition

Drill ammunition includes any type of ammunition or any component of any type of assembled without explosives or with inert materials, in simulation of regular ammunition. Drill ammunition is used for training an testing purposes only.

APPENDIX C-2

HAZARDOUS CONSTITUENTS OF EXPLOSIVE ORDNANCE

APPENDIX C-2

HAZARDOUS CONSTITUENTS OF MILITARY EXPLOSIVE ORDNANCE

Hazardous Constituents of Military Explosive Ordnance		
Constituent	**Cas No.**	**Method No.**
Acetone	67-64-1	8270
*Acetyl Triethyl Citrate	-	-
*Aluminum Powder	-	-
*Ammonium Nitrate	-	-
Antimony	Total	6010/7040/7041
Barium	Total	6010/7080
*Boron	-	-
*Butyl Stearate	-	-
Cadmium	Total	6010/7130/7131
Chromium	Total	6010/7190/7191
*Diazodinitrophenol	-	-
Diethyl Phthalate	84-66-2	8060/8270
Dimethyl Phthalate	-	8060/8270
Di-n-butyl phthalate	84-74-2	8060/8270
Di-n-octyl phthalate	117-84-0	8060/8270
*Dichromated Aluminum Powder	-	-
2,4-Dinitrotoluene	121-14-2	8090/8270
2,6-Dinitrotoluene	-	8090/8270
Diphenylamine	122-39-4	8270
*Ethyl Centralite	-	-
*HMX	-	-
Lead	Total	6010/7420/7421
*Magnesium Powder	-	-
*Magnesium Alloy Powder	-	-
Nickel Powder	Total	6010
*Nitrocellulose	-	-

Hazardous Constituents of Military Explosive Ordnance		
Constituent	**Cas No.**	**Method No.**
*Nitroglycerin	-	-
*Nitroguanidine	-	-
*Nitrostarch	-	-
*Pentolite	-	-
*Pentaerythritol tetranitrate (PETN)	-	-
*Phosphorous	-	-
*Potassium Nitrate	-	-
*RDX (Cyclonite)	-	-
*Resorcinol	-	-
Selenium	Total	6010/7740/7741
*Sodium Nitrate	-	-
*Strontium Nitrate	-	-
*Tetracene	-	-
*Tetryl	-	-
*Titanium Powder	-	-
*TNR (Trinitroresorcinol)	-	-
*TNT (Trinitotoluene)	-	-
*Tri Amino Guanidine NItrate	-	-
Vinyl Acetate	108-05-4	8240/8240
Vinyl Chloride	75-01-4	8010/8240
Zinc	Total	6010/7950
*Zirconium Powder	-	-

* These constituents did not have a specified test method in "Summary of Appropriate Analytical Methods for Appendix 9".

APPENDIX C-3

CHEMICAL COMPOSITION OF WASTE EXPLOSIVES

CHEMICAL COMPOSITION OF WASTE MUNITIONS TREATED THROUGH OPEN BURNING		
Compound	**Chemical Composition**	
1. M1 Propellant	Nitrocellulose	86.0%
	Dinitrotoluene	10.0%
	Dibutylpthalate	5.0%
	Diphenylamine	17.0%
2. M2 Propellant	Nitrocellulose	77.45%
	Nitroglycerin	19.5%
	Ethyl Centralite	.60%
	Barium Nitrate	1.40%
	Potassium Nitrate	.75%
	Graphite	.30%
3. M5 Propellant	Nitrocellulose	81.95%
	Nitroglycerin	15.00%
	Ethyl Centratlite	.60%
	Barium Nitrate	1.40%
	Potassium Nitrate	.75%
	Graphite	.30%
4. M6 Propellant	Nitrocellulose	87.0%
	Dinitroluene	10.0%
	Dibutylpthalate	3.00%
	Diphenylamine	1.00%
5. M7 Propellant	Nitrocellulose	54.60%
	Nitroglycerin	35.50%
	Ethyl Centralite	.90%
	Potassium Perchlorate	.30%
	Carbon Black	1.2%
6. M8 Propellant	Nitrocellulose	52.15%
	Nitroglycerin	43.00%
	Diethylphthalate	3.00%
	Ethyl Centralite	.60%
	Cryolite	.30%
	Potassium Nitrate	1.25%
7. M9 Propellant	Nitrocellulose	57.75%
	Nitroglycerin	43.00%
	Diethylphthalate	3.00%
	Ethyl Centralite	.60%
	Cryolite	.30%
	Potassium Nitrate	1.25%
8. M10 Propellant	Nitrocellulose	98.00%
	Dinitrotoluene	1.00%
	Potassium Sulfate	1.00%
	Graphite	.10%
9. M12 Propellant	Nitrocellulose	97.70%
	Diphenylamine	.80%
	Potassium Sulfate	.75%
	Tin	.75%

CHEMICAL COMPOSITION OF WASTE MUNITIONS TREATED THROUGH OPEN BURNING		
Compound	**Chemical Composition**	
10. M13 Propellant	Nitrocellulose	57.30%
	Nitroglycerin	40.00%
	Diphenylamine	.20%
	Ethyl Centralite	1.00%
	Potassium Sulfate	1.50%
	Carbon Black	.05%
11. M15 Propellant	Nitrocellulose	20.00%
	Nitroglycerin	19.00%
	Nitroguanidine	54.70%
	Ethyl Centralite	6.00%
	Cryolite	.30%
12. M16 Propellant	Nitrocellulose	55.50%
	Nitroglycerin	27.50%
	Dinitroltoluene	10.50%
	Ethyl Centralite	4.00%
	Potassium Sulfate	1.50%
	Carbon Black	.50%
	Lead Stearate	.505
13. M17 Propellant	Nitrocellulose	22.00%
	Nitroglycerin	21.50%
	Nitroguanidine	54.70%
	Barium Nitrate	.10%
	Cryolite	.30%
14. T2 Propellant	Nitrocellulose	57.50%
	Nitroglycerin	30.00%
	Dinitrotoluene	2.50%
	Ethyl Centralite	8.00%
	Lead Stearate	.50%
15. T8 Propellant	Nitrocellulose	58.00%
	Nitroglycerin	22.50%
	Dinitrotoluene	2.50%
	Ethyl Centralite	8.00%
	Lead Stearate	.50%
	Triacetin	8.50%
16. T23 Propellant	Nitrocellulose	67.25%
	Nitroglycerin	.25%
	Ethyl Centralite	6.00%
	Barium Nitrate	.75%
	Potassium Nitrate	.70%
	Graphite	.30%
17. Black Powder	Potassium Nitrate	74.00%
	Charcoal	15.60%
	Sulfur	10.40%

CHEMICAL COMPOSITION OF WASTE MUNITIONS TREATED THROUGH OPEN DETONATION			
Compound		**Chemical Composition**	
1.	Black Powder	Potassium Nitrate Charcoal Sulfur	74.0% 15.6% 10.4%
2.	TNT	$C_7H_6N_3O_6$	
3.	Composition B (60/40 Cyclotol)	RDX TNT Wax	60.0% 39.0% 17.0%
4.	PETN (Pentaerythrite Tetranitrate)	Chemical Formula Carbon Hydrogen Nitrogen Oxygen	 19.0% 2.5% 17.7% 60.8%
5.	Photoflash	Laminac Lupersol, DDM Iron Oxide	96.8% 3.0% 0.2%
6.	Composition C4	RDX Polysobulylene Motor Oil Di-(2-Ethylhexyl) Sebacate	91.0% 2.1% 1.6% 5.3%
7.	RDX (Cyclonite, Cyclotrimethylete - Trinitramine)	Chemical Formula Carbon Hydrogen Nitrogen Oxygen	 16.3% 2.7% 37.8% 43.2%
8.	Tetryl (Trinitro-phenylmethyl-nitramine)	Chemical Formula Carbon Hydrogen Nitrogen Oxygen	 29.3% 1.7% 24.4% 44.6%
9.	TPA Incendiary	Triethylaluminum	
10.	HMX (Homecyclonite, Cycloteramamethylene Tetranitramine)	Chemical Formula Carbon Hydrogen Nitrogen Oxygen	 16.2% 2.7% 37.9% 43.2%
11.	Lead Azide	Chemical Formula Nitrogen Lead	 28.8% 71.2%

CHEMICAL COMPOSITION OF WASTE MUNITIONS TREATED THROUGH OPEN DETONATION			
Compound		**Chemical Composition**	
12.	Lead Styphnate	Chemical Formula	
		Carbon	15.4%
		Hydrogen	0.65%
		Nitrogen	9.0%
		Oxygen	30.8%
		Lead	44.2%
13.	Amatol	Ammonium Nitrate TNT	
14.	Ammonium Nitrate	Chemical Formula	
		Nitrogen	35.0%
		Hydrogen	5.0%
		Oxygen	60.0%
15.	Composition A-3	RDX	91.0%
		Wax	9.0%
16.	Explosive A4	RDX	97.0%
		Wax	3.0%
17.	Explosive D (Ammonium Picrate)	Chemical Formula	
		Carbon	29.3%
		Hydrogen	2.4%
		Nitrogen	22.7%
		Oxygen	45.6%
18.	Haliete (EDNA, Ethylene-Dinitramine)	Chemical Formula	
		Carbon	16.0%
		Hydrogen	4.0%
		Nitrogen	37.3%
		Oxygen	42.75%
19.	HBX-1, 3, & 6	RDX	39.6%
		TNT	37.8%
		Aluminum	17.1%
		Densitizer Comp D2	5.0%
		CaCL	0.5%
20.	Octol	HMX	75.0%
		TNT	25.0%
21.	PBX	RDX	
		Polystyrene	
		Dioctyl pthalate	
22.	Pentolite 50/50	PETN	50.0%
		TNT	50.0%

CHEMICAL COMPOSITION OF WASTE MUNITIONS TREATED THROUGH OPEN DETONATION			
Compound		**Chemical Composition**	
23.	Pentolite 10/90	PETN TNT	10.0% 90.0%
24.	Picratol	Explosive D TNT	52.0% 48.0%
25.	Tetrytol	Tetryl TNT	
26.	Torpex	RDX TNT Aluminum	42.0% 40.0% 18.0%
27.	Tritonal	Aluminum TNT	
28.	Nitroglycerin	Chemical Formula Carbon Hydrogen Nitrogen Oxygen	 15.9% 2.2% 18.5% 63.4%
29.	Nitroguanidine (Picrate)	Chemical Formula Carbon Hydrogen Nitrogen Oxygen	 11.5% 3.9% 53.8% 30.8%
30.	Military Dynamite - Medium Velocity	RDX TNT Starch SAE No. 10 Oil Polysobutylene	75.0% 15.0% 5.0% 4.0% 1.0%
31.	Military Dynamite - Low Velocity	RDX/Dye* TNT Tripentaery Thritol Binder** Cellulose Acetate	17.5% 67.8% 8.6% 4.1% 2.0%

* The dye is 96% pure 1-Methylamino-anthraquinine (1-MA) used in the amount of 0.5% of the RDX solution.

** The binder is Vistac No. 1 consisting of polybutene and diotyseabacate.

APPENDIX C-4

CHEMICAL BY-PRODUCTS RESULTING FROM THE OPEN BURNING AND OPEN DETONATION OF WASTE EXPLOSIVES

TABLE 1
OPEN BURNING SIMULATION OF MATERIAL C-4

	RATIO OF MATERIAL C-4 TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
CO	41.1518	26.6440	0.0000
N_2	34.4283	113.2815	349.3828
CO_2	16.0265	40.4570	82.3220
H_2O	4.6955	17.8398	33.7172
H_2	3.0967	1.7766	0.0000
CH_4	.5972	0.0000	0.0000
NH_3	.0044	.0002	0.0000
CNH	.0002	0.0000	0.0000
O_2	0.0000	0.0000	34.1265
NO_2	0.0000	0.0000	0.0002
NO	0.0000	0.0000	0.0019

TABLE 2
OPEN BURNING SIMULATION OF
COMP. A-3

Combustion Products $\frac{g}{100\ gm}$	RATIO OF COMP A-3 TO AIR $\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
CO	41.114	36.184	1.02E-07
CO_2	16.120	41.226	81.249
H_2	2.953	1.153	8.04E-09
H_2O	5.187	18.491	32.013
N_2	34.429	113.282	270.978
NH_3	0.00334	0.00060	—
CNH	.0002	0.00001	—
CH_2O	1.74E-05	2.85E-06	—
H	1.34E-08	3.69E-07	2.22E-12
NH_2	2.18E-10	1.89E-09	—
CNHO	1.26E-05	5.69E-06	—
CH_3	1.16E-07	1.61E-09	—
HO	1.17E-10	6.04E-08	5.30E-05
C_2H_4	1.49E-06	2.14E-11	—
C_2H_2	1.72E-08	1.32E-11	—
C_3H_6	1.05E-10	—	—
C_2H_6	7.85E-07	—	—
CHO	2.48E-09	8.89E-09	—
C_3H_6	6.67E-12	—	—
NO	—	1.04E-09	1.01E-02
NHO_3	—	—	6.05E-09
NO_3	—	—	1.78E-11
HO_3	—	—	9.77E-08
NHO_2	—	—	1.11E-06
O	—	—	3.27E-08
O_3	—	—	9.79E-11
O_2	—	—	15.749
H_2O_2	—	—	6.19E-08
NHO	—	—	5.21E-11

TABLE 3 OPEN BURNING SIMULATION OF AMATOL 80-20			
	RATIO OF AMATOL 80-20		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
N_2	31.697	110.550	266.250
CO_2	27.126	27.127	27.127
CO	9.95E-06	3.39E-09	0.000
O_2	1.195	22.348	64.647
H_2	1.64E-06	0.000	0.000
H_2O	39.976	39.976	39.976
NO	4.77E-03	4.58 E05	8.62E-10
O	4.39E-07	0.000	0.000
HO	4.15E-04	5.52E-09	0.000
HO_2	2.68E-07	5.47E-11	0.000
H_2O_2	2.70E-07	2.95E-10	0.000
NHO_2	3.57E-07	1.32E-07	1.13E-09
H	9.03E-10	0.000	0.000
NHO	7.22E-10	0.000	0.000
NO_3	1.65E-12	0.000	0.000
NHO_3	3.62E-10	3.08E-08	7.58E-07
O_3	4.91E-11	0.000	0.000
NO_2	0.000	4.70E-05	2.27E-06

TABLE 4 OPEN BURNING SIMULATION OF MATERIAL PBX (PLASTIC BONDED EXPLOSIVE)			
	RATIO OF PBX TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
CO	43.543	39.246	0.000
N_2	32.158	111.008	347.559
CO_2	12.082	36.786	98.681
H_2O	3.692	10.044	35.473
H_2	3.338	2.823	0.000
CH_4	0.867	0.086	0.000
NH_3	0.005	0.004	0.000
O_2	0.000	0.000	18.276
NO	0.000	0.000	0.007
O_2	0.000	0.000	46.112
NO	0.000	0.000	0.001

TABLE 5 OPEN BURNING SIMULATION OF EXPLOSIVE C-3			
	RATIO OF EXPLOSIVE C-3 TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
CO	39.888	20.255	0.000
N_2	33.039	111.890	348.440
CO_2	18.077	48.926	80.747
H_2O	7.015	18.200	24.697
H_2	1.978	0.727	0.000
CH_4	0.001	0.000	0.000

TABLE 6 OPEN BURNING SIMULATION OF RDX EXPLOSIVE			
	RATIO OF RDX EXPLOSIVE TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
N_2	37.8374	116.6874	353.2383
CO	23.0023	.5979	.0000
CO_2	22.8415	58.5039	59.4390
H_2O	15.3090	24.1963	24.3318
H_2	1.0096	.0151	.0000
HO	.0001	.0009	.0000
O_2	.0000	.0001	62.9900
NO	.0000	.0006	.0001
NO_2	.0000	.0000	.0000

TABLE 7 OPEN BURNING SIMULATION OF PETN EXPLOSIVE			
	RATIO OF PETN EXPLOSIVE TO AIR		
Combustion $\frac{g}{100\ gm}$ Products	100/0	50/50	25/75
CO_2	47.0626	69.6041	69.6044
H_2O	20.6046	22.7952	22.7942
N_2	17.7220	96.5448	333.1240
CO	14.3469	.0002	.0000
H_2	.2430	.0000	.0000
HO	.0166	.0031	.0000
NO	.0024	.0000	.0000
H	.0011	.0000	.0000
O_2	.0008	10.9948	24.4773
O	.0001	.0000	.0000
NO	.0000	.0613	.0000
NO_2	.0000	.0000	.0000

TABLE 8 OPEN BURNING SIMULATION OF SMOKELESS POWDER			
	RATIO OF SMOKELESS POWDER TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
CO	39.412	18.991	4.77E-10
H_2	1.814	0.624	4.76E-11
CO_2	37.137	46.822	99.093
H_2O	9.069	19.724	25.303
N_2	12.555	91.406	249.105
CH_4	0.0112	1.27E-06	—
NH_3	0.00087	0.00012	—
CNH	.0004	—	—
CH_2O	1.13E-05	9.20E-07	—
CNHO	6.48E-06	2.63E-06	—
H	2.88E-08	—	—
CH_3	2.28E-08	1.37E-10	—
C_2H_4	3.30E-08	—	—
C_2H_6	6.17E-09	—	—
CHO	4.25E-09	8.53E-09	—
HO	9.87E-10	3.23E-07	2.55E-06
C_2H_2	1.88E-10	1.47E-09	—
NO	3.01E-12	9.69E-09	2.33E-03
O_2	—	2.06E-12	26.495
NHO_2	—	—	6.16E-07
HO_2	—	—	9.24E-09
NO_2	—	—	2.09E-04
H_2O_2	—	—	8.72E-09
NHO_3	—	—	1.28E-08
O	—	—	3.75E-10
O_3	—	—	1.49E-11
NO_3	—	—	9.86E-12

TABLE 9 OPEN BURNING SIMULATION OF PHOSPHOROUS			
	RATIO OF PHOSPHOROUS TO AIR		
Combustion g / Products 100 gm	100 / 0	50 / 50	25 / 75
P_4	78.306	56.882	6.29E-03
P_3N_5 (s)	29.584	—	—
P_4O_6	8.549	48.446	145.293
PN	8.05E-03	11.561	21.307
P_2	1.98E-03	7.860	3.422
N_2	1.197	75.250	229.916
PO	—	0.00000	5.12E-02
P	—	0.00000	6.25E-04
PO_2	—	0.00000	4.93E-03
O_2	—	—	5.02E-11
NO	—	—	8.72E-07
O	—	—	2.79E-08
N	—	—	6.19E-10

TABLE 10
OPEN BURNING SIMULATION OF
FLASH POWDER

	RATIO OF FLASH POWDER TO AIR		
Combustion g / Products 100 gm	**100 / 0**	**50 / 50**	**25 / 75**
BaCl	16.529	16.528	0.000
S_2	15.735	3.445	0.000
S	6.691	0.177	0.000
K	4.836	3.734	0.000
KCl	4.221	6.316	0.004
N_2	2.670	81.520	318.079
SO	2.078	4.728	0.000
AlS	1.956	0.000	0.000
AlCl	1.366	0.000	0.000
Al_2O	0.708	0.000	0.000
Al	0.702	0.000	0.000
Cl	0.151	0.001	0.000
SO_2	0.131	36.044	49.946
AlOCl	0.096	0.000	0.000
AlO	0.081	0.000	0.000
S_2O	0.056	0.226	0.000
$AlCl_2$	0.038	0.000	0.000
NS	0.020	0.002	0.000
O	0.019	0.001	0.000
NO	0.008	0.019	0.003
KO	0.007	0.012	0.000
Al_2O_2	0.002	0.000	0.000
O_2	0.001	0.004	56.612
$BaCl_2$	0.000	0.000	0.001
Ba	0.000	0.000	0.001
SO_3	0.000	0.001	0.000

TABLE 11 OPEN BURNING SIMULATION OF BLACK POWDER			
	RATIO OF BLACK POWDER TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
CO_2	16.635	32.227	32.105
S_2	7.637	—	—
N_2	10.391	89.235	246.941
H_2O	1.777	3.770	0.580
CO	10.300	6.86E-06	—
H_2S	1.714	—	—
K_2CO_3 (1)	46.842	50.879	—
K_2CO_3 (s)	—	—	51.261
KHO	2.470	0.1301	5.04E-11
H_2	0.080	9.04E-08	—
HS	5.13E-02	—	—
CS_2	1.10E-02	—	—
H	2.72E-06	2.13E-10	—
HO	2.77E-06	2.13E-10	—
CNHO	7.7E-07	—	—
CH_4	1.12E-08	—	—
O	1.61E-10	7.41E-07	—
NHO	1.01E-11	4.42E-10	—
K	9.47E-02	2.79E-05	—
$K_2H_2O_2$	9.47E-02	9.81E-05	—
S	3.07E-04	—	—
K_2	1.74E-04	—	—
KO	4.82E-06	2.02E-05	—
CH_2O	2.41E-07	—	—
SO_3	4.48E-08	0.659	—
$K_2C_2N_2$	3.55E-10	—	—
S_8	1.25E-11	—	—
CSO	0.938	—	—
S_2O	5.16E-02	—	—
CS	2.73E-04	—	—

TABLE 12 OPEN BURNING SIMULATION OF TNT			
	RATIO OF TNT TO AIR		
Combustion $\frac{g}{100 \text{ gm}}$ Products	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
CO	57.4357	61.4025	.0000
N_2	10.4999	97.3492	333.0965
CO_2	10.0577	34.8207	135.3325
H_2	1.9633	1.7765	.0000
H_2O	1.7593	3.4040	19.8291
CH_4	.2315	.2426	.0000
NH_3	.0015	.0026	.0000
CNH	.0004	.0002	.0000
O_2	.0000	.0000	10.6290
NO	.0000	.0000	.0121

TABLE 13 OPEN BURNING SIMULATION OF TOVEX			
	RATIO OF TOVEX TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{40}{60}$
H_2O	47.254	45.356	31.157
N_2	29.125	107.975	213.109
O_2	15.297	36.449	64.650
CO_2	2.088	2.087	2.085

TABLE 14 OPEN BURNING SIMULATION OF COMP B			
	RATIO OF COMP B TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
CO	48.4579	28.2903	.000
N_2	29.0035	108.6550	345.2051
CO_2	15.7407	47.5344	92.0142
H_2O	3.7625	14.4943	23.3935
H_2	2.1840	.9958	.0000
CH_4	.0495	.0000	.0000
NH_3	.0016	.0003	.0000
CNH	.0002	.0000	.0000
HO	.0000	.0000	.0000
O_2	.0000	.0000	39.3855
NO	.0000	.0000	.0014
NO_2	.0000	.0000	.0002

TABLE 15 OPEN BURNING SIMULATION OF H6			
	RATIO OF H6-1 TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
CO	45.0210	48.6565	.0000
N_2	15.7633	101.3153	337.8318
H_2	2.4731	2.0162	.0000
CNH	.3616	.0001	.0000
$CaCl_2$	.3508	.4225	.0353
Al(Cl)	.0595	.0000	.0000
CaCl	.0403	.0025	.0000
HCl	.0321	.0401	.0005
Ca	.0243	.0001	.0000
C_2H_2	.0185	.0000	.0000
CH_4	.0033	.0000	.0000
H	.0022	.0000	.0000
$AlCl_2$	.0020	.0000	.0000
Al	.0017	.0000	.0000
H_2O	.0016	4.2335	22.2700
CO_2	.0012	5.6665	82.1160
Al_2O	.0007	.0000	.0000
CaHO	.0006	.0365	.0004
AlH	.0003	.0000	.0000
CH_3	.0002	.0000	.0000
NH_3	.0001	.0002	.0000
HO	.0000	.0000	.0012
O_2	.0000	.0000	19.6069
$AlCl_2$	.0000	.0000	.0000
NO	.0000	.0000	.0750
Al_2O_3	.0000	.0000	.0000
H	.0000	.0002	.0000
$Al(Cl)_3$	.0000	.0000	.0000
NO_2	.0000	.0000	.0000

TABLE 16
OPEN BURNING SIMULATION OF
HBX-1

Combustion Products $\frac{g}{100\ gm}$	RATIO OF HBX-1 TO AIR		
	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{25}{75}$
CO	43.6463	52.2548	.0000
N_2	18.0629	100.9055	332.4292
H_2	2.5141	2.0295	.0000
CNH	.3714	.0002	.0000
$CaCl_2$	.3695	.4506	.0401
$Al(cl)_3$	.0490	.0000	.0000
CaCl	.0456	.0009	.0000
HCl	.0392	.0251	.0004
Ca	.0216	.0000	.0000
C_2H_2	.0172	.0000	.0000
CH_4	.0035	.0000	.0000
H	.0020	.0000	.0000
$AlCl_2$	.0017	.0000	.0000
H_2O	.0016	4.4922	22.6381
Al	.0013	.0000	.0000
CO_2	.0012	7.8521	89.9553
CAHO	.0006	.0193	.0003
Al_2O_3	.0005	.0000	.0000
CH_3	.0002	.0000	.0000
AlH	.0002	.0000	.0000
NH_3	.0001	.0003	.0000
HO	.0000	.0000	.0009
O_2	.0000	.0000	17.4581
Al_2Cl_3	.0000	.0000	.0000
NO	.0000	.0000	.0605
H	.0000	.0000	.0000
Al_2NO_3	.0000	.0000	.0000
$Al(cl)_3$	.0000	.0000	.0000
NO_2	.0000	.0000	.0000

TABLE 17 OPEN BURNING SIMULATION OF HBX3			
	RATIO OF HBX3 TO AIR		
Combustion g Products 100 gm	100 0	50 50	25 75
CO	44.481	46.157	0.008
Al_2O_3	2.246	0.032	0.000
H_2	2.075	2.085	0.000
Al	1.027	0.039	0.000
N_2	0.339	89.785	332.353
CNH	0.130	0.196	0.000
AlH	0.101	.003	.000
C_2H_2	0.085	0.001	0.000
H	0.010	0.008	0.000
CH_4	0.001	0.000	0.000
H_2O	0.001	0.003	18.762
CO_2	0.000	0.002	72.830
O_2	0.000	0.000	9.583
NO	0.000	0.000	0.306
HO	0.000	0.000	0.022

TABLE 18
OPEN BURNING SIMULATION OF
HMX

Combustion Products g/100gm	RATIO OF HMX TO AIR 100/0	50/50	25/75
N_2	37.8374	116.6075	353.2383
CO	23.7072	.5935	.0000
CO_2	22.1909	58.5073	59.4398
H_2O	15.2478	24.1951	24.3318
H_2	1.0164	.0152	.0000
HO	.0000	.0001	62.9900
O_2	.0000	.0005	.0000
NO	.0000	.0005	.0000
NO_2	.0000	.0000	.0001

TABLE 1 OPEN DETONATION SIMULATION OF TETRYL EXPLOSIVE			
	RATIO OF TETRYL EXPLOSIVE TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{20}{80}$
CO_2	35.3929	61.3952	107.2852
CO	26.1509	28.7367	.0000
N_2	24.3891	103.2388	339.7916
H_2O	4.3954	5.2587	15.6840
H_2	1.1689	1.0985	.0000
CH_4	.3743	.2692	.0000
NH_3	.0021	.0027	.0000
0_2	.0000	.0000	37.2380
NO	.0000	.0000	.0001

TABLE 2 OPEN DETONATION SIMULATION OF EXPLOSIVE C3			
	RATIO OF EXPLOSIVE C3 TO AIR		
Combustion Products $\frac{g}{100\ gm}$	**100/0**	**50/50**	**20/80**
CO_2	37.341	60.904	80.747
N_2	33.036	111.887	348.440
CO	12.843	12.508	0.000
H_2O	8.638	13.377	24.697
H_2	1.486	1.249	0.000
CH_4	1.237	0.071	0.000
NH_3	0.005	0.003	0.000
O_2	0.000	0.000	46.112

TABLE 3
OPEN DETONATION SIMULATION OF
PBX (PLASTIC BONDED EXPLOSIVE)

	RATIO OF PBX TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{20}{80}$
N_2	32.155	111.004	347.562
CO_2	28.929	50.481	98.681
H_2O	10.922	11.389	35.473
CO	10.856	19.723	0.000
CH_4	2.530	1.574	0.000
H_2	2.110	2.298	0.000
NH_3	0.008	0.009	0.000
O_2	0.000	0.000	18.280

TABLE 4
OPEN DETONATION SIMULATION OF
C4

	RATIO OF C4 TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{20}{80}$
N_2	34.4253	113.2748	349.8329
CO_2	32.6450	55.9038	82.3220
H_2O	11.5711	13.0497	33.7172
CO	9.3073	14.4287	.0000
CH_4	2.4459	1.3661	.0000
H_2	1.8620	1.9677	.0000
NH_3	.0003	.0091	.0000
O_2	.0000	.0000	34.1277

TABLE 5
OPEN DETONATION SIMULATION OF RDX

	RATIO OF RDX TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{20}{80}$
CO_2	48.7416	58.9424	59.4398
N_2	37.8328	116.6877	353.2383
H_2O	9.9767	24.3318	24.3318
CO	8.2893	.3135	.0000
CH_4	1.4184	.0000	.0000
H_2	1.2488	.0351	.0000
NH_3	.0057	.0000	.0000
O_2	.0000	.0000	62.9901
NO	.0000	.0000	.0000

TABLE 6
OPEN DETONATION SIMULATION OF PETN

Combustion Products $\frac{g}{100\ gm}$	RATIO OF PETN TO AIR $\frac{100}{0}$	$\frac{50}{50}$	$\frac{20}{80}$
CO_2	57.0348	69.6044	69.6044
N_2	17.7227	96.5733	333.1241
H_2O	16.5448	22.7942	22.7942
CO	7.9963	.0000	.0000
H_2	.6987	.0000	.0000
CH_4	.0021	.0000	.0000
NH_3	.0006	.0000	.0000
O_2	.0000	11.0279	24.4774
NO	.0000	.0003	.0000

TABLE 7
OPEN DETONATION SIMULATION OF FLASH POWDER

Combustion Products (g / 100 gm)	RATIO OF FLASH POWDER TO AIR 100/0	50/50	20/80
Al_2O_3	43.774	0.000	0.001
S_2	21.363	4.558	0.000
BaCl	16.529	16.528	0.000
KCl	5.172	6.318	0.000
K	4.342	3.739	0.000
N_2	2.677	81.529	318.080
S	2.328	0.026	0.000
AlS	2.188	0.000	0.000
AlCl	0.882	0.000	0.000
Al_2O	0.266	0.000	0.000
Al	0.232	0.000	0.000
SO	0.158	1.670	0.000
$AlCl_2$	0.027	0.000	0.000
Cl	0.019	0.000	0.000
AlOCl	0.014	0.000	0.000
S_2O	0.010	0.297	0.000
NS	0.008	0.000	0.000
AlO	0.005	0.000	0.000
SO_2	0.002	38.087	49.840
KO	0.000	0.003	0.000
NO	0.000	0.001	0.000
O	0.000	0.000	0.000
$BaCl_2$	0.000	0.000	0.001
Ba	0.000	0.000	0.001
SO_3	0.000	0.000	0.000
O_2	0.000	0.000	56.613

TABLE 8 OPEN DETONATION SIMULATION OF TNT			
	RATIO OF TNT TO AIR		
Combustion Products $\frac{g}{100\ gm}$	**100/0**	**50/50**	**20/80**
CO_2	32.7455	52.5221	135.6325
CO	23.8155	35.5236	.0000
N_2	18.4991	97.3486	333.9009
H_2O	5.4634	5.5565	19.8291
H_2	1.4507	1.4984	.0000
CH_4	.6223	.3904	.0000
NH_3	.0026	.0034	.0000
O_2	.0000	.0000	10.6348
NO_2	.0000	.0000	.0001
NO	.0000	.0000	.0026

TABLE 9 OPEN DETONATION SIMULATION OF TOVEX			
	RATIO OF TOVEX TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{40}{60}$
H_2O	34.474	20.837	14.860
N_2	29.125	107.975	147.400
O_2	15.297	36.449	47.024
CO_2	2.088	2.087	2.086

TABLE 10 OPEN DETONATION SIMULATION OF COMP B			
	RATIO OF COMP B TO AIR		
Combustion Products $\frac{g}{100\ gm}$	$\frac{100}{0}$	$\frac{50}{50}$	$\frac{20}{80}$
CO_2	36.5118	61.0846	92.0142
N_2	29.8013	108.6513	345.2058
CO	16.0221	18.9525	.0000
H_2O	7.6196	9.4311	23.3935
H_2	1.0082	1.4561	.0000
CH_4	1.4184	.4197	.0000
NH_3	.0144	.0047	.0000
O_2	.0000	.0000	39.3864
NO	.0000	.0000	.0000

TABLE 11 OPEN DETONATION SIMULATION OF H6			
	RATIO OF H6 TO AIR		
Combustion g / Products 100 gm	100 / 0	50 / 50	20 / 80
CO	25.4296	46.4200	.0000
N_2	22.4190	101.3142	337.8310
CO_2	35.3929	61.3952	107.2852
H_2	2.4846	2.1745	.0000
$CaCl_2$	.4704	.0012	.0003
CNH	.0882	.0003	.0000
CaCl	.0089	.0000	.0000
HCl	.0002	.0002	.0000
H_2O	.0005	2.8213	22.2700
CO_2	.0032	9.1624	82.1161
Ca	.0015	.0000	.0000
C_2H_2	.0012	.0000	.0000
$CaHO_2$	.0009	.0002	.0000
NH_3	.0003	.0014	.0000
H	.0001	.0000	.0000
O_2	.0000	.0000	19.6408
CH_4	.0122	.0065	.0000
NO	.0000	.0000	.0132

TABLE 12
OPEN DETONATION SIMULATION OF
HBX 1

Combustion Products $\frac{g}{100\ gm}$	RATIO OF HBX 1 TO AIR $\frac{100}{0}$	$\frac{50}{50}$	$\frac{20}{80}$
CO	32.0044	48.9195	.0000
N_2	22.0497	100.9035	337.4522
H_2	2.5107	2.2183	.0000
CO_2	.0840	12.8132	89.9553
H_2O	.0677	2.5818	22.6387
CH_4	.0576	.1017	.0000
$CaCl_2$	.0242	.0000	.0002
CNH	.0095	.0004	.0000
NH_3	.0000	.0026	.0000
HCL	.0002	.0000	.0000
$CaHO_2$	.0005	.0000	.0000
O_2	.0000	.0000	12.4853
NO	.0000	.0000	.0102

TABLE 13 OPEN DETONATION SIMULATION OF HBX3			
	RATIO OF HBX3 TO AIR		
Combustion g / Products 100 gm	**100 / 0**	**50 / 50**	**20 / 80**
CO	31.288	37.359	0.000
N_2	3.523	92.571	332.441
H_2	2.089	2.083	0.000
CNH	0.198	0.425	0.000
C_2H_2	0.023	0.005	0.000
Al	0.006	0.000	0.000
Al_2O_3	0.004	0.000	0.000
CH_4	0.003	0.002	0.000
H	0.002	0.001	0.000
H_2O	0.001	0.001	18.772
CO_2	0.001	0.001	72.841
O_2	0.000	0.000	9.688
NO	0.000	0.000	0.116
HO	0.000	0.000	0.004

TABLE 14 OPEN DETONATION SIMULATION OF HMX			
	RATIO OF HMX TO AIR		
Combustion g Products 100 gm	100 0	50 50	20 80
CO_2	40.8240	58.9476	59.4398
N_2	37.8328	116.6877	353.2383
H_2O	10.0549	24.0161	24.3318
CO	8.0631	.3133	.0000
CH_4	1.4329	.0000	.0000
H_2	1.2364	.0353	.0000
NH_3	.0057	.0000	.0000
O_2	.0000	.0000	62.9901
NO	.0000	.0000	.0000

APPENDIX C-5

REACTIVITY TEST METHODS

APPENDIX C-5

REACTIVITY TEST METHODS

1. US GAP TEST

The apparatus for the US Gap Test, Bureau of Mines reactivity test, is shown in Figure 1. The test is contained in a cylinder consisting of a 16-inch (40.6-cm) length of 1 1/2-inch schedule 80 black seamless steel pipe. A mild steel witness plate 6-inches (15.24 cm) square and 0.125-inch (0.32 cm) thick is mounted at the upper end of the sample tubing and separated from it by spacers 0.062-inch (0.16 cm) thick. The bottom of the cylinder is closed with two layers of 0.003-inch (0.008 cm) thick polyethylene sheet held in place with gum rubber bands and polyvinyl chloride electrical insulation tape. There is no other gap between the pentolite booster and the test sample as used in this test. A continuous velocity of detonation probe make of thin aluminum tube with an axial resistance of 7.62 ohms/inches (3.0 ohms/cm) is mounted on the wall of the sample tubing. The outer tubing of the probe is crimped against the inner wire at the lower end forming a resistor. When this assembly is inserted in a medium which transmits a shock wave, the outer wall crushes against the inner wire, as the wave moves up the tubing shortening the effective length and changing the resistance. If a constant current (usually 0.06 amperes) is make to flow between the outer and inner conductors, the voltage between them is proportional to the effective length and con be recorded as a function of the time using an oscilloscope. The slope of the oscilloscope trace is thus proportional to the velocity of the shock wave.

The sample is loaded to the top of the steel tube. Solid samples are loaded to the density attained by tapping the cylinder until further settling becomes imperceptible. The sample at 20°C 1 3°C is subjected to the shock wave generated by the detonation of a pentolite (50/50 PETN/TNT) pellet, 2 inches (5.08 cm) in diameter and 2-inches (5.08 cm) thick having a density of 1.6 1 0.05 g/cc. The pentolite pellet is butted against the bottom of the test sample and initiated with a No. 8 strength detonator. The detonator is held in place by a cork detonator holder.

The criteria for propagation are:

1. A stable propagation velocity greater than 4,900 ft/sec (1.5 km/sec) is observed.

2. A hole is punched through the witness plate.

3. The sample tube is fragmented along its entire length.

The overall test results are considered positive is any two of the three criteria are met.

2. DEFLAGRATION, DETONATION AND TRANSITION (DDT) TEST

The experimental arrangement for this Bureau of Mines is shown in Figure 2. The sample of material to be tested is contained in an 18-inch (45.7 cm) length of 3-inch in a schedule 80

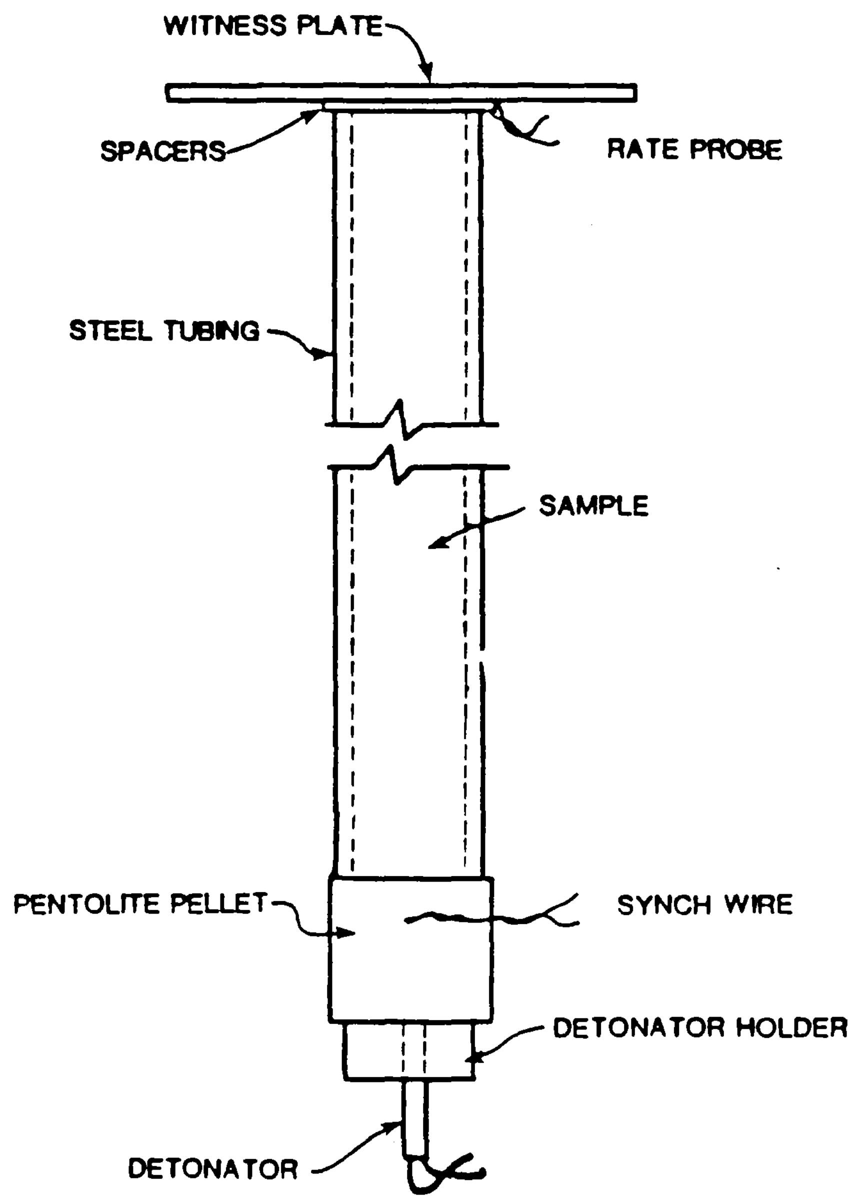


FIGURE 1

U.S. GAP TEST FOR SOLIDS

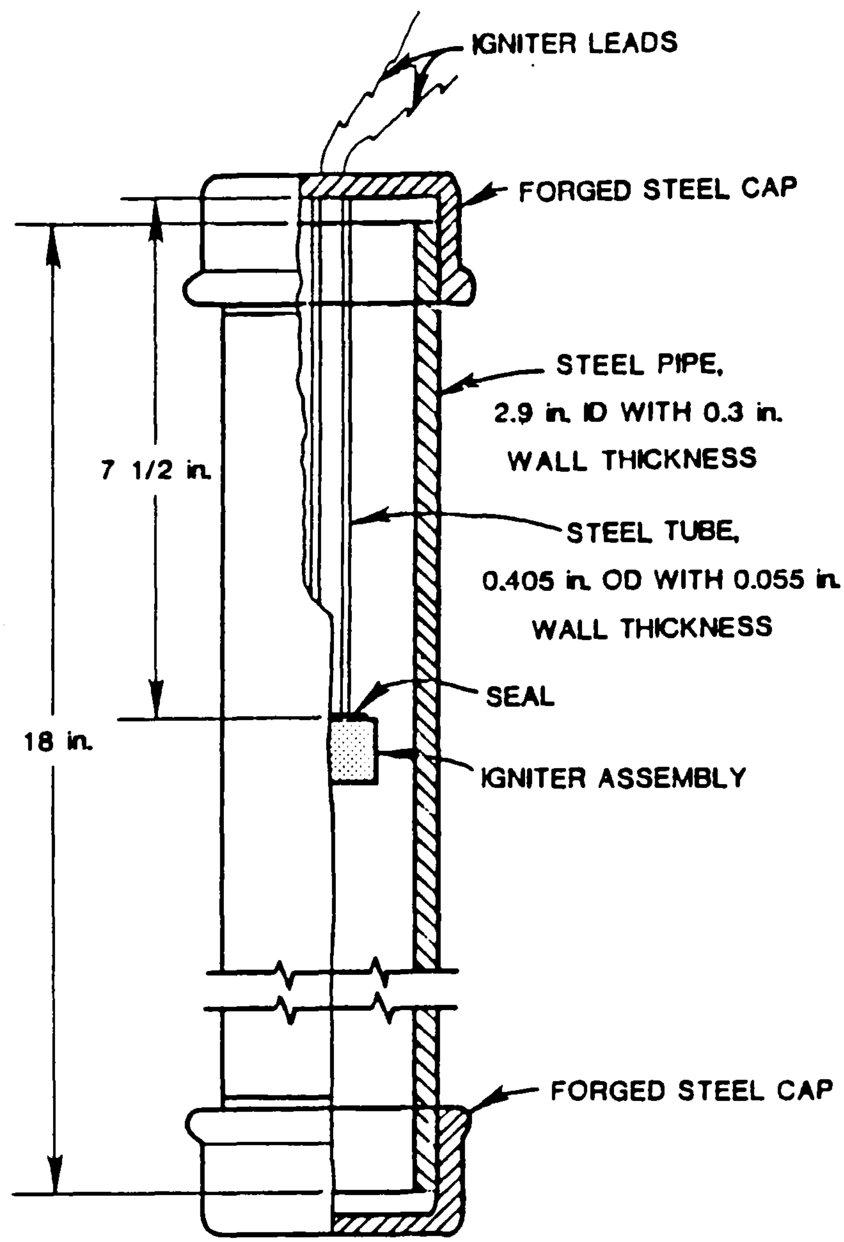


FIGURE 2

PIPE BOMB USED IN THE DEFLAGRATION DETONATION TRANSITION TEST carbon steel pipe with inside diameter 2.9-inch (7.37 cm) wall thickness 0.30 inch (0.76 cm), capped at both ends with *3,000 lb* forged steel pipe caps.

The sample is subjected to the thermal and pressure stimulus generated by an ignitor consisting of 0.7 oz. (20 g) of grade FFF black powder located at the center of the sample vessel. The ignitor assembly consists of a cylindrical container 0.81-inch (2.06 cm) in diameter and 2.5-inch (6.4 cm) long, which is held together by two layers of nylon filament cellulose acetate tape. The ignitor capsule contains a small loop formed from a 1-inch (2.54 cm) length of nickel-chromium alloy resistance wire 0.012 inch (0.030 cm) in diameter, having a resistance of 0.343 ohms. This loop is attached to two insulated copper-tinned lead wires 0.026 inch (0.066 cm) in diameter. The overall wire diameter including insulation is 0.05 inch (0.127 cm). These lead wires are fed through small holes in a brass disc approximately 0.4 inch (1 cm) in diameter and 0.03 inch (.08 cm) thick, which is soldered to the end of a 9-inch (23 cm) length of 1/8 inch steel pipe having a diameter of 0.405 inch (1.03 cm), which is threaded at the other end and screwed into a threaded hole on the inside of one of the pipe caps. This pipe supports the ignitor capsule and serves as a channel for the ignitor wires. The ignitor is fired by a current of 15 amperes obtained from a 20-voltx transformer.

The criterion currently used in the interpretation of this test is that for a positive result, either the pipe or at least one of the end caps be fragmented into at least two distinct pieces, i.e. results in which the pipe is merely split or laid open or in which the pipe or caps are distorted to the point at which the cops are blown off are considered to be negative results. Although it may be argued that a small number of fragments does not indicate the development of a detonation, it at least indicates a very rapidly rising pressure which in a larger sample could lead to development of detonation.

APPENDIX C-6

CONCLUSIONS OF AMCCOM OB/OD EMISSIONS AND RESIDUE STUDY

SECTION 7. CONCLUSIONS

7.1. Conclusions (Addressed by Study Objectives)

7.1.1. Objective 1 - BangBox Characterization: Characterize the BB chamber volume, ventilation rate, and combustion product cloud homogeneity level.

The chamber volume, ventilation rate, and cloud homogeneity were successfully determined, and found satisfactory for subsequent use throughout the data evaluation/analysis processes.

7.1.2. Objective 2 - Sampling and Analyses: Develop and improve proposed air sampling equipment and sample analysis procedures to be used in later phases on the FWAC, for sampling product clouds from large-scale follow-on outdoor OB/OD trials.

7.1.2.1. Samplers and detectors used in the BB tests that were felt to have performed well enough to be used for FWAC sampling of open-air clouds of OB/OD products included 0.85-L evacuated canisters; 6-L evacuated canisters; 32-L evacuated tanks; CO_2, CO, SO_2, and NO_x real-time gas monitors; quartz-fiber particulate filters; Teflon™ particulate filters; the Belfort integrating nephelometer; the RAM nephelometer; and DMPS, ASASP, and FSSP aerosol spectrometers.

7.1.2.2. Samplers used in BB tests that were felt to have performed marginally included the resin filters (both Porapak-R ™ and XAD-2 ™) which were an integral part of the VOST system and the Velostat ™ bag. The resin filters greatly constricted airflow, thus limiting their suitability for FWAC grab sampling. The bag proved inadequate for some volatile and semivolatile organic compounds, because of absorption and subsequent off-gassing.

7.1.2.3. The CO real time instrument did not perform properly. The CO data was obtained from the 6-L canister analysis.

7.1.3. Objective 3 - Comparison of SFC/MS and GC/MS: Refine, standardize, and compare SFC and GC techniques for extracting and analyzing resins, and filters, for trace quantities of semivolatile organic OB/OD combustion products and residues, using MS detectors.

Both SFC/MS and GC/MS are sufficiently sensitive analysis techniques to detect and quantify semivolatile organic (exotic) target analytes collected from chamber air by quartz-fiber filters, resin-filled canisters, and evacuated stainless steel cylinders. SFC is superior for some of the less thermally stable exotic species of interest, e.g. N-nitrosoamines, and some of the nitro compounds.

7.1.4. Objective 4 - Other Standard Analytical Methods: Verify adequacy of other standard analytical methods to be used for analyses of gases, particulates, volatile organic compounds, metals, and nonmetals.

7.1.4.1. The Velostat ™ bag sampler proved inadequate for some volatile and semivolatile organic compounds because of absorption and subsequent off-gassing problems.

7.1.4.2. The impingers used for measuring HCN, NH_3, and HCL in the cloud were adequate for the BB.

7.1.4.3. The extraction and analytical procedures (GC/FID) used for analysis of the volatile organics (VOC's) and the SF_6 (GC/ECD) proved to be highly successful.

7.1.4.4. Elemental analysis proved successful using XRF techniques.

7.1.5. Objective 5 - Identify and Quantify Specific Target Analytes: Identify and quantify specific target analytes for TNT, a double-base propellant, and a composite propellant.

7.1.5.1. TNT Detonation

7.1.5.1.1 The maximum EF values calculated from TNT detonation data are given in Table 7.1.

Table 7.1 Maximum Emission Factors From TNT Detonation by the Carbon Balance Method.

Species	Emission Factor (kg/kg)
Methane	1.3×10^{-4}
Acetylene	1.8×10^{-4}
Benzene	8.7×10^{-4}
Selected C_2-C_{10} non-methane paraffins	1.5×10^{-4}
Selected C_2-C_{10} olefins	3.0×10^{-5}
Selected non-benzene aromatics	3.0×10^{-5}
Phenol	2.5×10^{-5}
Naphthalene	1.5×10^{-4}
Other individual semivolatile (target analyte exotic) aromatics varied from	3×10^{-9} to 7×10^{-5}

7.1.5.1.2 Open detonation is an extremely efficient TNT thermal treatment method. Carbon-containing species measured from 227-gram (0.5-lb) TNT detonations were generally distributed as shown in Table 7.2.

Table 7.2 Distribution from Carbon-containing Species Measured From TNT.

Species	Percent
Carbon Dioxide	97.2
Carbon Monoxide	0.50
C_1 to C_{10} volatile hydrocarbons and other organics	0.57
Elemental carbon (soot)	1.71

7.1.5.2. Propellant Burn

7.1.5.2.1 Propellant burn maximum EFs were generally one to two orders of magnitude lower than those for the corresponding TNT detonation product.

7.1.5.2.2 Based on propellant carbon conversion to CO_2, open burning of double-base and composite propellants is an extremely efficient thermal treatment method. However, further work is needed to determine the fate of chlorine in the combustion products. Carbon-containing species measured from burning these fuels are distributed as shown in Table 7.3.

Table 7.3 Carbon-containing Species Measured from Propellant Burns.

Species	Percent	
	Double-Base	Composite
Carbon Dioxide	99.64	99.88
Carbon Monoxide	0.15	0.11
Organic Carbon	0.21	0.00
Elemental carbon (soot)	0.00	0.01

7.1.6. **Objective 6 - PCDD's and PCDF's: Assess polychlorinated dibenzodioxins (PCDDs) and dibenzofurans (PCDFs) levels generated from burning the composite propellant containing high concentration of NH_4ClO_4.**

None of the most toxic PCDDs were detected, and only one of two samples had a marginal value for the less toxic PCDFs indicating that their source was not derived from the composite propellant.

7.1.7. **Objective 7 - Morphology, Composition and Size Distribution of Particulate:** Provide information on the morphology, composition, and size distributions of airborne particulate material generated by OB/OD operations in the BB.

Particulate morphology and composition was accomplished by SEM and optical microscopy. The results showed that over 90 percent of the particulate was soot (carbon) with small amounts of calcium carbonate and non-asbestos insulating material.

7.1.8. Objective 8 - Carbon Balance Method: Examine, using data produced under controlled conditions, the validity of the proposed carbon balance method of calculating emission factors; compare the results with those calculated using the more-conventional cloud volume times concentration method.

7.1.8.1. The proposed carbon balance method of calculating emission factors of products of combustion resulting from OD of TNT and double-base and composite propellant burns has been verified under conditions which permit a careful comparison with the cloud-volume method.

7.1.8.2. EFs calculated by the carbon balance-method agreed within experimental uncertainty with those calculated by the more traditional concentration times cloud volume method. During periods of nonhomogeneity of cloud concentration the carbon balance-method provided better estimates of the EF.

7.1.8.3. Sufficient CO_2 concentrations (above background ambient levels) must be measurable to be able to apply the carbon balance method of calculating EFs during followon, large-scale outdoor OB/OD tests.

7.1.9. Objective 9 - QA/QC Procedures: Identify or develop appropriate program-specific QA/QC procedures.

A QA/QC program was developed specifically to address BB testing and subsequent analyses. This program, along with its findings and conclusions, is delineated in Volume 3 of this report.

7.1.10. Objective 10 - Sample Storage/Transport Procedures: Establish procedures for transport and storage of sample specimens.

Procedures were established to ensure that, during transportation and storage, semivolatile compounds would be retained by their respective sampling media, and that sample identity and integrity would be maintained. These procedures are described in Volume 3 of this report.

APPENDIX C-7

U.S. DEPARTMENT OF DEFENSE DOCUMENT PERTAINING TO OB/OD OF WASTE EXPLOSIVES AND PYROTECHNICS

PROPOSED RESPONSE TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
NOTICE OF DEFICIENCY (NOD)
FOR RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) PART B, SUBPART X,
PERMIT APPLICATIONS SUBMITTED IN REGION IV

1. Introduction.

a. The EPA, Region IV, recently sent letters to all Department of Defense (DOD) installations in that region advising that the RCRA Part B, Subpart X, rule was not intended to perpetuate the use of open burning and open detonation (OB/OD) technologies and their associated uncontrolled releases of combustion products and residues to the environment. Consequently, Subpart X permit applications for OB/OD operations may be denied if adequate justification is not provided to support these technologies. Also, alternatives can and should be developed for specific munitions and reactive wastes for which such a justification cannot be provided. In addition, EPA does not intend to issue permits for OB/OD units located in impact ranges.

b. This response is designed to address EPA concerns in these areas and provide information to justify the submittal and subsequent evaluation by EPA of Subpart X permit applications submitted by DOD in EPA Region IV. This justification describes DOD's conventional ammunition demilitarization program; existing alternative technologies to OB/OD currently available at some locations; ongoing research and development (R&D) programs to supplement and/or replace OB/OD technologies; and demilitarization equipment upgrade programs. In addition, the issue of OB/OD units located within impact ranges is also discussed in terms of currently ongoing actions occurring between EPA and the U.S. Army.

2. The DOD Conventional Ammunition Demilitarization Program. Demilitarization or disposal is a necessary and final step in the life cycle management of military ammunition and ordnance. Assets requiring demilitarization or disposal are managed in the Special Defense Property Disposal Account (SDPDA) which is euphemistically known within DOD as the "Demil Account." This account is an assets tracking system which ensures, among other factors, that appropriate final disposition considerations are made. Assignments of munitions and ordnance to the SDPDA or their classification as unserviceable, do not necessarily end up being demilitarized. They can and are included in the Foreign Military Sales Program, the Recycle Program, and/or are reworked to meet alternative specifications. Therefore, an assignment of any ammunition or ordnance item to this account does not constitute a designation of such items as waste, solid waste, or hazardous waste.

a. The Single Manager for Conventional Ammunition Demilitarization. In 1975, the U.S. Army was designated as the Single Manager within DOD for conventional ammunition disposal/demilitarization. Conventional ammunition does not include nuclear or lethal toxic chemical munitions and there are no biological weapons in the DOD inventory. DOD Directive 5160.65-M delineates the Single Manager and individual service responsibilities for this program. One purpose of the Single Manager concept is to achieve the most efficient and economical management of disposal and demilitarization options while ensuring safe operations and compliance with environmental regulations.

b. Other Military Service Demilitarization Programs. Demilitarization efforts conducted by services other than the U.S. Army under the auspices of the Single-Service Manager are relatively small and are generally confined to supporting local operations that include manufacturing and R&D programs. Additionally, the demilitarization of certain service-unique weapon systems are handled by the individual services. Examples of this type of operation include large rocket, missile motors, and torpedoes. Individual service responsibilities include funding, facilitation, and demilitarization/disposal technology development for service-unique weapon systems.

c. U.S. Army Training and Doctrine Command (TRADOC) and U.S. Army Forces Command (FORSCOM) Programs.

(1) Training. TRADOC and FORSCOM have the missions of training troops for combat and maintaining that readiness capability. As such, live fire training exercises are an inherent part of these missions. During artillery and mortar live fire training exercises not all propellant charges are used. The disposal of excess propellant charges is considered a part of the training exercise. All functions associated with live fire military training events are not considered to be demilitarization or waste disposal operations and, as such, are exempt from RCRA regulatory requirements.

(2) Range Clearance. Impact areas on live fire ammunition ranges are periodically cleared of unexploded ordnance. As a secondary mission, Explosive Ordnance Disposal (EOD) personnel who support installations with the management of training ranges. Operational requirements, in the interest of explosive safety considerations, require unexploded ordnance to be destroyed in place on the range. Ordnance that has failed to function as designed is inherently dangerous to move. Range maintenance includes the destruction of unexploded impacted rounds as the safest method of explosive hazard elimination. The destruction of unexploded impacted ordnance items found on impact ranges and destroyed on those impact ranges is also considered to be an intregral part of a training mission and is, therefore, exempt from RCRA regulations.

(3) Defective Ammunition. On occasion defective ammunition or ordnance items are identified by ammunition inspectors assigned to military installations. These items are retained in the installation's ammunition inventory for disposition determination which is a function of asset value and safety considerations, (i. e., unsafe to handle or unsafe to use for its intended purpose). If the items are unsafe to handle, immediate disposal is authorized and performed by EOD personnel or equivalent Federal civilian personnel. If the items are safe to handle but unsafe to use for their intended purposes and are valued at less than $1,000.00, the U.S. Army has authorized demilitarization as an executable option. However, hazardous waste

regulations do not apply at this time, since the demilitarization option, if exercised, is not an irreversible decision and those items may still be returned to a U.S. Army Materiel Command (AMC) installation for reworking to meet specifications. Disposition of defective items that are safe to handle and are valued at over $1,000.00 require special disposition instructions from the respective Item Manager.

(4) Turn-Ins After Training Exercises. Ammunition that has been issued for live fire training exercises that is not actually used and remains in unopened packages is returned under accountability to ammunition issue points for reinclusion into the inventory. Unpacked ammunition or ammunition in opened packages is also returned to the ammunition issue point under accountability and is inspected for serviceability prior to being returned to the inventory. Unserviceable ammunition is segregated for subsequent disposition determination.

(5) Turn-Ins During Amnesty Programs. Military installations that conduct live fire training exercises have instituted a no questions asked ammunition turn-in amnesty program to reduce the misappropriation and any subsequent inappropriate disposal/use of military ammunition and ordnance. Generally, soldiers are briefed before and after training events that retention of ammunition is illegal. For those individuals who initially ignore these warnings, amnesty collection points are designated on installations where soldiers may deposit ammunition with no questions asked. Ammunition items deposited at these amnesty points are often damaged and/or have unrecognizable nomenclature identifications from a quality control perspective and usually involve very low quantities. As such, these items are not suitable for training reissue. Through this program, ammunition is brought back under military control and included in proper military storage accountability for subsequent disposition determination.

d. Manufacturing Plant Explosive Wastes and Off-Specification End Items.

(1) During the manufacture of military energetic materials, off-specification and waste propellants and explosives are produced. The types of wastes produced during manufacturing operations include production remnants, scraps, and clean-up residues. The quantities of wastes and off-specification propellants and explosives requiring disposal are minimized to the maximum extent that is technically feasible through reclamation and recycling procedures. Production wastes and off-specification materials that can be incinerated safely are destroyed in explosive waste incinerators (EWIs) at those installations with this type of equipment. Those materials that are considered to be too unstable and, therefore, unsafe to incinerate are destroyed by OB. Thus, for safety reasons there has to be OB/OD capabilities at plants that manufacture energetic materials. Off-specification and waste energetic materials that cannot be reclaimed or recycled are determined to be wastes and hazardous waste regulations apply at the time of that determination.

(2) During the loading, assembling and packing of military ammunition, and ordnance end items, off-specification items are occasionally produced. These items are not immediately considered to be waste because they can be and often are reworked into specification items where technically feasible. However, once a determination has been made that items cannot be reworked, they are classified as waste and where applicable as hazardous waste.

e. Emergency EOD Operations.

(1) U.S. Army EOD units are primarily tactical military units which are trained to support deployed forces in war environments. EOD units during peacetime make use of their practical technical knowledge of ordnance functioning, design, and composition to the benefit of state and local communities and those civilian officials who are occasionally forced to deal with emergencies involving military ordnance that has migrated into their communities or is involved in commercial carrier accidents. Emergency EOD responses to the private sector also involve improvised nonmilitary items (homemade bombs) and foreign country ammunition and ordnance items brought into the United States as souvenirs from war zones. Generally, EOD units do not provide routine destruction of commerical explosives collected from civilian sectors.

(2) Basically, EOD units provide emergency services to protect citizens, return military ordnance to competent authority, institute proper accountability, and if determined to be appropriate, destroy these items within the capability of the EOD unit's host installation. During EOD emergency responses the risk level may require, in the judgement of the senior EOD person on-site, that on-site/in-place disposal be conducted, since transportation would present an unacceptable explosion hazard. If the ordnance item is deemed by the senior EOD person on-site to be safe to transport, then the preferred option is to transport the item to a military RCRA permitted OB/OD facility for treatment to avoid the exposure of citizens and their property to risks associated with an explosion. In most cases, the ammunition item can be transported to such an OB/OD site. The procurement of all transportation manifests and EPA emergency permits, where necessary, for disposal involving DOD owned assets is the responsibility of the U.S. Army. For emergency EOD responses that are determined on-site to involve non-DOD owned assets, this responsibility remains with the civil authorities not the U.S. Army. Existing policy must be waived to allow for the disposal of non-DOD assets on DOD property. Unrelated, nonrecurring incidents typify these emergency operations.

3. Existing Alternative Technologies to OB/OD. Multiple past efforts have proven there is no single demilitarization method or technology that will satisfy all of the requirements to safely dispose of the multitude of items in the existing SDPDA. Also, OB/OD is not an acceptable demilitarization technology for many munition items, (e. g., smoke filled and incendiary items and improved conventional munitions (ICMs) that contain multiple items such as bomblets). Existing U.S. Army policy prohibits OB/OD of many of the

pyrotechnic items filled with smokes and dyes. However, the U.S. Army has equipment developed or under development that can reduce the size, convert, and/or dispose of a large portion of the current SDPDA through disassembly. Demilitarization in most cases consists of disassembling the munition into a configuration that is appropriate for the final disposal process. This may involve cutting, punching, shearing, disassembly, or separation (removal of energetic material from the munition case) of the components and energetic materials. The nature of the material puts these processes at a greater safety risk than OB/OD. These disassembly and separation processes are very rarely the final disposal step.

a. Separation and Disassembly Technology. In most cases separation or disassembly of munition items is required if the method of destruction is other than OB/OD. Limited disassembly is sometimes possible for items that are suitable for OD operations but not suitable for other thermal treatment operations. Many methods of explosive component separation have been used over the years. These methods are labor and energy intensive and have the tendency to generate hazardous waste and place workers at a greater risk than OB/OD. Installations that have equipment to perform these separation methods have been used little in the last 15 years, and need extensive upgrade to bring them into compliance with today's environmental and safety standards. In addition, these units may have residual explosives in internal plumbing that would be an explosive safety problem if upgrades were implemented. A brief description of some of these existing U.S. Army technologies follows:

(1) Hot Water Washout. A process that uses either a stream or jet of low or high pressure hot water to separate energetic materials from munition cases. This method has generally been employed to remove trinitrotoluene (TNT) or similar semi-meltable explosives from projectile bodies. The Ammunition Peculiar Equipment (APE) 1300 unit is an example of this type of technology. These units were operated during the late 60s and early 70s to separate explosive fillers and recover projectile bodies for subsequent reloading. These units did not have waste water treatment capability and employed unlined lagoons where excess explosive contaminated water permeated into the surrounding soil. Restoration projects are currently underway at affected installations. Only one U.S. Army installation, Lexington-Blue Grass Army Depot, Kentucky, has an operational APE 1300 unit. Nine other U.S. Army installations have either laid away or dismantled their units.

(2) Steamout. Steamout is a process that directly applies steam to the energetic material filler to meltout and separate it from the munition case. This process is the most efficient separation process currently available. However, the process produces explosive contaminated waste water (less than for water washout). This process is also limited to meltable explosives. The U.S. Army has a steamout unit that is operational at Crane Army Ammunition Activity, Indiana, and laid away equipment at Cornhusker Army Ammunition Plant, Nebraska, Newport Army Ammunition Plant, Indiana, and Pine Bluff Arsenal, Arkansas. The U.S. Navy has an operational unit at Keyport Naval Weapons Station, Washington.

(3) Autoclave. The autoclave is an enclosed chamber in which heat is applied to the exterior of a munition to meltout the explosive filler. This technique is not as efficient as applying steam directly to the filler. The autoclave, when configured properly, reduces the amount of explosive contaminated water produced. It is limited in application to only those explosives that are meltable, such as TNT. The U.S. Army has an operational autoclave that is in use at Ravenna Army Ammunition Plant, Ohio.

b. Destruction. The alternative destruction methods to OB/OD that are currently employed by the U.S. Army rely primarily on incineration to demilitarize energetic materials. Due to safety considerations, the maximum quantity of confined explosive per item that can be processed through any existing incinerator is 600 grains. Therefore, most items that are to be destroyed by this means must be disassembled, separated, or processed in some manner to prevent detonations that would damage or destroy the incinerator. This additional processing adds to the inherent risk involved with these items.

(1) APE 1236/2210 Rotary Kiln Incinerators. The APE 1236/2210 incinerators are used for the destruction of small arms ammunition and ordnance items that contain less than 600 grains of confined explosive material in each item. The APE 1236 is the U.S. Army's standard unit and is currently undergoing upgrade to meet environmental regulatory standards. The U.S. Army has two APE 2210 incinerators, which are a variation of the APE 1236, located at Hawthorne Army Ammunition Plant, Nevada. One of these incinerators is in the current APE upgrade program. There are 18 APE 1236 incinerators located at various U.S. Army installations. Twelve of these incinerators are in the current APE upgrade program, of which one is a prototype not used for routine disposal. In addition, Pine Bluff Arsenal has an incinerator with the same basic design as the APE 1236. This unit has been upgraded independently of the APE 1236 upgrade program.

(2) Explosive Waste Incinerator (EWI). The EWI is also a modified APE 1236 which has a different feed system to accommodate bulk (unconfined) energetic materials (up to 5 pounds per serve for a total of 300 pounds per hour) and air pollution abatement equipment similar to the APE 1236. The U.S Army has 7 of these units at Iowa, Kansas, Lake City, Mississippi, Radford (two units) Army Ammunition Plants, and Savanna Army Depot Activity. All of these units, except for the one at Savanna Army Depot Activity, are currently operational and permitted. Although not APE designated units, three of these units were included in the current APE upgrade program.

(3) Fluidized Bed Incinerator (FBI). The FBI uses air to entrain solids in a highly turbulent combustion chamber. This equipment is not used for incineration of explosive materials but has been used for incineration of riot control agents and non-explosive munition fillers. The U.S. Army has one of these units at Pine Bluff Arsenal, Arkansas, which is RCRA permitted, and is operational.

(4) Electrochemical Reduction. Electrochemical reduction is a disposal process based on the chemical reaction caused by an electric current that converts energetic materials to less reactive materials, inert and/or other useful products. This process is only applicable to a very select few munition fillers. Efforts to date utilizing this technology have achieved limited success.

(5) Chemical Conversion. Currently the U.S. Army is disposing of sulfur trioxide-chlorosulfonic acid solution (FS), a bulk smoke producing mixture, by chemical neutralization. This process involves combining FS with a lime slurry in a 4 million gallon vat. The chemically neutralized product is then discharged to the sanitary sewer system.

(6) Western Area Demilitarization Facility (WADF). The WADF, located at Hawthorne Army Ammunition Plant, is a unique facility that was designed and built by the U.S. Navy specifically for the demilitarization of military ammunition and ordnance items. The U.S. Army assumed management of WADF in April 1984. The facility was originally designed to operate on a 3-shift, 8 hours per shift, 5 days per week basis for each of the operational components. Due to certain subsequently identified safety and/or interface problems, the facility cannot currently be operated as designed. However, specific individual components of this facility can and have been used. A recent review of the SDPDA inventory at Hawthorne Army Ammunition Plant indicated the tonnage in that account was slowly increasing. To provide an option to alleviate the associated storage problem, a proposed six year workload program was developed that identified all items that could be demilitarized in WADF components assuming a determination was made to actually demilitarize these assets. During this review certain items were identified that could not be processed through WADF.

(7) Environmental Permitting Status. RCRA permits have been granted for the EWIs located at Iowa, Kansas, Lake City, Mississippi, and Radford (two EWIs) Army Ammunition Plants. EWIs at Iowa, Kansas, and Lake City Army Ammunition Plants are currently being operated under the RCRA 720-hour shakedown provision. A final RCRA permit for reactive hazardous waste only has been issued for the deactivation incinerator at Iowa Army Ammunition Plant. Also, a final RCRA permit has been issued for the fluidized bed incinerator and rotary kiln deactivation furnace at Pine Bluff Arsenal. RCRA Part B permit applications have been prepared for ten APE 1236 incinerators located at the following nine installations: Anniston, Lexington-Blue Grass, Red River, Seneca, Sierra, Tooele (two APE 1236s) Army Depots; McAlester Army Ammunition Plant; Hawthorne Army Ammunition Plant; and Crane Army Ammunition Activity. With the exception of Hawthorne Army Ammunition Plant, all of these installations either have or will have submitted RCRA Part B permit applications by January 1991. The application for Hawthorne Army Ammunition Plant will be submitted upon completion of additional hardware modifications and engineering drawings. The first of the trial burn tests is scheduled to be conducted at Lake City in late February 1991, followed by Iowa in April 1991; Kansas, Anniston, and Tooele will follow.

c. Hazardous Waste Minimization (HAZMIN) Program.

(1) The U.S. Navy is investigating ways to develop and demonstrate a technology to recover scrap propellant generated during manufacturing operations. The recovery will include propellant process modifications and equipment to cut and consolidate the scrap. The intent of this program is to eventually return scrap propellant to the supplier for rework into raw product.

(2) In order to identify areas where reductions in the generation of energetic material wastes can be made the U.S. Army is conducting HAZMIN audits at its production plants and also those involved in loading, assembling, and packing munition items. These audits focus on all hazardous waste streams including propellants and explosives. Technical recommendations for completed audits are under review for possible implementation.

(3) The U.S. Army requires that HAZMIN considerations be included in all acquisition plans and modernization programs.

(4) The U.S. Army requires each of its installations to prepare a HAZMIN plan. The Army has an overall goal of 50 percent reduction of the 1985 waste generation volume by 1992. HAZMIN plans have to include all hazardous waste generation streams, specifically including those involving energetic materials. The U.S. Army recognizes HAZMIN as a vital part of environmental compliance and therefore has mandated reduction in hazardous waste generation at all of its installations.

d. Recycle Program. The first option considered and one of the main methods for disposal of military ammunition and ordnance and/or components of munition items is recycling. The U.S. Army is currently operating a White Phosphorus (WP) Conversion Plant at Crane Army Ammunition Activity. This plant is used to convert the WP contained in munitions to phosphoric acid which is then sold to commercial industries for manufacture of fertilizer. This program is very successful and has resulted in nearly all of these munitions being demilitarized. Approximately one more year will be required to demilitarize the remaining inventory.

e. Foreign Military Sales Program. Another method of disposing of munition items in the SDPDA is to sell them to North Atlantic Treaty Organization member countries and other countries that are allied to the United States. This program has met with a lot of success and is used at every opportunity.

4. Ongoing R&D Programs to Supplement and/or Replace OB/OD Technologies.

a. The U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). The Technical Support Division of USATHAMA is investigating the use of waste energetic materials as a supplement to fuel oils. The two primary explosives under study are TNT and cyclotrimethylenetrinitramine (RDX). Laboratory and bench scale tests have verified the principle as a workable alternative. Pilot scale testing is underway to develop fuel mixing/feeding procedures and to determine fuel mixture energy parameters. Using the energy stored in these explosives reduces fuel consumption while eliminating what would otherwise be a potential hazardous waste. Information to date indicates that the use of waste explosives as supplements to fuel for boiler plants appears to be a viable means of utilizing waste energetic materials. Before this technology can be fielded, explosive safety considerations, due to the location of boilers in administrative areas, will have to be overcome and may prove to be a limiting factor. Additionally, explosive materials will have to be separated from munition items and due to the small quantities of explosives that can be used as supplemental fuels only a small percentage of material that is typically demilitarized could be disposed of in this manner. Overall safety and risk consideration will make it difficult to field this technology.

b. The U.S Army Defense Ammunition Center and School (USADACS) Alternative Technologies Study. USADACS, located at Savanna Army Depot Activity, Illinois, has recently completed a literature research study on alternative technologies. This study summarizes and documents past, present, and potential technologies which are divided into 11 main technology families depending on munition and type of energetic material utilized. Promising technologies are and will be included in future R&D programs with an emphasis placed upon safety features. Some of these include the following:

(1) Cryofracture. This process is under development with an emphasis towards developing a technology for the demilitarization of lethal toxic military chemical agent munitions. However, the technology may have application for conventional ammunition demilitarization too. In the process liquid nitrogen is used to embrittle the munition casing which then enables it to be fractured in a 1,000-ton press. This technology may prove to be a rapid, safe method to reduce the size and expose explosive filler material contained in munition items. The fractured parts of the munition/explosive can then be incinerated if they are small enough.

(2) Water Jet Abrasive Cutting. This is a method under development for disassembly of munitions. A high pressure water jet with entrained abrasive is used in the process. This method would generate explosive contaminated water. There is also a safety consideration that has to be resolved involving the undefined effects of high pressure water combined with abrasive material impinging on explosive materials.

(3) High Pressure Washout. This process uses a stream or jet of high pressure water, up to 55,000 pounds per square inch, to separate energetic materials from munition cases. This technology is under development and may prove to be useful for press loaded munitions that have internal plumbing which renders existing washout methods ineffective. This system will also generate explosive contaminated waste water. There are also some safety concerns involving the impact of a high pressure water jet on energetic materials.

(4) Solvent Washout. This is a process that uses a liquid to dissolve energetic materials loaded in munitions. Several liquids have been demonstrated to achieve the desired separation. However, the liquids investigated that can solvate explosives tend to have unwanted properties such as carcinogenicity, toxicity, or flammability. They also have inherent disposal problems.

(5) Super- and Sub-Critical Extraction. This is a developmental method to separate energetic materials from munition casings. The process uses a material that is a gas at atmospheric pressure but converts to a liquid under pressure. In the liquid phase, the material can be used to dissolve energetic materials. When the liquid becomes saturated, the pressure is reduced which in turn causes the liquid to revert back to a gas causing the dissolved energetic material to precipitate out. Ideally, the system would be a closed loop system so that the gas could be collected and reused and the precipitated energetic material reclaimed or destroyed as appropriate.

(6) Biodegradation. This process uses micro-organisms or fungus to consume energetic materials and thus produce a less hazardous or inert material. The method is under development for use in disposing of red and pink water produced during the manufacture of explosives. The method may also be useful for the treatment of waste water generated from other demilitarization operations.

c. The U.S. Army Armament, Munitions and Chemical Command (AMCCOM) OB/OD Emissions and Residues Characterization Study.

(1) Until recently very little field/experimental data existed for emissions and residues generated during OB/OD operations. Up to this time, emissions data were based on theoretical calculations derived from computer models.

(2) With the promulgation of environmental regulations for OB/OD operations under RCRA it became apparent that experimental data collected during field testing of explosives and propellants by OB/OD were a necessity and would provide a valuable data base. This data base could then be used by DOD components to assist in the preparation of RCRA Subpart X and air emission permit applications.

(3) To accomplish this, an OB/OD emission/residue test program was established for above ground demilitarization operations only and has been ongoing for approximately the last two and one half years. The purpose of this study is to characterize emissions and residues from the OB/OD of some of the more common explosives and propellants and to determine the impact, if any, to the environment and human health caused by this practice. The study was modified to also include manufacturing residues from DOD manufacturing plants.

(4) Among the materials tested by OD were TNT, Composition B, Explosive D, and RDX. The OB test included single, double, and triple based propellants. The manufacturing residues included in the OB tests consisted of

various double base and composite rocket and missile motor propellants.

(5) Air and soil samples were collected and analyzed for target analytes in all pollutant categories. Treatment efficiencies are also being calculated by determining residual material left after the combustion and/or detonation. It was determined that ground water testing was beyond the scope of this study and was not addressed.

(6) Testing in the first phase of the program has been completed and the final report is being written. Data collected indicate that approximately 98 percent of emissions from detonation and 99 percent from burning go to carbon dioxide and water. The large hot fireballs (6,000 to 8,000 degrees Fahrenheit) generated during OD of high explosive munitions effectively destroy waste constituents considered hazardous by EPA. This holds true only for detonations involving 2,000 or more of high explosives. Detonations of less than 2,000 pounds of explosives do not produce the efficient fireballs required for complete destruction. Analyses of the data indicate that emissions from OB/OD generally fall well within Federal and state environmental guidelines and standards.

(7) Future plans for the OD emissions/residues test program involve under ground detonations of energetic materials suitable for OB/OD that are currently in the SDPDA and the development of an atmospheric dispersion model for these types of operations.

(8) This study has yielded data from which emission factors have been calculated for products of combustion for tested materials. This data base will be of value in conducting health risk assessments required under the provisions of RCRA Subpart X.

d. The U.S. Army Research, Development and Engineering Center (ARDEC). Currently, demilitarization of munitions is funded with Operational and Maintenance, Army, (OMA) type funds. Because this is also the type of funding used for personnel salaries there often has been a tendency for shortfalls to occur in supporting the demilitarization program including its R&D efforts. Starting in fiscal year (FY) 1992 (1 October through 30 September), the demilitarization program will be funded with Procurement Ammunitions, Army, (PAA) funds. By law, new technology cannot be developed using PAA funds, therefore the technology development portion of the demilitarization program is being transferred to ARDEC and will be funded with Research, Development, Testing & Engineering (RDT&E) funds. This administrative change is designed to resolve the problem of past insufficient funding levels for the demilitarization program and allow for the development of further alternatives to OB/OD. Initial projected funding levels are $83 thousand for FY91 and $1 million per year for FYs 92 through 97.

e. The U.S. Army Production Base Modernization Activity (PBMA). In order to identify alternate technologies, other than OB/OD, for treating propellant and explosive production wastes PBMA has completed a technological review of available commercial incinerator technologies for military adaptation. Concept designs have been investigated which include material feed systems, burner parameters, and pollution control equipment. A project has been submitted for funding to develop a pilot unit to demonstrate adaptable technologies.

f. Other Military Service Programs. The U.S. Navy is developing an incinerator to destroy munitions that contain colored smoke and flare compositions. Along with development of the incinerator, the program includes the development of real time emission gas monitoring systems for polynuclear aromatic hydrocarbon (PAH) compounds and trace metals. Problems may be encountered in separating these materials from the munition.

g. Inter-Service Programs.

(1) The Joint Ordnance Commanders Group (JOCG). The Munitions Demilitarization and Disposal Subgroup of the JOCG is conducting an R&D program for the demilitarization of large rocket and missile motors. This organization conducted a survey of technology development efforts within governmental organizations, industry, and academia. Identified existing and emerging demilitarization technologies have been narrowed down to four potentially feasible R&D projects. The overall program addresses both near term disposal of Hazard Class 1.3 (will vigorously burn with potential to detonate) propellants and long term demilitarization of Hazard Class 1.1 (unconfined it may detonate) propellants and explosives. Three emerging technologies have been selected to remove 1.1 energetic materials from motor cases.

(2) Large Rocket/Missile Motor (LRM) Demilitarization Program. By 1996, there will be over 83.9 million pounds of LRM solid propellant that will need to be demilitarized as a result of managing the Intercontinental Ballistic Missile's (ICBMs) normal life cycle support program and the proposed disarmament treaties. Long-term storage of these itmes is expensive, but more importantly, will pose an explosive safety hazard. A Joint Service LRM ad hoc working group has been organized and has already conducted a disposal technology review. Several technologies that encompass the steps involoved in LRM disposal have been identified. These technologies include biological treatment methods, high-pressure washout of energetic materials, critical fluid extraction, incineration, super-critical fluid oxidation, and biodegradation, and are in various stages of development. In addition, the technologies that are available in associated industries are also being reviewed and studied for their status and applicability.

(3) Joint Army-Navy-NASA, Air Force (JANNAF) Inter-Agency Committee. The safety and Environmental Protection Subcommitte of JANAF is addressing technologies for ordnance demilitarization and disposal or reclamation of propellants, explosives and pyrotechnics (PEPs). The subcommittee conducts workshops which provide a forum for government, scientific, and industry representatives to meet and exchange technology and related information.

technology review. Several technologies that encompass the steps involved in LRM disposal have been identified. These technologies are in various stages of development. In addition, the technologies that are available in associated industries are also being reviewed and studied for their status and applicability.

5. Demilitarization Equipment Upgrade Programs.

a. The U.S. Army is implementing a program to upgrade twelve APE 1236 incinerators, three EWIs and one APE 2210 incinerator which are used to demilitarize ammunition items and bulk explosive wastes. The APE upgrade program includes modifying the feed system to accommodate a computerized automatic waste feed cutoff, installing a high temperature afterburner, gas coolers, a shroud to trap fugitive emissions, and other air pollution control equipment. This equipment is limited to small items and has a history of requiring complicated modifications to meet emission requirements. The ability of the design to meet satndards has yet to be proven.

b. Incinerators at the following 15 U.S. Army installations are included in the APE upgrade program; three EWIs at Iowa, Kansas, and Lake City Army Ammunition Plants, one APE 2210 incinerator at Hawthorne Army Ammunition Plant, and twelve APE 1236 incinerators at Anniston, Letterkenny, Lexington-Blue Grass, Red River, Seneca, Sierra, Tooele (two APE 1236s) Army Depot, Savanna Army Depot Activity, McAlester Army Ammunition Plant, Crane Army Ammunition Activity, and Fort Richardson. The second incinerator located at Tooele Army Depot is used to develop ammunition feed rates, to perform test burn projects, and to provide operator certification training.

c. The APE upgrade program began in 1987 and will continue into at least 1992. As of December 1990 the following progress has been made:

(1) All upgrade hardware has been designed and procured. Shipment has been made to 14 of the 15 installations.

(2) Major hardware installation has occurred at 9 incinerators.

(3) Some late hardware modifications were made after the initial nine upgrade contracts were awarded; some were accomplished through contract vehicles, while others were accomplished by the U.S. Army APE technical teams. Modifications at three incinerators have been completed, three require attention from the APE teams, and the final three require some further contract modification work.

(4) Upgrade specifications for the last seven incinerators are being prepared. Of these, contract awards for Lexington-Blue Grass Army Depot and McAlester Army Ammunition Plant are projected for July 1991. The remaining five awards will follow over a 6-month period. These newer specifications will incorporate the features that required modifications to the first nine incinerators.

6. Policy.

The Army has existing policies and regulations which mandate all OB/OD facilities to be in full compliance with all applicable Federal, state, and local environmental regulations. Policies outline the types of OB/OD operations that require compliance with RCRA hazardous waste management requirements as well as define the point at which energetic materials become hazardous wastes. Regulations define general facility standards and operational procedures for OB/OD facilities to follow to ensure compliance.

7. Ongoing Subpart X Permit Application Support Program.

a. USATHAMA, as the Executive Agent for the Army Environmental Office for Army Subpart X permitting issues, has established and funded contracts to extend DOD's capabilities in the following areas:

(1) Develop an Army Position Paper on Subpart X permitting.

(2) Develop an Army Management Plan for Subpart X permitting.

(3) Develop an Army-wide Subpart X Status Report.

(4) Resolve NODs received for Subpart X permit applications.

(5) Establish an automated waste ammunition characterization data base.

b. The issues being addressed in the Army Position Paper fall into the two broad functional areas of health and environmental assessments and environmental performance standards. In the first functional area, topics under study include environmental monitoring to characterize the current migration status of any past releases; groundwater; surface water and soil assessments; health and environmental criteria; waste ammunition characterization specifications; and air quality assessments. In the second functional area topics under study include unit location requirements; selection of appropriate treatment technology; design and construction requirements; operational inspection and maintenance requirements; effectiveness of treatment; waste characterization plans; air monitoring plans; environmental monitoring plans; noise considerations, and closure plans. The objective of this effort is to provide additional environmental guidance for the conduct and monitoring of OB/OD operations; and to ensure that OB/OD operations are conducted in an environmentally acceptable and regulatory conforming manner.

8. Safety Considerations. Safety has in the past and continues to play a prominent role in decisions to perform OB/OD operations. In addition to emergency EOD operations, which have already been discussed, the following safety factors are considered for continuing OB/OD operations:

a. To preclude spontaneous combustion, demilitarization personnel are required to OB in a short period of time unserviceable artillery propellant with low or no stabilizer remaining. Similarly to prevent accidental detonation, any munition that is declared too dangerous to remove from its packaging, (i. e., 20 millimeter U.S. Naval rounds with copper azide formulation) must be disposed of through OD.

b. Amnesty and routine turn-ins of ammunition and explosives result in the generation of items that may be unserviceable, tampered with or have unidentifiable lot or nomenclature identifications. Installations that are regulatorily denied the ability to conduct OB/OD operations will be required to package, and transport these items over public highways, thus, potentially exposing the general public to unnecessary hazards.

9. Regulated Treatment or Disposal Units Located Within Impact Ranges. This section of the response addresses the EPA Region IV statement that "Regulated treatment or disposal units located within impact ranges will not be permitted due to the inability to adequately monitor soil or groundwater safely or accurately." There are several issues raised by this statement of position:

a. Surface soils can be tested for residual TNT, RDX, and heavy metals. Based on results, the extent of any further evaluation can be better determined. Some sub-surface soil investigation along with leaching studies in lieu of ground water monitoring may be warranted. Such testing was recently conducted at Camp Shelby, Mississippi (11 December 1990).

b. Ground water monitoring is not specifically required for Subpart X regulated units and may not be necessary based on the results of soil testing and due to the nature of the predominant activity, (i. e., live fire training) on the range.

c. The EPA Region IV position seems to assume that there has been an assessment that in all cases, OB/OD of energetic reactive wastes has an impact on ground water. The regulation is quite clear that permits for miscellaneous units are to contain such terms and provisions as necessary to protect human health and the environment, including, but not limited to, appropriate design and operating requirements, detection and monitoring requirements, and requirements for responses to releases of hazardous waste or hazardous constituents from the unit. The preamble to Subpart X, 52 Federal Register 46946, at 46955, states that an assessment must be conducted for each medium, however if the assessment shows that there will be no impact on a given medium, the permit need not specify conditions to protect that medium.

d. Section 264.601 sets out nine factors to be considered in the assessment of the impact on ground water or the subsurface environment. Applying these factors to OB/OD operations in impact areas should demonstrate that there is no impact on ground water and subsurface areas.

(1) The first factor includes the volume, concentration, and physical and chemical characteristics of the waste placed in the unit. The volume and concentration determine the maximum amount and concentration that may enter the ground water. This is an important factor in assessing OB/OD activity, since the volume and concentration of waste involved in OB/OD activity is minuscule compared to the volume and concentration of the contaminants generated by the impact range activity. Requiring OD to be conducted off range results in large expenditures and the possible contamination of a heretofore uncontaminated site, a result at odds with the purpose of protecting human health and the environment.

(2) The third factor, the existing quality of ground water, including other sources of contamination and their cumulative impact on ground water, more directly applies to the OB/OD activity in ranges. Even without testing, logic dictates that whatever effect, if any, OB/OD activity might have on the ground water, the range activity generates the very same contaminants in far greater volume in a much less controlled (from the regulations point of view, uncontrolled) environment. The preamble (page 46956) states this factor is useful in predicting the incremental risk of the new unit. If there is no measurable increment of risk present due to the existence of another source of contamination, then the assessment would show that the OB/OD activity in the range would have no impact on ground water quality.

(3) The sixth factor focuses on land use patterns. Given the relative permanence of military impact ranges and their unsuitability for any other uses (except OB/OD activity) the land use factor should point favorably to continued OB/OD activity in ranges without requiring ground water monitoring.

(4) The other factors are relevant only if there is not another source of contamination existing.

e. Other Issues.

(1) EPA Region IV's position indicates it has a view independent from EPA Headquarters concerning the scope of regulation for DOD OB/OD activities. Army Regulation (AR) 200-1, paragraph 6-7 establishes policies for the application of hazardous waste management requirements contained in Title 40 Code of Federal Regulations (CFR) Parts 260 through 271 to the demilitarization of conventional military munitions, including OB/OD training activities. These policies were staffed with EPA without objection. These policies were promulgated to subject OB/OD activity to RCRA regulation in only very narrow circumstances and with the recognition that the military is the expert authority on the arsenal. This was done by very narrowly defining when ordnance is categorized as waste. These narrow definitions are only understandable when coupled with an understanding of the unique characteristics of ordnance. For example, paragraph 6-7b(2) states that unserviceable ordnance is not waste if it is safe to handle and store and is accounted for and stored together with munitions or ordnance in the field service account. Similarly,

paragraph 6-7b(3) defines waste by the degree of management and control procedures exercised by DOD. Paragraph 6-7f declares that assignment of munitions and ordnance to the SDPDA or their classification as unserviceable are not designations of such items as waste. Paragraph 6-7d gives examples of U.S. Army actions which designate ordnance as waste, including disposal by tansfer to a commerical recycler, disposal of residues from OD or other thermal treatment, disposal of items resulting from treatment by any method that has the effect of transforming the treated item into an non-munition or non-ordnance item that is no longer subject to U.S. Army management and control.

(2) When ordnance is collected and handled at the installation EOD site, it is the U.S. Army's position that ordnance becomes waste upon the application of the treatment process. This further demostrates that the impact of regulated OB/OD activity upon the environment is negligible and the strict regulation requirements are not appropriate for units located within impact ranges.

10. Conclusions.

a. The DOD currently considers it of the utmost importance for those installations that have submitted Subpart X permit applications in Region IV to continue to have and maintain OB/OD operational capability. The ability to exercise a safe demilitarization option as and when it is needed does not necessarily equate to perpetuation.

b. The Single Manager for Conventional Ammunition Demilitarization has developed an overall demilitarization/disposal plan that first considers safety and then makes a relative balance between cost and energy implications while ensuring compliance with environmental regulations. The plan includes numerous options such as separation, disassembly, destruction, HAZMIN, recycling, sales, and R&D. OB/OD is only one of several thermal treatment destruction processes, all be it an important process, that is used to demilitarize military ammunition and ordnance.

c. Because the DOD inventory covers a large range of energetic materials and munitions, different alternative treatment methods need to be developed, scaled up, evaluated for overall risk, and permitted. While some alternatives have progressed past the conceptual or laboratory scale, most are still years away from showing a significant impact. R&D efforts are ongoing to field disassembly equipment to reduce the size of ordnance items to allow safe alternative demilitarization options to be implemented in addition to OB/OD. DOD has R&D and upgrade programs to implement alternative technologies to OB/OD. None of these concepts are mature enough to entirely replace OB/OD or evaluate their full impact upon health and the environment.

d. In regards to the issue of impact ranges, where contamination to specific media, (e. g., ground water and soils) are determined to be related to regulated OB/OD operations during the required assessments, environmental monitoring for that media is an appropriate permit requirement. Where there is no measurable contamination or no causal relationship can be made between media contamination and OB/OD operations, media monitoring is not an appropriate permit requirement. Media monitoring at or around impact ranges is not an appropriate permit requirement.

APPENDIX C-8

THERMOCHEMICAL CHARACTERISTICS OF EXPLOSIVES

THERMOCHEMICAL CHARACTERISTICS OF EXPLOSIVES				
			PRODUCTS OF COMBUSTION	
Material	Heat of Combustion, Calories per Gram at Constant Pressure	Heat of Formation, Kilogram Calories per Mole	Heat, Calories per Gram (H_2O) Gas	Gas, Milliliters per Gram
Primary Explosives				
Lead azide	--	-112 to -126.3	367	308
Mercury fulminate	938	-221 to -226	427	315
Diazodinitrophenol	--	956	820	
Lead Styphnate	1,251	92.3	460	440
Tetracene	--	270	658	1,190
Aliphatic nitrate esters				
BTN	2,167	368	1,458	--
DEGN	2,792	-99.4	1,161	--
Nitrocellulose: Pyroxlyn (12% N)	--	-216	1,020	--
Nitrocellulose: Guncotton (13.35% N)	2,313	-200	1,020	883.2
Nitrocellulose: High nitrogen (14.14% N)	--	-191	1,810	--
Nitroglycerin	1,603	-90.8	1,486	715
PETN	1,957	-128.7	1,510	790
TEGN	3,428	-603.7	750	--
TMETN	2,642	-422	--	--

THERMOCHEMICAL CHARACTERISTICS OF EXPLOSIVES				
			PRODUCTS OF COMBUSTION	
Material	Heat of Combustion, Calories per Gram at Constant Pressure	Heat of Formation, Kilogram Calories per Mole	Heat, Calories per Gram (H_2O) Gas	Gas, Milliliters per Gram
Nitramines				
HMX	2,231 to 2,253	11.3 to 17.93	1,480	--
RDX	2,259 to 2,284	14.71	1,480	908
EDDN	2,013	156.1	128 to 159	--
Haleite	2,477	20.11	1,276	908
Nitroguanidine	2,021	20.29	880	1,077
Tetryl	2,914	4.67 to 7.6	1,450	760
Nitroaromatics				
Ammonium picrate	2,745	95.82	800	--
DATB	--	-97.1 to -119	910	--
HNAB	--	-58 to -67.9	1,420	--
HNS	3,451	-13.9 to 1.87	1,360	--
TATB	2,850	-33.46 to -36.85	1,018	--
TNT	3,563 to 3,598	-10 to -19.99	1,290	730
Ammonium Nitrate	--	88.6	381	980

SECTION D

PROCESS INFORMATION

The information provided in this section is submitted in accordance with the requirements of 40 CFR 270.23, 40 CFR 264.17 and 264 Subpart I. The regulatory requirements of 40 CFR 264.601 and 602 will be addressed in Section L entitled Environmental Performance Standards, and the requirements of 264.603 shall be addressed in Section I entitled Closure Plan, Post-Closure Plan and Financial Requirements.

D-1 DESCRIPTION OF FACILITY [40 CFR 270.23]

Open burning and open detonation operations are conducted at two separate locations at the OB/OD facility. Operational characteristics include open detonation of high explosives in earthen pits and open burning of waste propellants and pyrotechnics in burning trays. The specific location for each of these operations is identified on the topographic map of the hazardous waste management area (Figure B-2). These facilities are limited in operation by the following PEP weight limits: 5,000 pounds, net explosive weight, per detonation for open detonation and 5,000 pounds, net explosive weight, per burn for open burning.

The area where the units are located is an impact range used by the Navy for target practice. The area is bombed more than 200 days per year with the same types of ordnance which are treated at the OB/OD units. Once or twice each year, the Navy Explosive Ordnance Detachment (EOD) clears paths into the target area so that the targets can be repaired. As part of this path clearing exercise, undetonated ordnance is located, removed from the soil and detonated for safety. It should be noted that neither the target practice nor path clearing activities are subject to regulation under RCRA.

The OB unit is a structureless unit with overall approximate dimensions of 100 x 100 feet. No treatment operations have been conducted at the facility since approximately 1987. During these previous OB operations, no burning pans were used since such equipment was not required at that time. However, future treatment of reactive materials from screw top munitions, pyrotechnics and initiators will be burned in approved burning trays equipped with secondary containment to prevent soil and groundwater contamination. A design of the equipment to be used is shown in Figure D-1. It is not planned for there to be more than a single burn event per day. The number of burning trays needed is yet to be determined.

The OD unit is a structureless unit with overall approximate dimensions of approximately 100 x 100 feet. During each treatment event, a single pit is excavated in which the waste ordnance is placed for detonation. The pit is circular with approximately a 30 to 50-foot radius; the pit

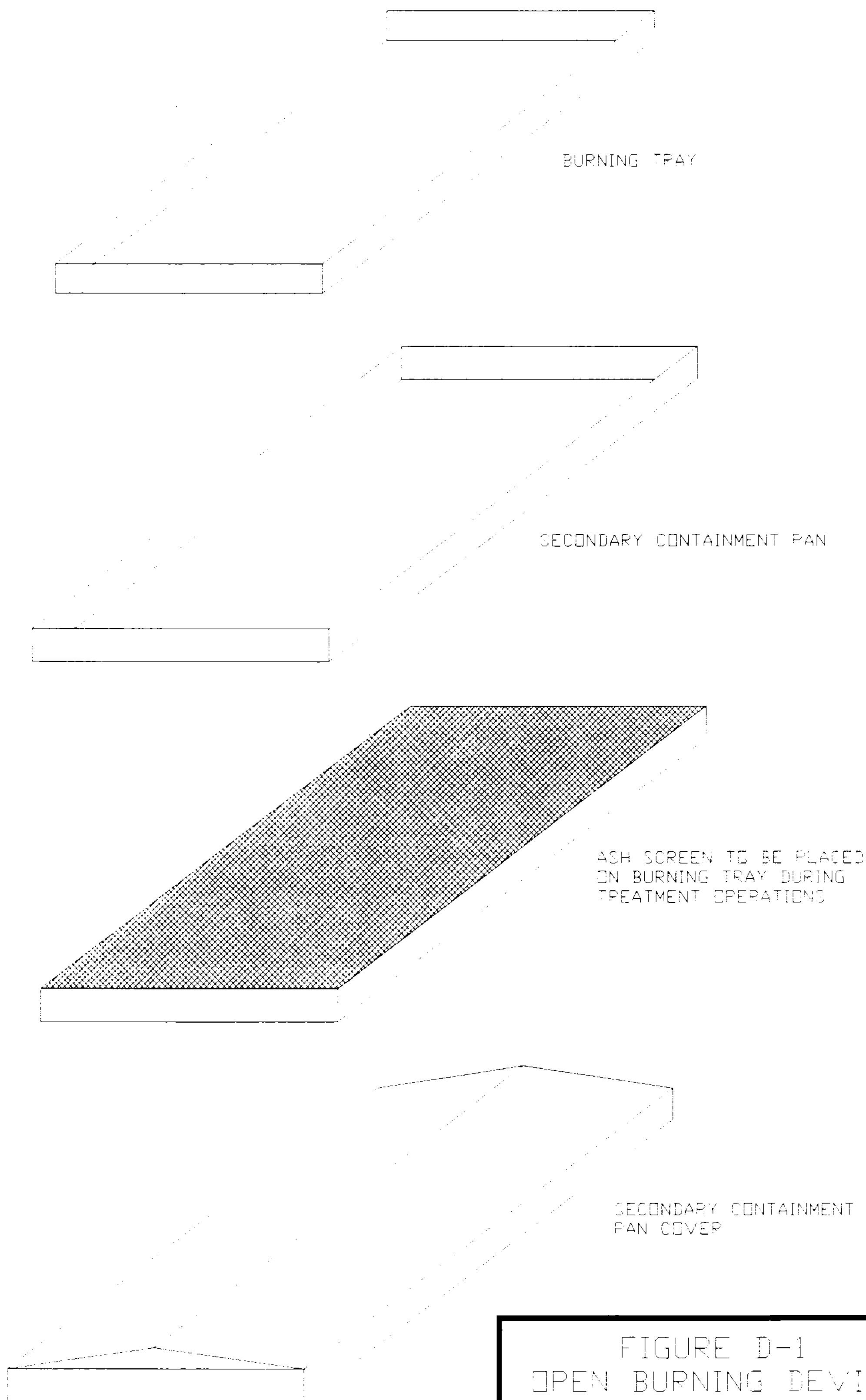


FIGURE D-1
OPEN BURNING DEVICE
AFWTF VIEQUES

DATE: 06/04/93 | DWG NAME: VIEQUES1

is from 6 to 8 feet deep. The pit has no specific location since the bombing activities tend to obliterate the unit between treatment events. The pit location may change due to site conditions. Cover materials are not used to cover ordnance prior to detonation since they would complicate the response in the event of a misfire. No more than one detonation occurs per day. No sound or shock barriers are utilized since personnel evacuate to OP-1 prior to detonation; OP-1 is located approximately 1.8 miles from the unit. DoD policy and the facility SOP state that a minimum 5,000-foot buffer is required between personnel and the detonation site; therefore, no protective bunkers are utilized at the unit. Such devices would be destroyed during ordnance bombing activities.

Grass and/or brush at each unit are controlled through cutting, burning, or the application of chemical herbicides as appropriate.

No drawings of the included in this application. The OD unit consists of nothing more than a pit, the location of which tends to change between treatment events. The OB unit has not been utilized since 1987. When the unit is brought back into service, a drawing of the unit layout will be provided as an addendum to this application.

D-1(a) Range Clearances

In order to gain access to the AIA, range clearances, or sweeps, must be performed along the road leading the range targets as well as the OB and OD units. The Standard Operating Procedure (SOP) for Unexploded Ordnance (UXO) Clearances and Retrograde Ordnance Disposal is included in Appendix D-1. This SOP provides detailed criteria for performing range clearances. Due to the dangers associated with entering the range prior to range clearances, inspections of the OB and OD units are only possible after completion of the semi-annual range clearances.

D-2 OPERATIONAL CHARACTERISTICS FOR OPEN BURNING

D-2(a) Detailed Plans of the OB Unit

Open burning operations are conducted in a secondary containment device constructed of .25 inch boiler plate or carbon steel with an aluminum cover to prevent rainfall from entering when the unit is not in use. An example of a device which may be used for conducting open burning operations has been provided as Figure D-1. This is provided merely an example and is not intended to obligate the U. S. Navy to conform to the specified dimensions or material of construction. However, the material of construction shall be capable of withstanding intense heat and provide adequate containment of initiating fluids such as diesel, gasoline, or kerosine as well as any residual ash that may be generated. No protective shelters are provided since such structures would be destroyed during bombing training and because all personnel evacuate to OP-1 prior to initiation of burning.

Waste materials have already been disassembled from the cartridge prior to transportation to the treatment range and are then placed in the burning tray according to SOPs as shown in Appendix D-1. A primer cord is attached to the circuit wire. Operators retire to the protective shelter, close the gate, raise the red flag, unlock the control panel, and ignite the propellants. This flashing process generates sufficient heat to completely burn residual propellants.

Based upon data from other facilities and DoD testing, burns range in duration from a few seconds to five minutes, depending upon the type of propellant/materials burned and whether a supplemental fuel is utilized to facilitate the burn. At this time, the use of supplemental fuels is not anticipated for any future open burning activities.

D-2(b) Operating Procedures for Open Burning

All open burning treatment operations shall be conducted in accordance with the NAVSEA OP 5 technical manual entitled *Ammunition and Explosives Ashore Safety Regulations for Handling, Storing, Production, Renovation and Shipping*. A summary of those safety requirements is provided below. A copy of Chapter 13 of NAVSEA OP 5, entitled *Disposal of Ammunition and Explosives*, is included as Appendix D-2.

GENERAL REQUIREMENTS

Treatment of ammunition by burning is only accomplished in an area approved by NAVSEA and destruction is not undertaken until NAVSEA has approved the operation.

The ground within the immediate vicinity of the burning unit area does not exceed a 10° grade. Burning shall be done in a containment device capable of withstanding high temperatures and containing any initiating liquids and residual ash.

Regardless of the type of ammunition, explosive, or other similarly hazardous material involved in an authorized disposition by burning, it is important to recognize that a detonation may occur. In order to provide adequate protection, burning units are required to be a minimum of 1800 feet away from any magazine, storehouse, inhabited building or other structure and any public highway or passenger railroad. The AIA unit is approximately 1.8 miles from the nearest structure.

The burning units are to be reasonably free from undergrowth or shrubbery. Prior to treatment, an area 300 feet square is freed of all long grass and undergrowth. All vegetation such as dry grass, leaves, as well as other combustible materials and glass or glass particles, is removed within a radius of 200 feet from the burning unit.

PRESCRIBED PROCEDURES

Prescribed specific procedures in connection with the disposition of watch specific type or condition of explosive are reviewed by all pertinent personnel and are available at the burning site during the burning operation.

PERSONNEL ASSIGNMENT

Commanding officers shall be responsible for the assignment of personnel to operations at OB areas. All OB personnel shall be well qualified, fully informed regarding the hazards to be encountered and the applicable operating safety precautions to be observed, and capable of safely performing their duties. The number of employees engaged in a destruction operation shall be limited, but at no time shall any person be allowed to work alone.

PERSONNEL PROTECTION

All personnel are instructed as to the dangers of inhaling toxic vapors resulting from burning hazardous materials. When prevailing winds would cause the inhalation of toxic fumes, operations are either suspended or personnel are equipped with respirators.

Sufficient and suitable protection for personnel is provided in the form of clothing and shelter at the treatment site. A minimum of two fire blankets are available for emergency use. Personnel engaged in treatment operations are instructed in the proper use of the fire blankets. As it is not possible to construct personnel protection areas or bunkers within the impact range, all personnel evacuate to OP-1 prior to initiation of treatment. Because OP-1 is located approximately 1.8 miles from the OB area, direct viewing of the burn is acceptable.

Due to the dangers involved in entering the impact range, it is not feasible to allow mobile fire fighting equipment to enter the range. Therefore, if an uncontrolled fire occurs, all personnel immediately evacuate the area via vehicle or, if vehicles are inoperable, by foot to rendezvous at OP-1.

Two-way radio communication with OP-1 is available during all operations. Communications units are not located at a distance greater than 2500 feet.

Treatment by burning is not undertaken during conditions of high wind velocity (in excess of 15 miles per hour). Contact with OP-1 is maintained in order to continuously monitor wind velocity. OB operations are suspended if there is an electrical storm within 10 miles. The local weather service is contacted for any radar activity. OP-1 also provides visual confirmation of a storm approaching outside the 10-mile radius. OB activities will be suspended in the event weather advisories indicate impending rain.

Guards and warning signs on all access roads are used to keep unauthorized personnel from danger areas during burning operations. The burning operations are not initiated unless all personnel are confirmed by the EOD Officer in Charge to have evacuated the range.

MATERIAL STOCKPILING

Materials awaiting treatment are kept far enough from the treatment location to be protected against accidental ignition or explosion from hurled fragments, grass fires, sparks, or burning embers. For burning operations, the stockpile area is maintained, at a minimum, 500 feet from any active burning unit.

ELECTRICAL STORMS

The treatment of ammunition, explosives, or similarly hazardous materials and operations incidental thereto is not undertaken during electrical storms.

ACCIDENTS

Any casualty, misfire, or accident involving fatalities or injuries to personnel or appreciable property damage is reported immediately by the most expedient method to Commander Fleet Air, Caribbean (COMFAIRCARIB). The commanding officer of the concerned activity immediately appoints a board of qualified but not involved personnel to investigate and assemble the pertinent details concerning the accident.

DELIVERY OF HAZARDOUS MATERIAL TO THE BURNING SITE

All motor vehicles used to transport hazardous material to the burning unit area are approved for explosive operations in accordance with OP 3681.

The containers of hazardous materials are carefully loaded into the vehicle and secured against falling or movement during transfer to the burning unit.

No person other than the driver, who is qualified to transport dangerous cargoes in accordance with OP 2239, and a maximum of two other authorized helpers, ride in or on a vehicle transporting hazardous materials.

The motor vehicle used to transport the containers to the burning unit is positioned for unloading at the burning unit with the exhaust outlet on the opposite side from which the containers are to be removed. The motor is not left running while hazardous materials are unloaded.

The motor vehicle, if retained at the burning unit for any purpose, is moved back a minimum of 50 feet from the nearest material prior to opening the containers. In addition, the vehicle is returned to the stockpile area and the motor shut off prior to ignition of the ignition train.

Containers of hazardous materials are handled carefully at all times. They are not to be dragged over the floor of the truck or over the unit and are not to be thrown, pushed or dumped off the truck to the unit. If the truck is not equipped with an elevator-type tailgate, the individual containers are individually lifted and placed on the ground by hand or by forklift. The containers are spaced evenly along the burning unit. If containers are palletized, pallets are placed alongside the burning unit and unbanded. Containers are not unpalletized within the vehicle.

REQUIRED TOOLS

Only authorized-spark resistant tools are used while working within a radius of approximately 15 feet from exposed hazardous materials. However, a clean sharp knife may be used when cutting time-blasting fuse for use with a nonelectric firing system.

Tools which may be used for handling explosive materials are not permitted to become heated by remaining near burning explosives.

PLACEMENT OF HAZARDOUS MATERIAL IN BURNING UNIT

Hazardous materials are always removed from containers, as attempts to burn certain hazardous materials under even slight confinement may result in an explosion. Materials being burned are examined carefully to make certain no detonator or blasting cap is included. No unauthorized admixtures of hazardous material with extraneous material, other explosives, detonators, or similar items are permitted.

In addition, all empty containers are moved back from the burning unit a minimum of 100 feet prior to igniting the powder train to avoid being dangerously overheated from the burn. Wet scrap propellant is burned in a different location or at a different time than dry scraps.

PLACEMENT OF HAZARDOUS MATERIALS IN BURNING UNIT

Prior to the delivery of any hazardous material to a burning unit, the unit is carefully inspected for the presence of dangerous objects or prohibited foreign material. If the burning unit has been previously used that day, it is inspected to assure that the ground is not dangerously warm and is free from flowing, smoldering, or burning embers and residues. Any detected hazardous materials are placed in a hazardous waste drum and disposed of as hazardous waste or retrieved for treatment with other explosives. All personnel retreat to the vehicle except one operator and the supervisor who shall remain to prepare for the ignition. Ignition of the explosives is accomplished by placing the squib or safety fuse in a small pile of small web (powder grains, for 3-inch cartridges or smaller) smokeless powder located so as to overlap the edge of the explosives to be burned. Ignition of the smokeless powder is either by an electric squib firing system or a non-electric system if available.

Treatment operations are only conducted during daylight hours.

POST-BURN REQUIREMENTS

Personnel remain at OP-1 until all the explosive spread for burning has been consumed.

After the burning has visually exhausted itself, a wait of at least 24 hours is required prior to anyone returning to the burn unit. The supervisor and one operator then return to inspect the general area of the burn for completeness of burn, heat retainment, and any other dangerous conditions. If no unusual conditions exist, the area is wet down thoroughly with water if available.

A period of at least 2 hours from the wet down time is required before another burn may be conducted in the same containment device. If water facilities are not available, a period of 4 hours must elapse. All ash is removed, containerized, and removed from the unit prior to additional treatment events.

CLEANUP

Following burning operations the area is inspected for the presence of unburned ordnance. All such discovered items are either re-treated immediately or returned to a proper magazine to await future treatment.

WASTE ANALYSIS

No burning of waste ordnance or PEPs has occurred since 1987. As a result, no ash has been generated and no sampling/analysis has been performed. When open burning activities are reinitiated, ash will be sampled and analyzed per the Waste Analysis Plan. The results will then be appended to the permit application.

Soils at the OB unit was sampled and analyzed in 1990. The results of this study are discussed in Section L of this document.

D-3 OPERATIONAL CHARACTERISTICS FOR OPEN DETONATION

D-3(a) Detailed Plans of the OD Unit

No engineered structures are located at the OD facility. During treatment operations, a pit is excavated in which the waste ordnance is placed for detonation. The pit is circular with approximately a 50-foot radius; the pit is from 6 to 8 feet deep. Material to be detonated is carefully placed in the hole according to SOPs. Demolition material which is used to destroy the ammunition or components is transferred from storage to the treatment range, as described in Section C. The waste ordnance designated for detonation is initiated by a non-electric explosive firing train. Upon placement in the pit, high explosives (HE) are placed in direct contact with the waste ordnance in order to maintain explosive continuity. The HE is tied in with primacord to a single initiation point. Two lengths of time fuse, cut to provide a 15-minute safe separation time, are capped with non-electric caps. The capped time fuse is connected to the primacord. Two M-60 fuse igniters are used to initiate the time fuse. The M-60s are pulled, initiating the 15-minute delay. As the time fuse burns down to the non-electric cap, the cap initiates and detonates the primacord. The primacord detonates the HE, which then detonates the waste ordnance. No protective shelters are utilized since such structures would be destroyed by bombing training and personnel evacuate the unit to OP-1 prior to detonation initiation.

Certified high explosives (C-4, HBX) are utilized to counter-charge the waste ordnance. Since all waste ordnance has high explosive properties, the important rule in placing the HE next to the waste ordnance is to maintain contact. The HE used is very insensitive to heat, shock, or friction, and is therefore extremely safe in handling. The amount used varies, but the combined total weight of waste ordnance and HE does not exceed 5,000 pounds. Although the HE is utilized as a supplemental material in open detonation operations, it is not technically a *fuel*, but rather an initiating mechanism. As a consequence, no supplemental fuels are utilized for detonation operations.

D-3(b) Operating Procedures for Open Detonation

All open detonation treatment operations are conducted in accordance with the NAVSEA OP 5 technical manual entitled *Ammunition and Explosives Ashore Safety Regulations for Handling, Storing, Production, Renovation and Shipping*. These safety requirements are summarized below. A copy of Chapter 13 of NAVSEA OP 5, entitled *Disposal of Ammunition and Explosives*, is included as Appendix D-2.

GENERAL REQUIREMENTS

Detonation of explosive material is undertaken only in those areas or locations which have been specifically approved by NAVSEA. The destruction is not undertaken until NAVSEA has approved the operation.

PRESCRIBED PROCEDURES

Prescribed specific procedures in connection with the disposition of each specific type or condition of explosives are reviewed by all pertinent personnel prior to the treatment event. In addition, copies of the procedures are available at the unit for review by all personnel. Likewise, appropriate station orders or regulations for the operation of detonation sites are established and available for review.

PERSONNEL PROTECTION

Due to the nature of the impact range, it is not possible to construct crew-protective areas such as personnel shelters or bunkers. Therefore, all personnel evacuate the unit to OP-1 prior to initiation of each treatment event.

FIRE FIGHTING EQUIPMENT

Since it is not possible for fire fighting equipment to enter the range, any fires which occur due to the treatment activities will be allowed to burn out naturally. Fires routinely occur during range training operations.

COMMUNICATIONS

The requirements for communication devices are the same as those specified for open burning.

WEATHER CONDITIONS

OD operations are suspended if there is an electrical storm within 10 miles. The local weather service is contacted for any radar activity. OP-1 also provides visual confirmation of a storm approaching outside the 10-mile radius. A torrential rain storm may also suspend OD operations if the EOD supervisor determines that visibility or ordnance handling is affected.

WARNING SIGNS

The requirements for the posting of warning signs are the same as those for open burning.

MATERIAL STOCKPILING

The distance to explosive material awaiting destruction varies in accordance with the class of site as approved by NAVSEA; however, in no case is material stored at less than intraline distance from the explosive being destroyed based on the largest quantity involved. No persons are assigned to this area when actual detonation operations are underway. No material is staged at the detonation site.

ELECTRICAL STORMS

The destruction of ammunition, explosives, or similarly hazardous materials and operations incidental thereto are not undertaken during electrical storms.

ACCIDENTS

The requirements for reporting accidents are the same as those required for open burning.

SAFETY REQUIREMENTS

The number of personnel on treatment operations is kept to a minimum, but in no circumstances does an operator work alone.

When actual detonation of explosive material is underway, no personnel are stationed at or near material awaiting treatment in the stockpile area.

The treatment crew remains at OP-1 for at least 30 minutes after detonation has been completed. Work is scheduled so that detonations will not occur within 30 minutes prior to securing the range at the end of the day.

AFWTF Range Control is notified that destruction by detonation is to be performed. The range is not secured until no probability of fire exists.

Only spark-resistant tools are used while working within a radius of 15 feet from explosive energetic material; a clean sharp knife may be used when cutting time blasting fuse/detonating cord. Detonation operations are performed during daylight hours only. Blasting caps are installed only when all operators except those doing the actual ignition work have retreated to the vehicles prior to evacuating to OP-1. Blasting caps are carefully handled at all times.

Ammunition and explosives to be destroyed are not roughly or carelessly handled. The regulations for handling ammunition and explosives are the same as those prescribed for open burning. Extra care is taken since in most instances the hazards of the ammunition or explosives to be destroyed are increased by such factors as age, deterioration, or damage.

DELIVERY OF HAZARDOUS MATERIALS TO DETONATION SITE

The motor vehicle used to transport hazardous materials to the detonation unit meets the requirements of NAVSEA OP 3681.

No person or persons other than the driver and two helpers ride in or on a vehicle transporting explosive material. The driver is qualified to transport hazardous materials. The requirements for material handling and transportation are the same as those required for open burning operations.

POST-DETONATION REQUIREMENTS

Following each shot, after a reasonable waiting period (minimum 30 minutes) a careful search of the surrounding grounds is made for unexploded ammunition or explosives. Items or material such as lumps of explosive or unfused ammunition are picked up and prepared for the next detonation. Fused ammunition or items which may have internally damaged components are generally detonated in place, based upon the discretion of the EOD officer/technician in charge.

WASTE ANALYSIS

The open detonation process does not generate a residue for which sampling/analysis can be conducted. If any unexploded PEP material remains following a detonation, it is either exploded in place or collected for immediate re-treatment. Therefore, no sampling of residues has been conducted. However, a soil sampling study was conducted in 1990 at the facility. The results of this study are discussed in Section L of this application.

D-4 MONITORING, ANALYSIS, INSPECTION, RESPONSE, REPORTING AND CORRECTIVE ACTION [40 CFR 264.15]

General Inspection Requirements [40 CFR 264.15]

Treatment operations occur only during two one-month periods each year. Since access to the range is only possible during those periods, inspections of the units occur only on those days (4 to 5 per year) that treatment occurs. All communication lines will be checked for viability prior to leaving for the site. Radio contact with the Range operator will be continuous during treatment. The initiating firing system is inspected for viability prior to each use. A log will be kept of all ordnance treated by use of the form 1348-1. A copy of the most current SOP is in Appendix D-1.

Testing and Maintenance of Equipment [40 CFR 264.33]

The operator of the OB/OD facility shall comply with the requirements of 40 CFR 264.33 by ensuring that all communications or alarm systems, fire protection equipment, spill control equipment, and decontamination equipment, where required, are tested and maintained as necessary to ensure its proper operation in time of emergency. Detailed information regarding these parameters shall be addressed in Section F.

Biennial Report [40 CFR 264.75]

The Explosive Ordnance Detachment will submit to the Environmental Engineering Division Director the information necessary to prepare and submit a single copy of a biennial report to the Regional Administrator by March 1 of each even numbered year. The biennial report will be submitted on EPA Form 8700-13B. The report will cover facility activities during the previous calendar year and will include all pertinent information of 40 CFR 264.75.

Unmanifested Waste Report [40 CFR 264.76]

The sole source of hazardous waste will be material shipped from Naval Station Roosevelt Roads and the Naval Ammunition Facility on Vieques. However, the material is not classified as hazardous waste until form 1348-1 is signed and the material is received at the site. This is per an agreement between the USEPA and the DOD.

Additional Reports [40 CFR 264.77]

In addition to submitting the biennial reports described in the previous sections, the operator of the OB/OD facility shall report to the Regional Administrator:

- Releases, fires, and explosions specified in 40 CFR 264.56(j).
- Facility closures specified in 40 CFR 264.115.
- As otherwise required by 40 CFR Subparts F and K-N.

Monitoring and Testing During the Operational, Closure and Post-Closure Periods [40 CFR 264.602]

Monitoring and testing is addressed in detail in Section L of this document.

D-5 POTENTIAL PATHWAYS OF EXPOSURE

Potential pathways of exposure will be addressed in Section L of this document.

D-6 DEMONSTRATION OF EFFECTIVENESS OF TREATMENT

Demonstration of effectiveness of treatment will be addressed in Section L of this document. Materials which are thermally treated at Vieques are conventional munitions, propellants, pyrotechnics, and explosives. As part of the manufacturing process, these items are specifically designed to combust or explode completely. Undetonated and unburned materials are retreated until they have lost their reactive properties.

D-7 HYDROLOGIC, GEOLOGIC, AND METEOROLOGIC INFORMATION

The information required to comply with 40 CFR 264.601 and 602 is discussed in Section L.

D-8 REQUIREMENTS FOR HANDLING GENERATED ASH

The open burning of waste explosives will generate residual ash. This ash shall be transferred from the containment device to a 55-gallon drum after each burning operation. Since it is not possible for the drum to remain at the burning unit, all drums shall be transported to the Defense Reutilization and Marketing Office (DRMO) at Naval Station Roosevelt Roads following each treatment operation. Since it is unknown whether the ash will be classified as a hazardous waste, all shipments of ash will be properly manifested prior to removal from the unit. Upon arrival at DRMO, the contents shall be sampled and analyzed according to the protocol established in the waste analysis plan. If the contents are determined to be nonhazardous, the ash may be disposed of at a solid waste landfill and shall not be subject to the waste management requirements of RCRA.

However, if the analytical results indicate that the ash is hazardous due to the presence of the specified heavy metals or due to its reactive characteristic, the residual ash shall be designated as a hazardous waste. The container shall be labeled and dispositioned to the hazardous waste storage facility at DRMO. Thereafter, containers shall be managed in accordance with the Naval Station Roosevelt Roads storage facility permit.

Handling of Burning Equipment

Burning equipment, including burning trays, containment devices, ash screens, and precipitation covers, is normally left at the OB unit between treatment operations. It is therefore possible that routine ordnance training operations will result in the destruction of or damage to the equipment. Any damaged equipment or debris will remain at the unit until closure of the unit is initiated. At that time, the equipment/debris will be transported offsite for disposal as hazardous waste debris. All appropriate handling and decontamination operations will be completed as described in the closure plan in Section I. As the equipment is decontaminated following each treatment event, destruction of this equipment during interim periods is not expected to contribute to any potential contamination.

Replacement equipment will meet all design and material specifications as that of the original destroyed equipment.

D-9 CLOSURE REQUIREMENTS

The closure requirements are discussed in Section I.

D-10 POST-CLOSURE REQUIREMENTS

The post-closure requirements are discussed in Section I.

D-11 ADDITIONAL INFORMATION [40 CFR 270.23(e)]

The following summarizes the operating guidelines as established by NAVSEA OP 5, an extensive document of hundreds of pages which is continually updated. Chapter 13 of NAVSEA OP 5 is included in Appendix D-2 in its entirety.

MINIMUM PROTECTIVE DISTANCES [40 CFR 265.382]

The following minimum protective distances from the open burning/open detonation operations to the property of others shall be adhered to:

- Open Burning of PEPs: 1,730 feet
- Open Detonation of Explosives: 1,730 feet

OPEN DETONATION OPERATIONS

1. Applicable portions of SOPs shall be conspicuously posted in rooms, bays, or other areas involving the handling of munitions. Supervisory personnel shall maintain copies of a complete standing operating procedure and be responsible for the enforcement of its provisions. There will be no deviation or changes from the approved SOP without prior approval of the installation Commander or his designated representative.

2. Any defect or unusual condition noted that is not covered in SOPs will be reported immediately to supervisory personnel.

3. Care will be taken to limit exposure to a minimum number of personnel, for a minimum time, to a minimum amount of hazardous material consistent with safe and efficient operations.

4. Each vehicle operator will have in his possession a valid operator's permit for the particular piece of equipment to be operated.

5. Explosive-loaded ammunition, packaged ammunition, or bulk explosives shall not be handled roughly. Large ammunition items, packaged in DOT-approved containers designed to permit dragging, rolling, or towing, may be so moved when necessary during handling for storage and transportation. Any ammunition determined to be dangerous to handle or store will be reported immediately to supervisory personnel. Operations will be suspended and if warranted, personnel will be evacuated pending further instructions. Doors of operating buildings should have panic hardware installed and must never be bolted or locked when operation are being conducted. Posted personnel and explosive limits must not be exceeded.

6. Equipment and grounds shall be tested for electrical resistance and continuity when installed and at intervals determined locally. All exposed explosives or hazardous materials shall be removed prior to making the test.

7. Appropriate fire symbols and/or chemical hazard symbols shall be displayed on vehicles used in transportation of ammunition. Leather or leather-palmed gloves will be worn by all personnel engaged in material handling operations. Steel-toed shoes will be worn by all personnel engaged in material handling operations.

8. No demilitarization/treatment operation will be conducted during an electrical storm or when such a storm is approaching within five kilometers. All personnel will be evacuated to a safe distance.

9. The supervisor is responsible to report to the Safety Office all injuries and accidents occurring during his/her shift. In the event of a fire or explosion, the person discovering the fire/explosion will notify the Fire Department and Safety Office.

10. All material transferred to salvage will be certified free of explosive contamination by the supervisor in charge and verified. Also, in all areas where the noise decibel reading is 85 or above, operators will wear ear protection and the area(s) will be properly marked.

11. Components or material being transported from disassembly operations to burning or detonation units or deactivation will be properly identified on the exterior pack; any misleading markings will be marked out or obliterated.

12. Servicing of OB/OD Sites:

    a. Trucks transporting explosive material to burning units shall meet the requirements of NAVSEA OP 5. No more than two people shall ride in the cab.

    b. Upon arrival at a burning or detonation ground, trucks may distribute explosive containers or explosive items to be destroyed at sites where destruction (treatment) is to take place. As soon as all item have been removed, trucks shall be withdrawn from the burning or detonation area to a safe location until destruction is complete. Containers of explosives shall not be opened until the truck has been withdrawn.

    c. Containers of explosives or ammunition items to be destroyed at the destruction site shall be spotted and opened at least 10 feet from each other and from explosive material previously laid for destruction to prevent rapid transmission of fire in the event of premature ignition.

    d. Empty containers shall be closed and moved a sufficient distance away to prevent charring or damage during burning of the explosives. Empty containers may be picked up by truck on the return trip after delivery of the next quantity to be destroyed.

13. Materials for Detonating Ammunition

    a. Detonation of explosives or ammunition should, where practicable, be initiated by non-electric detonating system. Ammunition and explosives shall not be detonated in containers.

        - Blasting or demolition shall not be conducted during an electrical storm or when a storm is approaching. All operations shall be suspended and all personnel must be removed from the treatment area to a safe location when an electrical storm approaches.

    b. Safety fuses are used in the detonation of explosives and ammunition when enhanced safety and efficiency will result. Safety fuses, when used, must be tested for burning rate at the beginning of each day's operation and whenever a new coil is used. Sufficient length of fuse shall be used to allow personnel to retire to a safe distance, but under no circumstances should a length be less than 3 feet or have less than a 120-second burning time. Crimping of a fuse which is too large in diameter to enter the blasting cap without forcing it is not allowed. Before igniting the safety fuse, all personnel, except the supervisor and not more than one assistant, shall retire to the vehicle or be evacuated from the treatment area.

d. When using blasting caps involving the non-electric system of destruction, the explosives end of the blasting cap shall always be pointed away from the body.

14. Detonation of Ammunition

a. Ammunition of explosives to be destroyed by detonation should be detonated in a pit at least 4 feet deep. The components should be placed in intimate contact on top of the item to be detonated. Where space permits, and the treatment area is remotely located from inhabited buildings, boundaries, work areas, and storage areas, detonation of shells and explosives may be accomplished without the aid of a pit. In either event, however, the total quantity to be destroyed at one time, dependent on local conditions, should be established by trial methods to assure that adjacent and nearby structures and personnel are safe from the blast effect or missiles resulting from the explosion. This procedure should be used for the destruction of fragmentation grenades, HE projectiles, mines, photo-flash munitions, mortar shells, bombs, and HE rocket heads which have been separated from motors. Rocket motors containing solid propellants should not be destroyed by detonation.

b. After each detonation, a search shall be made of the surrounding area for unexploded material and items. Items or material such as lumps of explosives or unfused ammunition may be picked up and prepared for the next detonation. Fused ammunition or items which may have internally damaged components should be detonated in place unless the item can be safely handled by using mechanical retrievers providing protection to personnel.

c. In case of misfires, personnel shall not return to the point of detonation for at least 30 minutes; no more than two qualified personnel shall be permitted to examine the misfire.

15. Operation of Motor Vehicles

a. During loading and unloading of munitions, the brakes must be set. In addition, when on a grade, at least one wheel must be chocked.

b. Trucks containing ammunition or explosives should not be refueled within magazines or explosives areas, including refueling from mobile units. A central station located outside the restricted area should be used.

c. No person shall be allowed to ride in or on the truck body or van of a motor vehicle transporting ammunition or explosives, except in cases involving limited quantities of small arms ammunition with non-explosive bullets. In the latter case, the small arms ammunition must be in closed containers which are properly secured in the truck body and seats shall be provided for personnel, restricted in number to the minimum required.

d. No explosives shall be loaded or unloaded from motor vehicles while their motors are running. Motors may be kept running when required to provide power to vehicle accessories such as mechanical handling equipment used in the loading and unloading of the vehicle, provided:

- The accessory is an integral part of the vehicle.
- The exhaust gases from the motor are emitted at least 6 feet from the point at which the loading operations are conducted and are directed away from this point.
- The exhaust pipe is equipped with a spark arrestor.

16. Inspection of Vehicles

a. All vehicles used to transport ammunition and/or explosives will be inspected monthly using DD Form 626.

b. Government-owned motor vehicles used for transportation of hazardous materials shall be inspected at frequent intervals by a competent person to see that mechanical conditions and safety devices are in good working order and that oil and motor pans under engines are clean. Daily inspection shall be made by operators to determine that:

- Fire extinguishers are serviceable.
- Electric wiring is in good condition and properly attached.
- Fuel tank and piping are secure and not leaking.
- Brakes, steering, and other equipment are in good condition.
- The exhaust system is not exposed to accumulation of grease, oil, gasoline, or other fuels, and has ample clearance from fuel lines and other combustible materials.

17. Government motor vehicles involved only in on post shipments shall be equipped, at a minimum, with one Class 10-BC rated portable fire extinguisher mounted outside the cab on the driver's side of the vehicle.

OPEN BURNING OPERATIONS

This section only summarizes the servicing of the destruction site, the general burning requirements, and the open burning of out-loaded HE projectiles. Other general safety precautions for handling pyrotechnics and propellants are the same as those for handling explosives described in the previous section.

1. Servicing of Destruction Site

    a. Trucks transporting explosive material to burning grounds shall meet the requirements of NAVSEA OP 5. No more than two people shall ride in the cab.

    b. Upon arriving at a burning or treatment ground, trucks may distribute explosives containers or explosive items to be destroyed (treated) at sites where destruction is to take place. As soon as all items have been removed, trucks shall be withdrawn from the burning or treatment area to a safe location until destruction is completed. Containers of explosives shall not be opened until the truck has been withdrawn.

    c. Containers of explosives or ammunition items to be destroyed at the destruction site shall be spotted and opened at least 10 feet from each other and from explosives material previously laid for destruction to prevent rapid transmission of fire in event of premature ignition.

    d. Empty containers shall be closed and moved a sufficient distance away to prevent charring or damage during burning of the explosives. Empty containers may be picked up by truck on the return trip after delivery of the next quantity to be destroyed.

    e. When materials being processed at destruction sites are to be handled by gasoline or diesel powered forklift truck, the requirements of NAVSEA OP 5 will be observed. All such material handled will be properly packaged and must not be contaminated with explosives.

2. General Burning Requirements

    a. Except in specific cases, such as projectiles loaded with Explosive D, ammunition and explosives shall not be burned in containers.

b. Bulk initiating explosives and others used predominantly in detonator and photo-flash compositions shall be destroyed by detonation except that small quantities (not exceeding 28 grams) may be decomposed chemically.

c. Loose explosives, other than initiating explosives, may be burned in beds not more than 3 inches deep. Wet explosives may require a thick bed of readily combustible material such as excelsior underneath and beyond to assure that all the explosives will be consumed once the materials are ignited. From the end of the layer of explosives the combustible material should be extended in a train to serve as the ignition point. If an ignition train of combustible material leading to the explosives is used, it must be arranged so that both it and the explosives burn into the wind. The combustible train of explosives, if ignited directly, must be ignited by a safety fuse long enough to permit personnel to withdraw safely to the protective shelter. In some cases, it may be necessary to tie two or more squibs together to assure ignition of the combustible train. When a misfire occurs, personnel shall not return to the point of initiation for at least 30 minutes. Not more than two qualified persons shall be permitted to examine the misfire.

- Loose, dry explosive may be burned without being placed on combustible material if burning will be complete and the burning does not become unduly contaminated. The ground must be decontaminated as frequently as necessary for the safety of personnel and operations.

- Wet explosives shall not be burned without first preparing a bed of nonexplosive combustible material upon which the explosives are placed to assure complete burning. It is necessary to burn RDX wet to prevent detonation.

- Dry grass, leaves, and other extraneous combustible material in amounts sufficient to spread fire shall be removed within a radius of 200 feet from the point of destruction.

3. Burning Out-Loaded HE Projectiles

a. TNT, Explosive D, Composition B, pentolite, and other explosives filler in open projectiles may be burned out when destruction by detonation or washing out and burning the explosive filler separately is impracticable.

b. Projectiles to be burned out should be placed on their sides and arranged in groups of no more than six projectiles, with all open ends facing in one direction. Open ends of projectiles should not be pointed into the wind.

c. Combustible material such as excelsior or scrap lumber should be used to ignite the explosive filler. Oil-soaked waste may also be used; however, it shall not be placed in the interior of the fuse activities.

APPENDIX D-1

STANDARD OPERATING PROCEDURE FOR UNEXPLODED ORDNANCE CLEARANCES AND RETROGRADE ORDNANCE DISPOSAL

APPENDIX D-2

NAVSEA OP 5
AMMUNITION AND EXPLOSIVES ASHORE — SAFETY REGULATIONS FOR HANDLING, STORING, PRODUCTION, RENOVATION AND SHIPPING

CHAPTER 13
DISPOSAL OF AMMUNITION AND EXPLOSIVES

CHAPTER 13

DISPOSAL OF AMMUNITION AND EXPLOSIVES

13-1. BACKGROUND

The disposal of ammunition, explosives, and other hazardous materials may be required because they have become unserviceable due to age, deterioration, damage, obsolescence, overstock, or lack of identity. It is the policy of NAVSEASYSCOM to dispose of these materials using the most economical method consistent with established safety and environmental standards. When arranging the safe, effective, expeditious, and economical disposal of ammunition, explosives, and other hazardous materials, consideration must be given to demilitarization of materials that can be safely and economically reused or sold. Materials that cannot be safely and economically salvaged shall be safely disposed of or destroyed in accordance with the specifications described throughout this chapter.

13-1.1. AUTHORIZATION FOR DISPOSAL. Ammunition, explosives, and other hazardous materials regardless of type or condition shall not be destroyed, except in the case of Marine Corps activities, without specific authorization and instructions from NAVSEASYSCOM (SEA-665). When the commanding officer of a Naval activity decides that, in order to protect life and property, immediate destruction of dangerously deteriorated or damaged ammunition or explosives is necessary, NAVSEASYSCOM shall be contacted by the quickest available means. Technical disposal instructions will be issued promptly. Under similar circumstances, Marine Corps activities shall follow disposition instructions from the Commandant, Marine Corps, if the material is under the technical direction of the Marine Corps. When material is under the technical direction of NAVSEASYSCOM, disposition instructions shall be requested from NAVSEASYSCOM (SEA-06M). Disposal operations must comply with all applicable local, state, and federal requirements for disposal and decontamination operations. Policy, responsibility, and procedures for release of hazardous or nonhazardous, large or small quantities of ammunition, explosives, and other hazardous materials for demilitarization/disposal are contained in NAVSEAINST 4570.1 (series). The procedures outlined in this paragraph are not meant to prohibit routine disposal of small amounts of ammunition, explosives, and other hazardous materials by any activity in accordance with the specific provisions of this chapter.

NOTE

> All disposal sites, such as burning pits, grounds, burn furnaces, incinerators and detonation sites/areas are considered hazardous waste treatment facilities. In the United States, they will be included on the activity hazardous waste permit according to Title 40 CFR Parts 260-265. Overseas activities must comply with host nation regulations as determined by the status of forces agreements.

13-1.1.1. Emergency Disposal. The provisions of this chapter may be modified, as required, by authorized agencies such as Explosive Ordnance Disposal (EOD) teams/detachments or qualified graduates of the Naval Explosive Ordnance Disposal School, who, in the performance of their duty in an emergency, are called upon to render safe, destroy, or otherwise dispose of ammunition or explosives in an approved manner. The following situations are included here as a guide to commanding officers when determining what constitutes an emergency with regard to the disposal of explosive ordnance, and when determining the type of personnel responsible for specific disposal operations. These situations are not intended to preclude the use of EOD personnel if circumstances warrant, or if experienced ordnance personnel are not available.

a. Acute emergencies when the services of an EOD team/ detachment or qualified graduates of the Naval Explosives Ordnance Disposal School are essential. These include:

(1) Disasters where unexploded, live ammunition is an ongoing hazard to lives and property.

(2) Mines or torpedo warshots that are washed ashore in locations where immediate action is necessary, where disposition by detonation or burning on the site cannot be accomplished without endangering life and property, or where for any reason they must be rendered safe prior to removal or disassembly.

(3) Bombs, rockets, missiles, and projectiles that are in hazardous condition as a result of firing or dropping.

(4) Crashed aircraft containing live bombs or rockets that are in a fuzed condition, or have been exposed to fire. This type of emergency includes water crashes that present an ongoing hazard to lives or property.

(5) Armed, unexploded depth charges with unsafe settings that present an ongoing hazard to lives or property. If the setting is not known, it should be considered unsafe.

(6) Other unforeseeable emergencies not safely remediable through the local or area command involving hazardous ordnance and requiring the services of specially trained personnel. In case of doubt, an item shall always be considered to be in its most dangerous condition.

b. Situations not in the acute emergency category, but for which the services of qualified graduates of the Naval Explosive Ordnance Disposal School are desirable include:

(1) Clearing dud ammunition from training or test ranges where necessary due to the disposal of the land, for safe range operation or for similar reasons.

(2) Investigation and disposal of foreign or unknown types of explosive ordnance in exposed locations or when the explosives are known to be deteriorated.

(3) Disposal of explosive ordnance by demolition when special techniques are required.

(4) General EOD work in combat areas.

(5) Explosive charges of any type washed ashore in remote areas where they may be safely disposed of by demolition without moving.

13-1.1.2. <u>Routine Disposal</u>. Disposal of the following items is normally within the capabilities of local ordnance personnel.

a. Souvenirs containing known types of explosives may be disposed of within the continental United States after specific approval by NAVSEASYSCOM.

b. Ammunition, ammunition components and explosives manufacturing waste may be disposed of by burning or detonation where a safe suitable area is available and approved by NAVSEASYSCOM, and if required environmental operating permits have been issued.

c. Inert ordnance items may be disposed of by scrapping.

13-1.1.3. <u>Approved Procedures for Disposal</u>. Explosive ordnance disposal personnel shall use rendered safe procedures developed by the Explosive Ordnance Disposal Technical Center (NAVORDTECHCEN), Indian Head, MD., for emergency disposal of ammunition or explosives. Standard operating procedures, developed per paragraph 2-1.1, shall be used by all personnel conducting routine disposal operations of ammunition or explosives. These procedures shall be reviewed by the cognizant EOD group commander or Commanding Officer of subordinate mobile and training units and approved by the CO of the activity where the routine disposal is being conducted.

NOTE

Guidelines for the conduct of demolition and disposal operations are contained in SW060-AA-MMA-010.

13-1.1.4. Waivers. No authority is recognized or granted to any commanding officer for the purposes of altering, waiving, or relaxing regulations included in this publication and in future directives regarding the disposal of ammunition, explosives, and similarly hazardous materials unless specific approval has been granted by NAVSEASYSCOM. In case of doubt about any procedures, clarification and confirmation shall be requested from NAVSEASYSCOM.

13-1.2. METHODS OF DISPOSAL. Ammunition and explosives that are dangerously deteriorated or damaged, obsolete, subject to malfunctions, or otherwise unserviceable and cannot be economically salvaged or safely sold, are normally destroyed. Destruction is accomplished by burning, detonating, neutralizing or "bleeding off," as prescribed in this chapter or in other applicable instructions provided by NAVSEASYSCOM. Use of methods other than those prescribed by regulations or standard military manuals shall be approved by NAVSEASYSCOM. Disposal by ocean dumping may be permitted only in cases of extreme emergency.

13-1.3. ENVIRONMENTAL CONSIDERATIONS. The intentional disposal of any hazardous substances such as ammunition and explosives in significant quantities or on a continuing or periodic basis is considered a major action that may significantly affect the quality of the environment. Navy policy regarding such actions is delineated in OPNAVINST 5090.1 (series). The treatment or disposal of hazardous wastes is regulated by the Environmental Protection Agency (EPA). Operations such as open burning, open detonation, neutralization and chemical decomposition are treatment and disposal methods which fall under the purview of federal, state and local environmental regulations such as the Resource Conservation and Recovery Act. In addition, the products of decomposition such as ash, residue and chemical solutions are environmentally regulated. In most cases, routine disposal and treatment of propellants, explosives and pyrotechnics requires an environmental permit. Likewise, Federal Aviation Administration (FAA) clearance for restricted or controlled firing areas shall be obtained as per OPNAVINST 3770.2 (series).

13-1.3.1. Prohibited Methods of Disposal. Burying of ammunition or explosives, as well as ocean dumping, or dumping in wells, marshes, streams, inland waterways, waste places, or pits is prohibited. Ocean or deep water dumping of any types of materials, including ammunition and explosives, is regulated by the EPA. The criteria for ocean dumping are promulgated in the Title 40 CFR, Part 227. These regulations provide general grounds for the issuance of permits as well as information concerning prohibited acts, and acts that are strictly regulated. Under no circumstances, other than an extreme emergency, will disposition of ammunition, explosives, or other related hazardous materials by ocean dumping be conducted by any Naval vessel, aircraft, or activity without prior approval of CNO.

13-1.3.2. Selecting a Site. The disposal of ammunition, explosives, or similarly hazardous materials shall be undertaken ashore only in areas or locations specifically approved for that purpose by NAVSEA-SYSCOM. In emergencies at activities without approved disposal areas, sites or areas that are considered to be suitable for the purpose shall be proposed to NAVSEASYSCOM, along with sufficient details describing the area, upon which NAVSEASYSCOM may base its decision. In planning disposal operations and selecting disposal sites, consideration shall be given to the effect these operations will have on population or buildings in the area surrounding the site or to the possibility of fragments or shock, or release of potentially hazardous by-products.

13-1.4. PERSONNEL SEPARATION DISTANCES.

13-1.4.1. Separation Distances for Non-Essential Personnel. The minimum separation distances between ranges and non-essential personnel are determined by the following:

a. Distance (feet) = $328W^{1/3}$, but not less than 1,250 feet, for non-fragmenting explosive materials. If known, maximum debris throw ranges, with an applicable safety factor, may be used to replace the 1,250-foot minimum range.

b. Distance (feet) = $328W^{1/3}$, but not less than 2,500 feet, for fragmenting explosive materials. For bombs and projectiles with caliber 5-inch or greater, use a minimum distance of 4,000 feet. The maximum fragment throw range (including the interaction effects for either stacks of items or single items), with an appropriate safety factor, may be used to replace the 2,500-/4,000-foot minimum ranges. Items should be sited so that lugs and/or strongbacks and nose and/or tail plate sections are oriented away from personnel locations.

Protective structures for personnel, or measures taken to suppress blast and/or fragment effects at disposal operations, may be used to reduce the required withdrawal distances. EOD operational incidents involving threat devices require all non-essential personnel to withdraw to distances required by paragraph 4-4.1.1c.

13-1.4.2. Separation Distances for Essential Personnel. Essential personnel conducting EOD training operations, or operations involving demolition of explosives and ammunition, do not require minimum separation distances. Competent on-site authorities, as directed by NAVSEASYSCOM, shall determine the minimum separation distances for protection of essential personnel at disposal operations. These authorities shall also determine, subject to NAVSEASYSCOM approval, who are essential personnel.

13-2. DISPOSAL OF AMMUNITION AND EXPLOSIVES BY BURNING

The following paragraphs describe the types of ammunition and explosives that can be disposed of by burning, where and by whom the burn operation will be performed, and the precautions that shall be observed during burning operations.

13-2.1. TYPES OF AMMUNITION AND EXPLOSIVES DESTROYED BY BURNING. Destruction by burning is authorized for the following types of ammunition and explosives:

a. Black powder.

b. Certain Group B chemical agents and ammunition.

c. Limited quantities of dynamite in bulk.

d. Floating smoke pots (HC-filled) or similar ammunition.

e. Group C chemical ammunition.

f. Bulk high explosives.

g. Group D chemical munitions.

h. Nitrocellulose.

i. Primers.

j. Pyrotechnics.

k. Small-arms ammunition.

l. Smokeless powder.

m. TNT demolition blocks.

n. Tracer mix and other pyrotechnic mixtures.

o. Rocket motor propellant grains.

p. Propellant, explosive and pyrotechnic manufacturing wastes.

NOTE

The handling and disposition of ammunition, explosives, and similarly hazardous materials shall not be undertaken unless the items are specifically identifiable and their characteristics are known. Furthermore, the amount of material to be destroyed at one time shall be consistent with reasonable and safe operation. The amount of material to be burned during a single operation shall not exceed the maximum amount recommended by these or other applicable regulations. In the absence of an established procedure, the number of units that may be destroyed safely at one time shall be determined carefully by starting with a limited number and then gradually increasing that number until the maximum that can be destroyed without risks to life and property is determined. In addition, environmental operating permits often specify limits on quantities of materials which can be disposed of at any given time.

13-2.2. GENERAL REQUIREMENTS FOR BURNING OPERATIONS. General requirements for burning operations include choosing a burning site and obtaining site approval, obtaining necessary environmental permits, and choosing the material to be burned, selecting and protecting personnel, observing precautions associated with the burning process, and emergency procedures to be followed in case of an accident.

13-2.2.1. <u>Requirements for Burning Sites</u>.

a. Burning of explosive material shall be undertaken only in those areas or locations that have been specifically approved for that purpose. Disposal of ammunition by burning shall be accomplished at a Naval facility in an area approved by NAVSEASYSCOM. When disposal takes place at another facility, such as an Army installation, the criteria established by the host activity shall be used. Sites for burning shall be separated from other facilities based on the hazards associated with the quantity and type of material to be destroyed. The disposal shall not be undertaken until NAVSEASYSCOM has approved the operation.

b. The ground within the immediate vicinity of the burning pad area shall not exceed a 10-degree grade. Burning shall be done on a dirt surface or where specified, in an improved containment device such as a burn pan. Burning on concrete, gravel, or cinder surface is prohibited.

c. Regardless of the type of ammunition, explosive, or other similarly hazardous material being disposed of by burning, it is important to realize that a detonation may occur. In order to provide adequate protection, burning grounds normally shall be a minimum of 1,800 feet away from any magazine, storehouse, inhabited building, or other structure, and from any public highway or passenger railroad. Lesser distances may be authorized by NAVSEASYSCOM under the following conditions:

(1) When a non-fragmenting material is burned and test data and/or a hazard analysis approved by NAVSEASYSCOM has established that use of lesser distances is applicable for these materials.

(2) The burning ground surface and subsoil are clean and not permeated with debris capable of detonating and producing fragments.

(3) Blast overpressures will not exceed acceptable limits of 1.0 psi at the lesser distance based on a detonation of the quantity of material being burned. If a lesser distance is proposed, prior approval of NAVSEASYSCOM shall be obtained.

d. Burning grounds shall be reasonably free from undergrowth or shrubbery. The burning area shall consist of a square or pad, measuring 300 feet by 300 feet. The pad should be entirely cleared, so that a flatbed of sand or dirt remains. A 200-foot border beyond the square pad should be cleared of all vegetation, grass, glass, glass particles, and any other combustible materials.

e. One site shall not be located within 50 feet of another site where material has been burned if the area has not been cleared.

13-2.2.2. Posting of Prescribed Procedures. Prescribed procedures, specific to the disposal of materials or items by burning shall be posted at the burning site. Also, established station orders or regulations for the operation of the burning grounds shall be posted.

13-2.2.3. Disposal Personnel. The following requirements apply to selection and protection of personnel conducting burning operations:

a. Assignment. Commanding officers or a delegated representative shall be responsible for assigning personnel to operations at disposal areas. All disposal personnel shall be well qualified and capable of safely performing their duties. In addition, they shall be fully informed of the hazards they may encounter and the safety precautions they shall observe. To assure safe operational policies and procedures, all disposal personnel shall be given periodic overall instruction as frequently as considered necessary in addition to the annual certification program. The number of employees engaged in a destruction operation shall be the minimum consistent with safe performance. However, no person shall be permitted to perform this work alone. Disposal operations shall be under competent supervision at all times.

b. Protection. Suitable protective clothing and shelter must be provided for personnel at the disposal area. A minimum of two fire blankets shall be available for emergency use. Personnel engaged in disposal operations shall be instructed in the proper use of fire blankets. A personnel protection area that includes a personnel shelter shall be provided at the burning ground. If the shelter is protected by a barricade, a minimum distance of 100 feet between the shelter and the burning pad is required. Otherwise, the shelter shall be a minimum of 500 feet from the burning pad. All windows of the shelter shall be securely fastened to the building and shall be made of Lexan 500 material or its equivalent. There shall be no direct viewing ports. See paragraph 13-3.2.4b.

13-2.2.4. Firefighting Equipment. No burning ground operations shall be undertaken unless properly manned and equipped mobile firefighting equipment is standing by in a safe location or is available within 5 minutes. The requirement for standby firefighting equipment is particularly important when the fire hazard is high due to dry conditions and/or when there is danger to structures or other property.

13-2.2.5. Communications. Telephone or two-way radio communication with the station network, including emergency and firefighting units, shall be available during burning operations. Communication equipment (telephone) shall normally be located at a minimum distance of 2,500 feet from the burning area. If this requirement cannot be met; i.e., communication equipment must be closer, radio transmitting equipment may be located at a minimum distance determined for the transmitter in use in accordance with NAVSEA OP 3565/NAVAIR 16-1-529/NAVELEX 0967-LP-624-6010, based upon the hazard created by the material/items to be burned. Radio transmitting equipment shall be secured during positioning of electric blasting caps/squib wires and subsequent connections or tests of the electric firing system except in an emergency.

13-2.2.6. <u>Warning Signals</u>. Guards, safety signals, road blocks, and warning signs shall be used to keep unauthorized personnel from dangerous areas during disposal operations. The burning operation shall not be initiated unless a red flag is prominently displayed and/or a whistle or siren is sounded.

13-2.2.7. <u>Weather Conditions</u>. Disposal by burning shall not be undertaken when the wind velocity is in excess of 15 miles per hour, except under circumstances where any interruption of disposal operations would impose an unacceptable hardship or hazard. There shall be instrumentation at the burning ground for measuring wind velocity. The destruction of ammunition, explosives, or similarly hazardous materials, along with associated operations, shall not be undertaken during electrical storms or severe weather conditions.

13-2.2.8. <u>Accidents</u>. Any casualty, mishap, or accident involving fatalities or injuries to personnel or appreciable property damage shall be reported immediately to NAVSEASYSCOM. The commanding officer of the concerned activity shall immediately appoint a board of qualified personnel, not involved with the operation, to investigate and assemble pertinent details concerning the accident. When a casualty, mishap, or accident occurs in any operation during the disposal of ammunition, explosives, or similarly hazardous material, work shall be suspended as quickly and safely as possible, and a report of attending circumstances shall be submitted to NAVSEASYSCOM. Operations shall resume only upon receipt of authorization from NAVSEASYSCOM. Refer to paragraph 1-5.3 for accident investigation and reporting requirements.

13-2.2.9. <u>Stockpiling of Materials</u>. Material awaiting destruction shall be kept far enough from the disposal location to be protected against accidental ignition or explosion from hurled fragments, grass fires, sparks, or burning embers. For burning operations, the stockpile area, or the temporary disposal storage area, shall be a minimum of 500 feet from any active burning pad. Only the material intended for disposal that day shall be stored in the stockpile area. No operator should be assigned to the area when actual operations are underway. Explosive storage huts at the burning ground used for storage of powder train and ignition materials including smokeless powder, squibs, and safety fuze, should be protected from the burning area by barricades. Unless designed for permanent storage, these huts should be used only for temporary storage on a daily basis as specified in chapter 11. Permanent magazines shall be sited at appropriate intraline distance in accordance with chapter 7.

13-2.3. SPECIFIC REQUIREMENTS FOR BURNING OPERATIONS. The following requirements are necessary to ensure safety during burning operations.

13-2.3.1. <u>Safety Requirements</u>.

a. SOP's covering the disposition of items to be disposed of by burning shall be available for use by personnel conducting disposal operations at the disposal ground. These SOP's shall contain specific procedures regarding the disposition of each specific type of condition of explosives to be disposed of. If desired, prescribed specific procedures for disposal of special/unique items may be posted at the disposal ground.

b. Appropriate station orders or regulations for the operation of burning grounds shall be established.

c. Ammunition and explosives to be disposed of shall not be roughly or carelessly handled. The regulations for handling ammunition and explosives prescribed in other chapters of this manual shall be observed. Extra care should be taken since in most instances the hazards of the ammunition or explosives to be disposed of are increased by such factors as age, deterioration, or damage.

d. All ground areas or sites over which hazardous material is to be placed or spread for disposal shall be carefully inspected to assure against the presence of heat retained in the ground, or "live" sparks, embers, or burning material resulting from previously disposed of materials in the vicinity.

e. Downwind burning pads in the burning ground area shall be selected first so that successive burnings will be on pads in an upwind direction from previous burnings.

f. All operators shall be equipped with conductive safety-toed shoes, fire retardant outer garments and headwear, and any other safety apparel needed for personnel protection.

g. Only authorized spark resistant tools shall be used while working within a radius of approximately 15 feet from exposed hazardous material; however, a clean sharp knife may be used when cutting time blasting fuse for use with a nonelectric firing system.

h. Tools which may be used for handling explosive material shall not be permitted to become heated by remaining near burning explosives.

i. Burning shall not be performed when the wind velocity is in excess of 15 mph except where delay would cause unacceptable hardship or hazard. There must be instrumentation at the burning location capable of determining wind velocity.

j. The number of personnel involved in disposal operations shall be kept to a minimum, but in no case shall an operator work alone.

k. All personnel shall be instructed as to the dangers of inhaling toxic vapors resulting from burning hazardous materials. When prevailing winds would cause the inhalation of toxic fumes, operations shall be suspended or personnel shall be equipped with proper respiratory protection.

l. When actual burning is underway, no personnel shall be stationed at or near material awaiting disposal in the stockpile area.

m. All burning operations, including wet down if performed, shall be completed a minimum of 30 minutes before personnel leave the burning grounds.

n. Burning shall normally be accomplished during daylight hours only. If due to unforeseen circumstances burning continues after daylight hours, a watch of at least two responsible personnel will be maintained until it is determined no probability of fire exists.

o. Responsible personnel; i.e., security, fire department, etc., shall be notified that burning is to be performed and they should make periodic checks of the burning ground, after burning is completed, for possible restart of fires.

13-2.3.2. Delivery of Hazardous Material to Burning Site. Requirements for delivering hazardous material to burning sites are as follows:

a. The motor vehicle used to transport hazardous material to the burning site shall be approved for explosive operations in accordance with O[illegible]1.

b. Containers holding hazardous materials shall be carefully loaded into the vehicle and secured against falling or moving during transfer to the burning site.

c. If practical, all containers shall be full. Containers that are partially filled shall be set aside and loaded into the vehicle last. These containers should be removed first on arrival at the burning site. Care shall be taken to minimize the motion of hazardous material within the container so that the generation of static electricity will be minimized.

d. Only the driver, who shall be qualified to transport dangerous cargoes in accordance with [illegible] 2239, and a maximum of two authorized helpers shall ride in [illegible] vehicle transporting hazardous material. See paragraph 12-5.[illegible].

e. The motor vehicle used to transport containers to the burning pad shall be positioned for unloading at the burning pad with the exhaust outlet on the opposite side from where the containers are to be removed or with the exhaust outlet as far away from the unloading point as possible. The motor shall be kept running during the unloading of the material.

f. During the dumping of hazardous material, if the transport vehicle is retained at the burning pad, it shall be moved back a minimum of 50 feet from the nearest material prior to opening any containers. The vehicle shall be returned to the stockpile area and its motor shut off prior to igniting the ignition train.

g. Motor vehicles may be used to deliver hazardous materials for successive burns provided a minimum distance of 50 feet is maintained from the previous burn pad. This requirement applies to any vehicle returning to the burn pad for any purpose after a burn has been completed. The 50-foot requirement is not applicable if 2 hours have elapsed since the wet down or 4 hours have elapsed if the pad has not been wet down. The use of hand-drawn dollies shall be held to a minimum.

h. Containers of hazardous materials shall be handled carefully at all times. They shall not be dragged over the floor of the truck or over the ground and shall not be thrown, pushed, or dumped from the truck to the ground. If the truck is not equipped with an elevator-type tailgate, the individual containers shall be lifted and placed on the ground by hand, one at a time. The containers shall be spaced evenly along the burning pad. If containers are palletized, place the pallets at the burning pad and unband. Do not remove containers from pallets in the vehicle.

13-2.3.3. Preparation of Hazardous Material to be Burned. Material to be burned shall always be removed from containers, because attempts to burn certain hazardous material under even slight confinement may result in explosions. Material being burned must be examined carefully to make certain that no detonator or blasting cap is attached. Attempts to burn hazardous material containing ignition sources such as caps, detonators or fuzes will almost certainly result in an explosion. No unauthorized mixture of hazardous material with extraneous material, other explosives, detonators, or similar items shall be permitted. To avoid being damaged or dangerously overheated from the burn, all empty hazardous material containers shall be moved back from the burning pad a minimum of 100 feet prior to igniting the powder train.

13-2.3.4. Placement of Hazardous Material on a Burning Pad. Prior to the delivery of any hazardous material to a burning pad, the pad shall be carefully inspected for the presence of dangerous objects or prohibited foreign material. If the burning pad has been used that day, it shall be inspected to make certain the surface is not dangerously warm and is free from flowing, smoldering, or burning embers and residue. It may be necessary to rake the burning surface to inspect for smoldering material and other dangerous conditions existing just beneath the surface before attempting a successive burn at the same burning pad. When hazardous material is found or if conditions are not safe, the burning pad shall not be used until safe conditions are restored. If required, the material to be burned shall be carefully placed on a bed of combustible material such as scrap lumber, wood, or excelsior.

13-2.3.5. Preignition Requirements. The burning operation shall not be initiated unless the following requirements are satisfied:

a. Ample visible and/or audible warning is given, such as a red flag displayed and/or a whistle or siren sounded.

b. Adequate and operable communication facilities are available.

c. Properly manned and equipped firefighting equipment is standing by or is readily available within 5 minutes.

d. The range safety officer or operation supervisor has ascertained that the field is clear, and that all personnel are accounted for and safely sheltered.

e. All equipment of value, such as motor cars and trucks, is at a safe distance from the hazard area.

f. All nearby ammunition, explosives, or similarly hazardous materials awaiting destruction, whether in a vehicle or not, are at a safe distance and protected from flying embers, fragments, sparks, and the like.

13-2.3.6. Postburn Requirements. The following requirements apply upon each completion of a burn cycle:

a. Personnel will remain in the protective shelter until all the material spread for burning has been consumed.

b. After the burning has visually exhausted itself, a wait of at least 5 minutes is required prior to anyone returning to the burn pad. The supervisor and one operator shall then be allowed to return to inspect the general area of the burn for completeness of burn, heat retainment, and any other dangerous conditions. If no unusual condition exists, the area may be wet down thoroughly with water.

c. A period of at least 2 hours from the wet down time is required before successive burns are conducted on the same burning pad. If water facilities are not available or unfavorable weather conditions; e.g., subfreezing temperatures, etc., exist, a period of 4 hours shall elapse prior to consideration of the pad for a successive burn.

d. Preparation for a successive burn can begin at a bed 50 feet and upwind from a previous burn, provided the previously used pad has been wet down thoroughly with water or a period of 4 hours has elapsed.

e. Successive burning cycles may be performed the same as the first as time permits.

NOTE

Detailed procedures, specifications, methods for ignition of material to be burned, as well as procedures to be followed in the event of a misfire, etc. are found in NAVSEA SW060-AA-MMA-010.

13-3. DISPOSAL BY DETONATION

The following paragraphs identify the types of ammunition and explosives that can be disposed of by detonation, where and by whom the detonation operation should take place, and the precautions that shall be observed during detonation operations.

13-3.1. TYPES OF AMMUNITION AND EXPLOSIVES TO BE DESTROYED BY DETONATION. Ammunition and explosives may be destroyed directly by initiating the explosion of an item, or indirectly by the detonation of explosives placed in contact with the item(s). Destruction by detonation may be authorized for the following types of ammunition and explosives:

a. Detonators, both separate electric and percussion.

b. Large quantities of dynamite in bulk.

c. Explosive-loaded grenades.

d. Group C chemical ammunition as described in paragraph 13-15.4.3.

e. High explosive bombs.

f. Mortar ammunition.

g. Projectiles.

h. Rocket/missile warheads.

i. Mines.

j. Bulk initiating explosives.

NOTE

Under no circumstances shall ammunition, explosives or similar hazardous items be disposed of by detonation unless they are specifically identified and their characteristics are known.

13-3.2. GENERAL REQUIREMENTS FOR OPERATIONS. General requirements for detonation operations include choosing a detonation site and posting it, securing requisite environmental permits, choosing materials to be disposed of by detonation or stockpiled awaiting disposal, selecting and protecting personnel, observing precautions associated with the detonation process, and emergency procedures to be followed in case of an accident.

13-3.2.1. Requirements for Detonation Sites.

a. Demolition, demonstrations and routine EOD explosives operations shall be undertaken only in those areas or locations that specifically have been approved for that purpose. The classification of detonation sites is shown in table 13-1. Disposal of ammunition by detonation shall be accomplished at Navy and Marine Corps activities in areas approved by NAVSEASYSCOM. In instances when disposal takes place at another services facility such as an Army installation, the criteria established by the host activity shall be used. Minimum separation distances for non-essential personnel viewing the destruction of ammunition including EOD operations shall be determined as described in paragraph 13-1.4. The disposal shall not be undertaken until NAVSEASYSCOM has approved the operation.

b. All vegetation including dry grass, leaves, and other combustible materials shall be removed within a radius of 500 feet or firebrand distance, whichever is greater around the disposal site.

Table 13-1. Classifications of Detonation Sites

CLASS OF DETONATION SITE	QUANTITY (IN POUNDS) OF EXPLOSIVE		DISTANCE (IN FEET) FROM POINT OF DETONATION TO					EARTH COVER REQUIRED
	OVER	NOT OVER	INHABITED BUILDING (6)	RADIUS OF CLEARED AREA	BARRICADED CREW SHELTER(1)	NON-SHELTERED RETREAT AREA	EXPLOSIVE HOLDING AREA(2)	
A	500	3000	5000	500	1000	5000	1800	NO
B	150	500	3000	500	500	3000	1245	YES(3)
C	25	150	2500	500	300	2500	1245	YES(3)
D(5)	0	25	1800(4)	500	200	1800(4)	1245	YES(3)

(1) These are the desired recommended distances and may be reduced; however, under no circumstances shall the distances be less than the intraline barricaded distances based on the maximum quantity of explosive involved for each special class of site. If these distances are reduced, personnel in the shelter may require ear protection.

(2) These are the desired recommended distances and may be reduced to the intraline barricaded distance provided the holding area is afforded as a minimum overhead and frontal protection.

(3) Earth cover required only when missile hazard is a safety factor.

(4) May be reduced to 1250 feet providing no (18) class 1, division 2 material is on the range.

(5) Demolition training sites using 5 pounds explosives or less may be sited in accordance with paragraph 13-3.2.2.

(6) The criteria of paragraph 13-1.4.1b must be applied for the detonation of fragmenting explosive materials.

13-3.2.2. Demolition Training Ranges. Because the quantity of explosives required to maintain demolition and EOD proficiency is small, the criteria for training ranges can be reduced from the required criteria for other detonation sites. Table 13-2 provides the siting criteria for demolition training and explosives handling requalification. All vegetation including dry grass, leaves, and other combustible materials shall be removed within a radius of 50 feet from the point of detonation.

13-3.2.3. Posting of Prescribed Procedures. Prescribed procedures specific to the disposal of materials or items by detonation shall be posted at the detonation site. Furthermore, established station orders or regulations for the operation of detonation sites shall be posted.

13-3.2.4. Disposal Personnel. The following requirements apply to selection and protection of personnel conducting detonation operations:

Table 13-2. Demolition Training Ranges

Quantity in Pounds of Explosives		Inhabited Building Distance (feet)	Restrictions
Over	Not Over		
2.5	5.0	500	Notes a, b, and c. Note d should be applied unless the barricade would pose an operational hazard.
1.25	2.5	300	Notes a, b, c, and d.
0	1.25	200	Notes a, b, c, and d.

NOTES:

a) Only encased, non-fragment-producing explosives will be used.

b) All detonations will be conducted on a 12-inch deep sand pit to eliminate secondary fragment hazards.

c) Inhabited building separation destances will not be further reduced due to public traffic routes or use of EOD protective devices.

d) A barricade shall be constructed 10 feet from the detonation point. The barricade will totally enclose the detonation site, be the equivalent of two sandbags thick, six feet high, and have two entrances 180 ° apart. Each entrance must also be barricaded to the same requirements to assure protection from fragments as shown in figure 13-1.

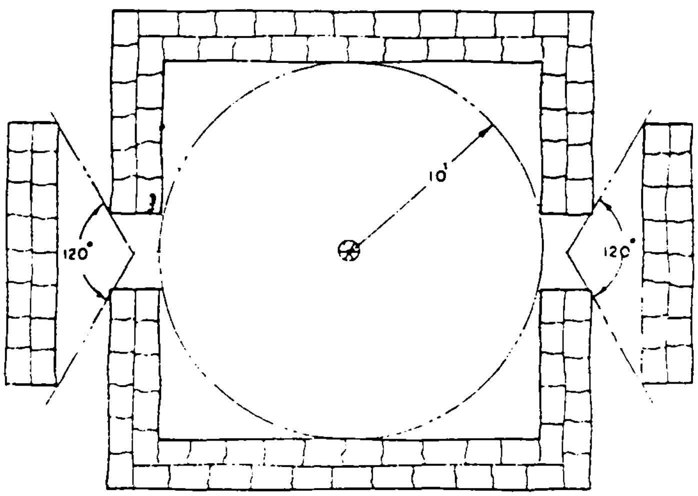


Figure 13-1. Detonation Training Range

a. Assignment. The requirements of paragraph 13-2.2.3a shall apply when assigning personnel to operations at detonation sites.

b. Protection. Each detonation site shall provide a crew-protective area that may include a personnel shelter. If such a shelter is utilized, it shall be approved by NAVSEASYSCOM, shall have overhead protection and frontal protection with no direct viewing ports. Mirrors or periscopes may be used for visual observation. The required distance from the point of detonation, for various quantities of explosive to be detonated, shall be in accordance with the site classifications in table 13-1. The specific design of the crew shelter shall be submitted to NAVSEASYSCOM (SEA-665) for review and approval prior to submission to NAVSEASYSCOM for final approval. There also shall be an emergency area or shelter available at the detonation site for personnel to use in emergency situations. This area/shelter, a 4-foot hole or 4-foot earthen embankment, for example, shall provide personnel protection from high velocity fragmentation. The emergency area/shelter shall not be used for normal operations, but shall be used only when it is impossible for personnel to reach the protective crew shelter.

13-3.2.5. Firefighting Equipment. When the fire hazard is high in wooded and grassy areas because of dry conditions, disposal operations shall be undertaken only if properly manned mobile firefighting equipment is standing by in a safe location or can be made readily available within 5 minutes.

13-3.2.6. Communications. See the requirements for communications equipment in paragraph 13-2.2.5.

13-3.2.7. Warning Signals. The requirements for warning signals at burning sites described in paragraph 13-2.2.6 also apply to detonation sites.

13-3.2.8. Weather Conditions. Prior to detonation, the supervisor or EOD officer in charge shall obtain information on local cloud and air mass conditions from the nearest weather station. This person shall decide whether to conduct detonation operations based on weather conditions as well as on his experience and knowledge of local soil and rock strata conditions. Detonation shall not be performed during periods of heavy, low total overcast or during electrical storms.

13-3.2.9. Accidents. Refer to paragraph 13-2.2.8 for reporting requirements concerning accidents at detonation sites.

13-3.2.10. Material Stockpiling. The required distance between the detonation site and explosive material awaiting disposal will vary in accordance with the class of the approved site. However, in no case shall material be stored at less than intraline distance from the explosive being destroyed based on the largest quantity involved. No one shall be assigned to the storage area when actual detonation operations are underway. No material shall be staged at the detonation site.

13-3.3. SPECIFIC REQUIREMENTS FOR DETONATION OPERATIONS. Specific procedures for placement of items at the detonation site, the placement of the ignition charge, the method of priming, and other requirements pertaining to the particular ammunition to be detonated are prescribed by EOD or by Routine Ordnance Detonation Advisory Procedures (RODAP), and prepared by Naval activities in accordance with the requirements of chapter 2. In addition, the following requirements apply.

NOTE

Information, guidance, and instructions covering detailed procedures to be utilized to prepare explosive materials for disposal by detonation, performance of detonation operations, and actions to be taken in the event of a hang fire and/or misfire is found in SW060-AA-MMA-010 (series). All personnel conducting detonation operations shall be familiar with this publication.

13-3.3.1. Safety Requirements. The following safety requirements are to be followed during detonation operations:

a. The number of personnel conducting detonation operations shall be kept to a minimum, but under no circumstances shall an operator work alone.

b. When detonation operations are underway, no personnel shall be stationed at or near material awaiting disposal at the stockpile area.

c. After detonation operations have been completed, the demolition crew shall remain at the protective crew area at least 5 minutes after single shots and the last shot of a series, provided that the number of shots have been counted. If in doubt, use misfire procedures and wait 30 minutes after the last shot. Operations shall be scheduled so that detonations will not occur less than 30 minutes prior to securing the range at the end of the work day.

d. The fire department shall be notified that detonation operations are to be performed. The range shall not be secured if any probability of fire exists.

e. Only authorized spark resistant tools shall be used while working within a radius of 15 feet from exposed energetic material. However, a clean sharp knife may be used for cutting time blasting fuze/detonating cord.

f. Detonation operations shall be performed during daylight hours only.

g. Blasting caps shall be installed only after all operators except those doing the actual ignition work have retreated to the protective crew shelter. Blasting caps shall be carefully handled at all times.

h. Ammunition and explosives to be destroyed shall not be handled roughly or carelessly. Regulations for handling ammunition and explosives prescribed in other chapters of this manual shall be observed. Extra care should be taken since, in most instances, the hazards of the ammunition or explosives to be destroyed are increased as a result of age, deterioration, or damage. See paragraph 13-3.3.3.

i. Personnel should anticipate the possible presence of spark and flame discharges from the accumulation of electrostatic charges and take necessary precautions to minimize their potential hazard.

j. If the material being disposed of produces high fragmentation, the detonation shall take place at an area surrounded by an earth barrier at least 4 feet high or in a pit or trench at least 4 feet deep. Unless the demolition site meets the requirements for class A as specified in table 13-1, a covering of earth shall be used to effectively limit the range of fragments.

13-3.3.2. Delivery of Hazardous Material to Detonation Site. The following requirements apply to delivery of hazardous material to detonation sites:

a. The motor vehicle used to transport hazardous material to the demolition ground shall meet the requirements of OP 3681.

b. Only the driver and two helpers shall ride in or on a vehicle transporting explosive material. The driver shall be qualified to transport hazardous material in accordance with OP 2239. See paragraph 12-5.5.1.

13-3.3.3. Requirements for Handling Material at a Detonation Site. The following requirements apply to the handling of materials at detonation sites:

a. Material appearing to be in an unusual or abnormal condition should not be unbanded or removed from its pallet. All personnel shall report the condition of this material to their immediate supervisor. The supervisor shall proceed as follows:

(1) If, in the supervisor's opinion, further movement of the material will create an additional hazard, the material shall not be moved. All personnel shall be evacuated from the immediate area to a safe place, and the supervisor shall take appropriate steps to eliminate the hazard.

(2) If, in the supervisor's opinion, the material does not present an abnormal or hazardous condition, the material should be handled as usual.

b. The delivery vehicle and all handling equipment shall be moved from the area and shut off before preparing and priming the material for detonation. All pallets and other containers shall be moved to the stockpile area before preparing the ignition train.

13-3.3.4. Post-Detonation Requirements. A waiting period specified by local SOP, but no less than that specified in paragraph 13-3.3.1c shall be observed. Subsequently, a careful search of the surrounding grounds for unexploded ammunition or explosives shall be conducted. Unexploded items or material such as lumps of explosive or unfuzed ammunition may be collected and made ready for the next detonation. Fuzed ammunition or items that may have internally damaged components should be detonated where found.

13-4. DISPOSAL OF AMMUNITION AND EXPLOSIVES BY NEUTRALIZATION

Disposal of certain ammunition and explosives may be accomplished by neutralization. Methods of neutralization include dissolving water soluble material, chemical decomposition, and venting or "bleeding off." The principles behind these methods are described in the following paragraphs.

13-4.1. NEUTRALIZATION BY DISSOLUTION IN WATER. Disposal of explosives by dissolution in water requires that the explosive material be in part readily soluble in water, and that the resulting solution as well as any residue be innocuous or disposed of as hazardous waste. Local environmental personnel should be notified of any potential hazardous waste generation or disposal operations prior to operation. Due to prohibitions against disposal of liquid wastes, alternate methods or treatments may be required.

13-4.2. NEUTRALIZATION BY CHEMICAL DECOMPOSITION. Small quantities of initiating explosives may be decomposed chemically. If directions regarding quantities, order of treatment, and so forth are followed, no explosive material should remain, and the solution may be disposed of. Analysis should be conducted to determine if the waste meets the criteria for disposal as hazardous waste. Normal caution regarding handling of chemicals should be observed.

13-4.3. NEUTRALIZATION BY VENTING. Certain chemical ammunition may be disposed of by venting or "bleeding off" to the atmosphere provided this meets applicable federal, state, and local environmental regulations. However, use of this method of disposal is limited to small quantities of nonpersistent agents under controlled conditions. Venting must be accomplished at selected locations, and at a controlled rate so nuisance threshold levels or toxic concentrations of vapors or aerosols will not reach points beyond the control of the installation.

13-5. DISPOSAL OF SURPLUS HAZARDOUS MATERIALS BY SALE

Requirements and procedures for the sale of surplus ammunition, explosives, and other hazardous materials are provided in OP 2165 Volume 1.

13-6. SPECIFIC PROCEDURES FOR THE DISPOSAL OF HIGH EXPLOSIVES

High explosives include primary, booster, and main charge explosives. Black powder, while not a high explosive, is included in this grouping.

13-6.1. BLACK POWDER. Black powder may be disposed of by burning. The following procedure shall be followed:

a. Contents of only one container, not exceeding 25 pounds, shall be burned at one pad. Containers of black powder shall be opened, one at a time.

b. The powder to b[illegible]ed shall be removed from the container and distributed in a trail [illegible] the burning surface which has been free of fire for at least 24 [illegible]s. The powder trail shall not exceed 2 inches in width. No part o[illegible] the trail shall parallel any other part at a distance of less than 10 feet and no part of the trail shall cross any other part.

c. The black powder shall be ignited by an electric squib firing syste[illegible] time fuse and igniter in accordance with the instruc[illegible]W060-AA-MMA-010 (series).

d. Empt[illegible] shall be thoroughly flushed with water, as serious explosio[illegible]curred with supposedly empty black powder containers.

13-6.2. HIGH EXPLOSIVES. H[illegible]sives should be destroyed by burning as described in paragraph [illegible] or by chemical destruction. Regulations are as follows.

13-6.2.1. Burning. Destruction of bulk high explosives by burning should be in accordance with the following requirements:

a. Weight of Explosive. The types and maximum weight limits of explosives which may be destroyed by burning are presented in table 13-3. It is emphasized that the limits set forth are the maximum weights allowable per explosive pile. The pile should be as small as can practically comply with local requirements.

b. Pile Separation Distance. The simultaneous burning of as many piles of high explosives as can be accommodated on the burning pad is authorized provided the distance between piles and the weight of the piles are limited in accordance with table 13-3.

c. Figure 13-2 depicts a typical high explosive burning area layout. The minimum distances are established in table 13-3.

d. Explosives having particle size larger than 2-inch cube shall not be accepted at the burning pad unless approved by NAVSEASYSCOM.

e. Explosives to be burned must be examined carefully to make certain no detonator or blasting cap is included. Any attempt to burn high explosives with ignition sources such as caps, detonators, or fuzes will almost certainly result in an explosion.

f. Only one kind or type of explosive shall be burned at one time on any one pad, except that small quantities up to 25 pounds total of mixed explosives derived from various production operations may be spread and burned as a single explosive unless larger quantities are authorized by NAVSEASYSCOM.

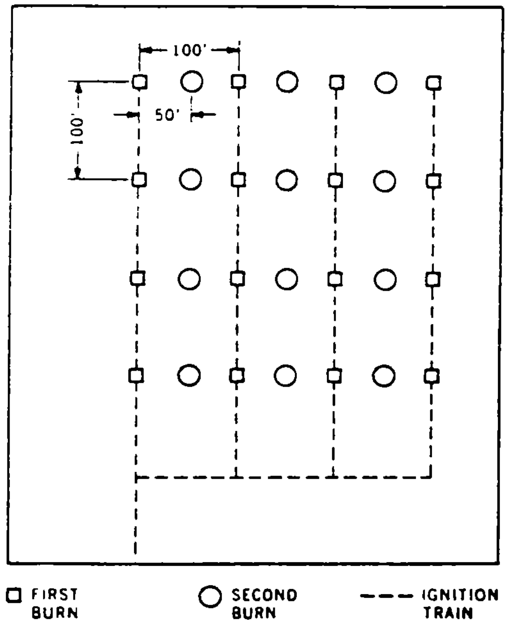
Table 13-3. Maximum Weight Limit for Burning High Explosives

EXPLOSIVE	MAXIMUM WEIGHT LIMIT (POUNDS)	PILE SEPARATION (FEET)
Amatol	500	100
Black Powder	25	50
Composition "A"	500	100
Composition "B"	500	100
Composition "C"	500	100
Cyclotol	200	100
Explosive "D"	500	100
HBX Composition	500	100
H-6	500	100
Minol II	500	100
Nitroguanidine, Dry	500	100
**Nitroguanidine, Wet	50	100
Octol	200	100
*PBX	200	100
PBXN	200	100
PBXW	200	100
*Pentolite	25	50
***PETN	25	50
*Picratol	200	100
***RDX/HMX	50	100
Tetryl	50	50
*Tetrytol	50	50
TNT	500	100
Torpex	50	50
*Tritonal	500	100

*The burn weight limit and pile separation distance for this material have not been firmly established. Therefore, when burning these items the weight limit and the separation distance should be determined carefully by starting with a very limited number of pounds of explosive and the separation distance shown. The weight limit may then gradually be increased. However, the maximum limit specified shall not be exceeded.

**Wet Nitroguanidine has been found to be very difficult to burn. The piles should be saturated with fuel oil or similar material in accordance with the local environmental operating permit.

***These explosives should be shipped to the burning ground wet, spread on the burning surface and allowed to partially dry, prior to ignition.



1. When more than one pad of explosives is prepared, the pads may be connected with a continuous ignition train as shown above.

2. The distance between successive burns shall be a minimum of 50 feet as required in paragraph 13-2.3.6.

Figure 13-2. Typical High Explosives Burning Area

g. It is possible that explosives such as TNT will melt and flow away from the burn pile into drainage facilities, crust over, and not be burned. To prevent this from happening, it is required that a dam, a minimum of 3 inches high, be erected on the downstream side of the pile to contain any melted explosive and accomplish complete burning.

h. Should the explosive be delivered for burning in a moist condition, the explosive shall be spread on a pad of combustible material and soaked with fuel oil meeting environmental regulations to encourage complete combustion. The combustible material used shall be scrap lumber, wood or other material such as excelsior. Where such materials are used, they shall be spread a minimum of 2 inches deep on the pad prior to spreading explosives.

i. Each operator (or pair of operators, if two are required to handle containers due to size) shall open only one container at a time, and it shall be emptied of its contents and the lid replaced before another container is opened. When explosive is delivered in metal containers, the grounding requirements specified for smokeless powder in paragraph 13-7.1.2 apply.

j. Explosives shall be spread evenly over the burning surface in a uniform thickness. The maximum thickness of the explosive is limited to 2 inches unless greater thickness is authorized by NAVSEASYSCOM.

k. Prepare the ignition train and ignite it.

l. Inspection and wet down of the pad shall be in accordance with paragraph 13-2.3.6.

m. Preparation for successive burns may commence in accordance with paragraph 13-2.3.6.

13-6.2.2. Chemical Destruction of Explosives. The chemical destruction of loose explosives or ammunition except as provided below shall not be permitted unless approval is given by NAVSEASYSCOM. Chemical methods must be supervised by qualified personnel having knowledge of chemistry. Chemical methods shall not be used in an attempt to destroy explosives which are enclosed or pressed into components such as detonators. The following procedures may be used under adequate supervision for 28 grams or less of the explosives named.

a. Mercury Fulminate. Place a quantity of aqueous sodium thiosulfate (hypo) solution (20 percent by weight of sodium thiosulfate) equal to 10 times the weight of mercury fulminate to be destroyed in a wood or earthenware container. While agitating the hypo solution, add water-wet mercury fulminate. The mixture shall be agitated by air or mechanical means but not by hand. Agitation must be continued until all fulminate has been dissolved, usually within 2 hours. Operators shall keep to the windward of the container or wear gas masks to avoid inhaling any cynogen gas evolved.

b. Nitroglycerin. Small quantities of nitroglycerin may be neutralized or destroyed with a mixture of the following solutions:

(1) Solution A. Sodium sulfide (pulverized) - 9 parts by weight and water - 30 parts by weight.

(2) Solution B. Denatured ethyl alcohol - 70 parts by weight and acetone - 20 parts by weight. Do not combine the two solutions until immediately before use since potency of the mixed solutions diminishes on storage. This mixture should be only for very small quantities of nitroglycerin; e.g., the oily film that adheres to surfaces after the nitroglycerin has been removed with sponges or absorbed in wood pulp or sawdust. Operators using this solution should wear rubber gloves.

c. Lead Azide.

(1) Lead azide accumulated on surfaces should be taken up with water wet cloths. The cloths should then be washed out in one of the solutions named below after which the complete desensitizing treatment is carried out in the solution. The cloths should be

thoroughly washed with water before reuse. Empty shipping bags while still water-wet should be turned inside out and treated. Approved chemical methods for destroying lead azide include those described below.

(2) Sodium nitrite-acetic acid method. For destruction of a quantity of 1 ounce of lead azide, the ounce of lead azide should be placed in one-half gallon of a 10 percent solution of ammonium acetate to which is added a solution of two and one-half ounces of sodium nitrite in 1 pint of water. The mixture is stirred and while stirring, 7 ounces of glacial acetic acid or its equivalent of weaker acid is added. The entire solution should be allowed to stand in a warm place for 1 hour more before disposal.

(3) Another method is to use sodium nitrite and nitric acid. The lead azide should be destroyed in small quantities at a time by successive treatment with a 25 percent solution of sodium nitrite and a 36 percent solution of nitric acid. Place water, then lead azide to be destroyed in a ceramic crock or other suitable container of ample size (at least 500 cc of pure water per gram of azide). Add sodium-nitrite solution and agitate carefully but thoroughly; and add the nitric acid solution slowly with continual agitation. Heat is generated during the decomposition so all additions must be made slowly. Decomposition is rapid and complete if sufficient quantities of the killing solution are employed. The resultant solution is clear. Ferric chloride solution is used to test for incomplete decomposition of the azide. A red color appears if azide is still present. Toxic fumes may be evolved during the killing reaction.

(4) The third method is to dissolve lead azide in 10 percent ammonium acetate solution, from which the lead is precipitated with 10 percent aqueous potassium bichromate. This is followed by a thorough washing with water. However, this procedure may leave a sludge containing sensitive explosive material and appropriate precautions must be taken. All wash cloths or brushes used to apply ammonium acetate solution should be treated with a sodium bichromate solution.

(5) A fourth method (preferred) is to use a 20-25 percent aqueous solution of ceric ammonium nitrate for the chemical destruction of lead azide. When small quantities of lead azide are destroyed in this manner the reaction is not violent. Since one of the products of the reaction is a gas, the ending of the gas evolution indicates completion of destruction. This method offers the following advantages over preceding ones:

(a) Safer to use because the chemical reaction is less violent than those involving acid.

(b) Residue formed is more readily disposed of than lead chromate.

(c) Evolved gas acts as indicator to assure completion of the reaction.

(d) Other Explosives. RDX, HMX and compositions A, B, and C may also be destroyed by heating a slurry of the explosive material in water with an excess of sodium hydroxide _ enough to make the solution strongly alkaline. The resulting solution should be disposed of in accordance with requirements for disposal of corrosive hazardous waste.

13-6.3. PRIMARY (INITIATING) EXPLOSIVES. When necessary, large quantities of primary explosives such as lead azide, lead styphnate, and mercury fulminate, shall usually be destroyed by detonation in accordance with instructions obtained in each instance from NAVSEA-SYSCOM. Small quantities of 1 ounce or less of lead azide may be destroyed by chemical decomposition as described in paragraph 13-6.2.2. However, only lead azide may be so destroyed.

13-7. DISPOSAL OF PROPELLANTS

Precautions for the safe disposal of smokeless powder and nitrocellulose are described in the following paragraphs.

13-7.1. SMOKELESS POWDER AND CASTING POWDER. Smokeless powder and casting powder, including sheets, flakes, shavings of ballistite, and bag charges should be disposed of by burning.

13-7.1.1. Supervision of Burning Operations for Smokeless Powder and Casting Powder. All burning operations associated with the disposal of smokeless powder and casting powder by burning shall be under the immediate supervision of a qualified and experienced ordnanceman specifically designated for the purpose by the ordnance officer, the safety officer, or by delegation of the commanding officer. The supervisor shall be responsible for enforcing all safety precautions and provisions for the safety of all personnel during operations in the burning ground area.

13-7.1.2. Special Instructions for Burning Bulk Smokeless Powder and Casting Powder. In addition to the general requirements contained in paragraph 13-2 for the burning of hazardous material, the following shall apply for burning bulk smokeless powder and casting powder:

a. Bulk smokeless powder and casting powder shall be transported to the burning ground in closed, standard, smokeless powder containers, approved fiberboard containers, closed powder charge tanks or conductive plastic bags.

b. No more than 4,000 pounds of smokeless powder and casting powder shall be transported to the burning pad area at one time.

c. Containers of smokeless powder and casting powder shall not be exposed to direct sunlight long enough to raise the temperature of the powder above 100 °F. Containers that require protection from the sun shall be covered with a fire-resistant tarpaulin placed so that air can circulate through the stack. The rate of decomposition becomes relatively high at 100 °F, and is dangerously accelerated at temperatures above 110 °F, when spontaneous combustion of the powder can result.

d. The container and lid should be electrically bonded. The container should be grounded before the lid is removed, and the powder is dumped. Equipment used to ground containers during lid removal, dumping of powder, and lid replacement shall be tested for conductivity prior to each day's operation. The maximum acceptable value for electrical resistance to ground shall be 100,000 ohms.

e. Each operator or pair of operators, if two are required to handle containers due to size, shall open only one container at a time, empty its contents, and replace the lid before another container is opened.

f. The grounding shall not be removed until the lid is replaced on the container.

g. Not more than 4,000 pounds of large web smokeless powder and casting powder shall be burned at one time. If the powder is small web, the maximum amount burned at one time shall be limited to 2,000 pounds. The size of powder grains in 3-inch cartridges and smaller is considered small web.

h. The smokeless powder and casting powder to be burned shall be spread in straight rows approximately 4 feet wide and not more than 6 inches deep for large web smokeless powder or not more than 3 inches deep for small web smokeless powder.

i. Care shall be taken to avoid walking on the dumped powder.

j. Operations shall be arranged to minimize exposure of personnel should a fire be initiated at any point along the burning pad.

k. The ignition train shall be laid and ignited in accordance with procedures described in SW060-AA-MMA-010 (series).

l. Inspection and wet down of the pad shall be in accordance with paragraph 13-2.

m. Preparation for successive burns should be accomplished in accordance with paragraph 13-2.

13-7.2. NITROCELLULOSE. Nitrocellulose should be destroyed by burning in accordance with the following procedure:

a. Not more than 500 pounds of wet nitrocellulose shall be burned at one time unless larger amounts are approved by NAVSEASYSCOM, and if practical, smaller increments should be burned. Nitrocellulose wet with flammable solvent shall be limited to increments of 500 pounds.

b. Nitrocellulose to be disposed of by burning shall be wet with not less than 30 percent, by weight, of water or flammable solvent and it shall be contained in suitable metallic containers, such as steel drums, for delivery to the burning area.

c. A layer of combustible scrap lumber and excelsior shall be arranged on the burning surface with enough wood cribbing used under the layer or pile to provide a good draft and complete combustion.

d. The wet nitrocellulose to be burned shall be removed from the transportation containers by means of wooden or nonferrous shovels and evenly spread on the pile of lumber in a layer not thicker than 2 inches, unless a greater thickness is authorized by NAVSEASYSCOM.

e. Successive increments of nitrocellulose to be burned shall be positioned only one at a time, and a burning site shall not be used twice in the same day. The immediate area or site over which an increment of nitrocellulose is to be spread for burning shall be carefully inspected as required by paragraph 13-2.3.1 prior to spreading the material.

f. The ashes remaining from the burning of any quantity of nitrocellulose shall be wet down with water at the end of each operating day and carefully inspected and screened for any particles or fibers of unburned nitrocellulose.

g. No personnel shall approach the burning site following the burning of an increment of nitrocellulose until the fire has burned out and the nitrocellulose has been completely destroyed. In the event of a misfire in the ignition train, personnel shall not approach the site for at least 30 minutes. Dry nitrocellulose is exceedingly sensitive and will cause very hot flash-fires. Therefore, all equipment, such as transportation vehicles, containers, tools, and the clothing of personnel, shall be thoroughly cleaned and made free of all traces of nitrocellulose which would constitute a hazardous condition when dry.

13-8. DISPOSAL OF SEPARATE LOADING AMMUNITION CHARGES

Separate loading ammunition charges may be disposed of by burning. Special precautions for disposal of separate loading ammunition charges are the same as for burning smokeless powder. Refer to paragraph 13-7.1.

13-8.1. SPECIAL INSTRUCTIONS FOR BURNING SMOKELESS POWDER BAG CHARGES. In addition to the requirements contained in paragraph 13-2 for the burning of hazardous material in general, the following shall apply for burning smokeless powder bag charges:

a. Except when palletized in horizontal position, the bottom of the tanked charge must be held lower than the top (top end up) to prevent the build-up of static charges from the shifting of the charges within the tank.

b. The quantity of smokeless powder bag charges to be transported to the burning pad at one time shall not exceed 4,000 pounds.

c. The tanked charges shall not be placed on the burning surface exposed to the direct rays of the sun for any period of time longer than necessary to complete burning operations.

d. The tank and its lid shall be electrically bonded and the tank grounded before the lid is removed and the bag charge removed from the tank. If primers are present (Marine Corps ammunition), they shall be removed and packed into an ammunition box marked for later disposition. Spacers shall be left in their respective tanks. Grounding equipment used to ground the containers during lid removal, removal of bag charges, and lid replacement shall be tested for conductivity prior to each day's operation. The maximum acceptable value for electrical resistance to ground shall be 100,000 ohms.

e. Each operator (or pair of operators if two are required to handle the containers due to size) shall open only one tank at a time and the bag charges shall be removed and the lid replaced before another tank is opened.

f. The grounding is not to be removed until the lid is placed back on the tank.

g. The bags shall be placed on the burning surface with the laced side up in a single row side by side with all ignition ends facing the same direction.

h. The explosive limit of the bag charges for one burn shall not exceed 4,000 pounds, including the black powder ignition ends.

i. Prepare the ignition train and ignite.

j. Inspection and wet down of the pad shall be in accordance with paragraph 13-2.

k. Preparation for successive burns may commence in accordance with paragraph 13-2.

13-9. DISPOSAL OF GUN AMMUNITION

Gun ammunition includes the components of fixed ammunition such as projectiles, cartridge cases, and other miscellaneous components.

13-9.1. DISPOSAL OF PROJECTILES. Projectiles, including those resulting from breakdown of fixed ammunition, may be disposed of by either demilitarization or detonation. Demilitarization procedures are covered in paragraph 9-4. The following procedures should be used when disposing of projectiles by detonation:

a. The projectiles to be destroyed shall be placed on their sides in a pit or trench which is at least 4 feet deep.

b. Demolition explosive blocks shall be placed in contact with the sides of each projectile and held in position by earth packed around the projectile and blocks. The number of blocks to be used for each caliber of projectile is shown in table 13-4.

c. The projectile shall be covered with 2 or more feet of earth to reduce the range of fragments upon detonation.

Table 13-4. TNT Demolition Blocks Required for the Destruction of Projectiles

PROJECTILE (CALIBER)	NUMBER OF 1/2-LB TNT BLOCKS OR EQUIVALENT REQUIRED
40 mm	1
3 inch	2
4 inch to 6 inch	3
8 inch	3
12 inch to 16 inch	6

d. After the last shot, the ground in the vicinity shall be searched for any unexploded material (see paragraph 13-3.3.4). Any such material found shall be destroyed.

13-9.2. DISPOSAL OF CARTRIDGE CASES. Cartridge case intended for disposal shall be emptied of smokeless powder, the primer fired or removed as specified in current instructions, and the case disposed of in accordance with current instructions. The powder shall be destroyed of in accordance with paragraph 13-7.1.

13-10. DISPOSAL OF SMALL-ARMS AMMUNITION

Small-arms ammunition may be destroyed by burning in a retort furnace or an incinerator which meets environmental requirements. The following general information is provided concerning furnaces and incinerators:

a. Furnace - General. In the retort furnace, small arms are fed by a conveyor into the front of the furnace and are moved down by the interior spirals in the rotating furnace. At the rear of the furnace is a burner which projects a flame which provides the necessary heat for cook off of the items. Located underneath the burner is a conveyor for carrying the remaining material out of the barricaded area to a collection point. Furnaces vary in design. Detonation furnaces No. APE 1236 (Army design) and NAPEC 0141 (Navy design) are examples of furnaces currently in use.

b. Incinerator - General. Incinerators vary in size and design; however, they are generally enclosed by material of sufficient strength to confine repeated detonation of small-arms ammunition. It is mandatory that the inclined chute or pipe through which the material is fed into the incinerator have a positive interlock so that, at a minimum, one door is closed at all times. The incinerator is either loaded with combustible material or a burner is provided so that the necessary heat for cook off can be obtained. In any case, the incinerator shall have a means of igniting the combustible material/burner remotely. After reaching the operating temperature, the cartridges are fed through the feed chute and into the incinerator for cook off. Care should be taken to prevent an accumulation of unexploded ammunition in the incinerator.

c. Operational Requirements. Operation of the furnace or incinerator shall be as set forth in applicable operational manuals or SOP's. Barricades and warning signs shall be used to prevent personnel from entering the discharge area of a furnace when it is in operation.

NOTE

Furnaces and/or incinerators utilized for destruction/demilitarization of small-arms ammunition up to and including 20 mm (TP) may be sited at inhabited building distances specified in table 7-24 of this manual if constructed of or enclosed by material of sufficient strength to confine repeated detonation of such ammunition. Furnaces/incinerators utilized for destruction/demilitarization of materials of higher classifications shall be sited at appropriate unbarricaded intraline or inhabited building distances based on material hazard, quantity, and potential targets.

13-11. DISPOSAL OF BOMBS AND BOMB-TYPE AMMUNITION

Explosive bombs and bomb-type ammunition may be disposed of by detonation following the requirements and precautions for disposal of projectiles. Refer to paragraph 13-9. However, since bombs and bomb-type ammunition have thin walls and contain more explosive than projectiles of corresponding weights, extreme caution must be taken to avoid structural damage to buildings and injury to personnel resulting primarily from blast. Bombs that are awaiting destruction in the immediate vicinity of the detonating pit or trench should be segregated in small piles 100 feet or more apart and at least 500 feet from the pit. Extreme care must be taken to protect bombs awaiting destruction against accidental initiation by fire, fragments, or propagation.

13-12. DISPOSAL OF ROCKETS AND SOLID PROPELLANT MOTORS

NOTE

Rocket motors containing solid propellants should not be destroyed by detonation.

a. Infantry and aircraft type HE and practice rockets shall be destroyed as follows:

(1) Wherever practical, separate the rocket motor from the HE head and dispose of the head as specified for projectiles. If separation of the motor and head is impractical, short range rockets may be destroyed in pits in the manner prescribed by paragraph 13-9.1. Sufficient charge must be used to assure destruction, in place, of the motor and head.

(2) Remove the nozzle or nozzle plate from the rocket motor and take out the igniter and solid propellant charge if possible. The

igniter and solid propellant charge shall then be destroyed or salvaged in accordance with applicable directives.

(3) In certain rocket motors the propellant cannot be removed from the motor. In this case, the nozzle shall be removed, the motors firmly held and the propellant burned. Rocket motors greater than 8 inches in diameter shall be disposed of according to paragraph c below.

(4) Propellant in 5-inch (and smaller) practice rockets and rocket motors (without heads) may be destroyed by static firing with the nozzle in place.

b. Wherever practical, propellant must be removed from rocket motors and destroyed by burning. In the event removal of the propellant is not practical, the rocket motor should be positioned or restricted to prevent movement and propellant in the units shall be destroyed by static firing. When units are to be destroyed by static firing, complete details of the procedures must be submitted to NAVSEASYSCOM for review and approval.

c. Rocket or missile propellants (solid) may weigh as much as several thousand pounds per grain, and the polymer-oxidizer type may be extremely difficult to ignite at atmospheric pressures. Large size rocket motors for specific systems may be destroyed in accordance with instructions contained in technical manuals applicable to such units.

13-12.1. DISPOSAL OF LIQUID PROPELLANTS. For information regarding the destruction of liquid propellants including fuels, oxidizers and catalysts, refer to NAVORD OP 3199; Chemical Propulsion Information Agency (CPIA) Hazards of Chemical Rockets and Propellants Handbook, Volume III; NAVSEA S6340-AA-MMA-010 and other applicable weapon publications.

13-13. DISPOSAL OF EXPLOSIVE INITIATING DEVICES, FUZES, BOOSTERS, PRIMERS, AND TRACERS

Fuzes, boosters, and detonators should be destroyed by detonation as described in paragraph 13-3, or burned in a retort furnace or incinerator, depending on physical size and explosive weight. Primers shall be destroyed by burning or firing depending on the size of the primer.

13-13.1. SEPARATE DETONATORS. Separate electric or percussion detonators contained in relatively thin copper or metal containers shall be destroyed by detonation. This method of disposal shall not be used for destroying fuzes or detonators assembled in fuzes. No booster, booster explosive, powder, or other explosive except the separate detonator shall be destroyed with the detonators or be in the vicinity of destruction operations.

13-13.1.1. Personnel. No more than three persons, and preferably two, shall actually perform the detonation operation. Only capable, experienced, responsible, and reliable persons shall be assigned to perform this work.

13-13.1.2. Location. Detonation shall be performed in a location which is at least 300 feet away from any building, magazine, or structure, and at least 500 feet away from private property or a public highway. Fire hose or suitable hand fire extinguishers should be readily available to control possible grass and brush fires.

13-13.1.3. Explosive Limit. No more than 100 Mk 1 Percussion Detonators (approximately 1 pound of high explosive) or a number of other types of detonators having an explosive content equivalent to 100 Mk 1 Percussion Detonators shall be exploded at one time.

13-13.1.4. Preparation for Detonation. Detonators to be disposed of should be removed from the boxes, one at a time, and carefully piled on a bench, covered with a layer of soft felt. Approximately 20 of these detonators should be selected to form a bundle and a serviceable detonator shall be inserted in a bundle. The complete bundle should be held together by a rubber band or tied with a string. The bundle should be carefully placed in a container meeting the following specifications:

a. The container to be used for detonation shall consist of a metal cylinder with a bottom. The cylinder should be quarter-inch steel plate, about three feet in diameter and three feet deep. In the absence of such a container, an ironhooped, tight, open-top barrel such as an alcohol or oil barrel, can be used. The barrel must have a bottom, so that the operator can determine whether or not all detonators have been fired, because in a unlined pit, the detonators might be driven into the soil. The container should be sunk in the surface to within approximately three inches of the top. It should be empty except for the detonators to be destroyed.

b. Inside the container, an open-top, pasteboard box or other container sufficiently strong to hold the weight of the detonators to be destroyed, should be supported about 12 inches from the bottom of the outer container by means of strings tied to the container and attached to the edge of the outer container by hooks.

The detonation will be initiated behind a barricade, which should be about 6-1/2 feet high, constructed of 2-inch planks not over 12 feet long nailed to trees or posts in the ground. A slight amount of overhead cover, extending from the barricade about two feet, is also desirable. The barricade should be securely built and braced. The barricade should be approximately 100 feet from the detonating site. Further, all brush or long grass should be removed for a distance of about 25 feet around the detonating site.

13-13.1.5. Inspection. Prior to exploding any detonators, all apparatus shall be inspected to determine that it is in proper order. One or two serviceable detonators shall be exploded singly without other detonators in the container, or in the vicinity, to determine that the circuit and set-up is in order. During this inspection procedure, all conditions should be identical to actual detonation conditions, and personnel shall remain behind the barricade. If apparatus and set-up is in order, the actual detonation can proceed.

13-13.1.6. Detonation Procedure. The detonation should proceed as follows:

a. The prepared bundle of detonators to be disposed of should be carefully placed in the box in the outer container, and a lead wire attached to the serviceable detonator in the pack. The lead wire should be about 100 feet long.

b. All personnel shall take cover behind the barricade prior to completing the circuit and exploding the detonators.

c. The lead wire should be attached to a battery or magneto located behind the barricade. Detonation procedures shall be repeated until all detonators are disposed of. The number of detonators or boxes of detonators brought to the site should be limited as much as possible and all detonators to be disposed of shall be kept in a covered chest at a safe distance. Under no circumstances shall more than 100 Mk 1 Percussion Detonators or equivalent be exploded at one time.

13-13.1.7. Safety Precautions. Since all the operations involved in the disposal of detonators are of a highly dangerous nature, all precautions shall be taken to prevent accidents. Sufficient time must elapse after the explosion before proceeding to the scene of detonation (see paragraph 13-3.3.1). In case of a misfire, the circuit must be broken in such a manner that it cannot be accidentally closed while personnel are not behind the barricade.

13-13.2. PRIMERS. Small and large primers shall be disposed of by different methods, as described below.

13-13.2.1. Small Primers. Small primers, i.e., primers that have an ignition charge of less than 30 grains of black powder, shall be destroyed by burning as follows:

a. A trench approximately 2-feet deep, 1-foot wide, and of sufficient length to accommodate the number of primers to be burned at one time should be prepared. A quantity of excelsior or similar combustible material should be placed in the trench to ensure a hot fire throughout its length. A piece of sheet metal should be placed over the trench to confine flying fragments as much as possible. Sufficient space should be left to allow a draft through the trench.

b. The primers should be removed from their outside boxes and placed on the excelsior before the fire is lighted. Inner pasteboard cartons need not be opened before they are placed in the trench.

c. After the primers are in place, a train of combustible material leading into the pit should be prepared. The covers should be placed on the trench and the train lighted. All personnel except the two assigned to light the ignition train shall withdraw to a safe distance before the ignition train is ignited.

d. The stock of primers awaiting destruction shall not be allowed within 500 feet of the burning operations, and great care shall be taken to protect the pile from accidental ignition by flying fragments or sparks. This stock shall be limited to a day's supply.

13-13.2.2. Large Primers. Large primers; i.e., primers that have an ignition charge of 30 grains or more, are subject to explode en masse if destroyed in large quantities by burning. These types should be destroyed as described in paragraph 13-10 for small-arms ammunition, except that only one primer should be dropped down the chute at a time and the operator shall wait until it has exploded before introducing another primer into the chute. Where the quantities of the primers for disposal are such that, for the purpose of recovering the scrap metal it would be economically feasible to do so, they may, with NAVSEASYSCOM approval, be destroyed by firing either by percussion or electrically as may be applicable. The equipment and methods to be used for this purpose must in each instance have prior approval of NAVSEASYSCOM.

13-13.3. TRACER MIX. Tracer mix is to be burned. The burning shall be accomplished in the same manner as that for bulk high explosives (paragraph 13-6.2.1) except that not more than 50 pounds shall be burned at one time.

13-14. DISPOSAL OF LANDING FORCE AMMUNITION

Landing force ammunition includes grenades and mortar ammunition.

13-14.1. GRENADES. Grenades include explosive hand and rifle grenades and chemical hand and rifle grenades.

13-14.1.1. Explosive Hand and Rifle Grenades. Grenades may be destroyed by detonation following safety precautions applicable to projectiles in accordance with paragraph 13-9. If detonation is authorized, not more than 20 grenades shall be piled in close contact with each other in the pit. Three demolition blocks placed on top of the pile should be sufficient to accomplish destruction.

13-14.1.2. Chemical Hand and Rifle Grenades. The destruction of grenades loaded with white phosphorus may be accomplished by burning, as described in paragraph 13-2. Grenades loaded with other chemicals and/or with pyrotechnics may be destroyed in accordance with paragraphs 13-15.4 and 13-16 as applicable.

13-14.2. MORTAR AMMUNITION. Mortar ammunition may be destroyed by detonation in the same manner as projectiles as described in paragraph 13-9. Illuminating shells and flare shells shall be disposed of as pyrotechnics in accordance with paragraph 13-16. Two 1/2-pound demolition blocks are required for detonating each 60 and 81 mm mortar projectile. High capacity mortar projectiles contain a larger bursting charge than other types of projectiles of the same caliber. Additional care should be taken to limit the number of projectiles destroyed at any one time, in accordance with paragraph 13-9, and to protect projectiles awaiting destruction from flying fragments.

13-14.3. LAND MINES AND GROUND-TYPE ROCKETS. For disposal of land mines and ground-type rockets, refer to the appropriate Army, Marine Corps, or other technical manual and paragraph 13-12.

13-15. DISPOSAL OF CHEMICAL AGENTS AND CHEMICAL AMMUNITION

NOTE

Chemical agent, as used in this paragraph, is intended to mean lethal and incapacitating vice riot control smoke, etc. Incapacitating means down and out, not vomiting, crying, etc.

Destruction of chemical agents, defined as chemical compounds (Chemical Groups A and B) used in military operations to kill, seriously injure, or incapacitate persons through their chemical properties; excluding research, development, test and evaluation, dilute solutions, riot control agents, chemical defoliants and herbicides, smoke, flame and incendiaries and industrial chemicals; will be accomplished in accordance with requirements outlined in regulations [either Army (AMC) or Navy (NAVSEASYSCOM)] for the specific type of agent involved. As a matter of policy, open pit burning of lethal (Chemical Group A) or incapacitating (Chemical Group B, excluding riot control and screening smokes), agents or agent-filled munitions in any quantity is prohibited. Chemical agents (Groups A and B) in bulk form and munitions containing these agents, with or without explosives, will not be disposed of by burial or dumping into waterways. Production equipment, munitions and other items which have been contaminated with toxic chemical agents will not be disposed of or released for sale as scrap until they have been thoroughly decontaminated and certified as being free of agent and explosives in accordance with the regulations for the specific type of agent. (Emergency disposal is governed by Army Regulation AR 75-15. Chemical Group B (riot control and screening smokes), Group C and Group D materials and munitions may be disposed of by detonation, burning, chemical decomposition, venting, or normal functions as described in the following subparagraphs and in regulations for the specific item. Under no circumstances do the regulations and/or requirements for disposal set forth in this section do away with the commanding officer's responsibility for the safety of personnel and the protection of property under his command nor negate this authority to employ any means necessary to safeguard life and property in the event of emergency or unusual circumstances. All deviations from mandatory provisions of this section as well as any known ammunition or inadequacies shall be reported to NAVSEASYSCOM.

NOTE

Information and instructions regarding disposal and decontamination procedures for lethal and incapacitating chemical agents and munitions may be obtained from:

(1) U.S. Army Chemical Research and Development Center, Aberdeen Proving Grounds, Aberdeen, MD 21010.

(2) U.S. Army Office of Program Manager for Chemical Munitions, Safety and Security Division, Aberdeen Proving Grounds, Aberdeen, MD 21010.

(3) U.S. Army Armament Munitions and Chemical Command Field Safety Activity, Indiana Army Ammunition Plant, Charlestown, IN 47111.

Regulations for handling and disposal of chemical agents and munitions aboard ship are promulgated by the Navy. NAVSEA-SYSCOM shall be contacted for instructions in the absence of specific information. Approval to use any methods other than those prescribed by regulations or manuals for standard military items shall also be obtained from NAVSEASYSCOM.

13-15.1. PUBLIC RELATIONS. All disposal operations shall be planned with consideration to the effect they will have on the public in the area surrounding the disposal site. The operation shall be conducted so that fumes, smoke, noise, and concussion from the operation do not result in adverse publicity or claims against the government.

13-15.2. DATA REQUIREMENTS. Prior to planning disposal and destruction operations, the following minimum data must be available concerning chemical agents and ammunition:

a. Agent characteristics, both physical and chemical.

b. Nomenclature.

c. Physical configuration.

d. Condition and code.

e. Degree of hazard and safety.

f. Detection and control methods.

g. Method of decontamination, detoxification, and final disposition of residue.

h. Environmental assessment.

i. Site requirements and equipment.

j. Safety regulations and documentation.

k. Authority.

13-15.3. DISPOSAL METHODS - GENERAL.

13-15.3.1. Chemical Decomposition. Chemical decomposition is the preferred method for disposing of chemical agents and hazardous chemicals. It is usually accomplished by use of neutralizing agents in accordance with regulations for specific items. Products of decomposition are disposed of in accordance with local environmental regulations. Analysis should be conducted to determine the specific hazard presented by the waste material. (Waste will not be discharged into or be permitted to contaminate surface water or water tables.)

13-15.3.2. Burning.

a. Controlled Burning. Chemical agents and chemicals, with the exception of Groups A and B, may be disposed of in special incinerators (controlled burning) designed to produce temperatures which exceed the decomposition temperature of the material being processed. The product of decomposition shall be nontoxic combustion products when discharged to the atmosphere. Prior to incineration, if called out by regulations for a specific agent or hazardous material, the material should be treated with a detoxifying agent which will render the material safe to handle. Such burning shall be conducted in accordance with environmental regulations established for the area in which the incinerator is installed in a manner which will preclude nuisance, concentration of vapors or aerosols from being carried beyond the disposal area. The operation shall be conducted in an area where toxic solid residues (if produced, will not contaminate natural water sources).

NOTE

Group A and B agents may be destroyed by controlled burning at the discretion of the commanding officer after notifying NAVSEASYSCOM, if required to eliminate immediate and extreme hazard to the public.

b. Open Burning. Incendiary items, smoke producing items, incendiary gels, and pyrotechnic agents shall be disposed of by burning in accordance with environmental regulations for specific items or as prescribed in subsequent paragraphs in this manual, including possession of the required environmental permits.

c. Solid Waste Disposal. Solid waste remaining from burning operations should be analyzed to determine if any hazardous constituent or by-product remains. If no hazard is present the material may be disposed of by sanitary land fill methods prescribed by the U.S. Army Corps of Engineers and consistent with state and local government regulations for disposal of waste. Materials from agent operations, such as duct work, laboratory equipment, and so forth, that cannot be decontaminated must be disposed of in accordance with environmental regulations. Salvageable metal parts, such as agent containers and shell cases, shall be decontaminated by prolonged heating above the temperatures needed to decompose the chemical agents they contained. Certification that material is free of contamination shall be made by the agency responsible for processing the material.

13-15.3.3. Land Burial. Due to significant restrictions regarding land burial or landfill disposal of hazardous materials or waste, this alternative must be very carefully considered before any materials are interred. Local environmental regulations should be reviewed to ensure a permitted facility is authorized to receive the waste or contaminated material. If land treatment (sludge application or biodegradation) is suggested, additional permits and monitoring criteria must be met. Consult the local environmental point of contact prior to conducting disposal by land burial.

13-15.3.4. Venting. Small amounts of nonpersistent agents may be disposed of by direct venting to the atmosphere under controlled conditions providing all requirements of state and local environment laws are observed. If authorized in accordance with regulations for specific items, venting shall be done at selected locations using a controlled rate which will assure that nuisance thresholds or toxic concentrations of vapors or aerosols are not emitted beyond the area of the activity.

13-15.3.5. Normal Function. This method of disposal may be utilized for destruction of certain chemical munitions items in accordance with regulations for the specific items. Such disposal shall be conducted at an approved disposal area in compliance with pertinent environmental permits/regulations.

13-15.3.6. Detonation. Disposal of certain chemical munition items by detonation may be conducted in accordance with regulations and procedures for the specific items. Such disposal shall be conducted at an approved disposal area in compliance with local environmental permits/regulations.

13-15.4. DISPOSAL METHODS BY CHEMICAL GROUP.

13-15.4.1. Group A shall be destroyed in accordance with specific Army or Navy regulations for each agent and then under stringent control. Concurrence of NAVSEASYSCOM is required for each disposal operation. As a general policy, destruction by open pit burning of any quantity of agent is prohibited.

13-15.4.2. Group B shall be destroyed in accordance with specific Army or Navy regulations for each agent under stringent control. Concurrence of NAVSEASYSCOM is required for each disposal operation in which Group B incapacitating agents. Exception: riot control chemical agents, screening smokes and munitions containing these materials may be destroyed by Navy activities at approved disposal areas in accordance with regulations for each item to be destroyed. In general, with the exception of FS smoke mixture, Group B riot control and smoke munitions may be destroyed either by burning or normal functioning. Instructions for the disposal of FS smoke mixture can be obtained from Naval Surface Warfare Center Division Crane (NAVSURFWARCENDIV) (Code 40222).

13-15.4.3. Group C. Group C chemical munitions may be disposed of by either detonation or burning in accordance with specific regulations for the specific item if permitted by local environmental regulations. Contact the local environmental staff prior to commencing operations. The following procedures may be utilized:

a. Detonation. Group C chemical munitions or components should be destroyed one round or item at a time at an approved disposal site at which fragmentation will not create a hazard and smoke will not create a nuisance. (Paragraph 13-3.2.1.) The round or component shall be destroyed by static firing. The required amount of demolition explosive to ensure destruction of representative types of Group C munitions is shown in table 13-5.

Table 13-5. TNT Demolition Blocks Required for the Destruction of Group C Ammunition

GROUP C CHEMICAL AMMUNITION	NUMBER OF 1/2-LB TNT BLOCKS OR EQUIVALENT REQUIRED
3-inch and 75 mm projectile	4
5-inch and 155 mm projectile	5
8-inch projectile	6
81 mm projectile	2
4.2-inch chemical mortar projectile	3
5-pound aircraft bomb	1
25-pound aircraft bomb	2
50-pound aircraft bomb	2
100-pound aircraft bomb	3

b. <u>Burning</u>. Disposal of burning shall be conducted in accordance with the requirements of paragraph 13-2.2. Local, state, and federal regulations shall be observed. Before burning ammunition, fuzes, bursters and other explosive components shall be removed if removal can be accomplished without hazard. These components may be disposed of separately in accordance with procedures described for similar components. Before burning liquid-filled ammunition or containers, the cases shall be vented to eliminate the possibility of fragmentation as a result of hydrostatic rupture.

13-15.4.4. <u>Group D</u>. Group D chemical ammunition may be disposed of by normal functioning, static firing or burning. Included in this group are incendiary munitions (incendiary oil/gasoline compounds and incendiary gels). Burning shall be conducted at burning areas as required by paragraph 13-2.2 of this manual and other appropriate regulations for disposal of specific items.

13-16. DISPOSAL OF PYROTECHNICS

The following instructions shall be observed when disposing of pyrotechnics.

13-16.1. GENERAL INSTRUCTIONS. Pyrotechnics that do not, upon ignition, eject canisters, burning signals, grenades, or similar items may be disposed of by burning as described in paragraph 13-2. These pyrotechnics include those containing pressed pyrotechnic compositions. However, if the applicability of these burning procedures to an item is in doubt, clarification may be requested from NAVSEASYSCOM prior to disposal action. Burning pyrotechnic materials may produce toxic or noxious by-products. Prior to burning any pyrotechnics, contact the local environmental staff to ensure all environmental regulations will be complied with.

13-16.2. INSTRUCTIONS FOR BURNING. Burning of selected pyrotechnic items may be accomplished in an open trench. This method of disposal is restricted to items that have no expelling and/or propelling charges. The trench shall be a minimum of 4 feet deep and may be formed by digging or by erecting two parallel earthen barricades. Each barricade should be 2 feet wide at the top. The trench may be steel lined [illegible] in no case will gravel, cinders, concrete or other similar ma[illegible] used to form the burning surface. The following more detaile[illegible]ctions are prescribed in addition to those given in paragraph 13-2.

a. Clean trench of all scrap from previous burns.

(1) There shall be a 36-hour cooling down period after the previous burn before the trench is cleaned. If water is used to cool the trench and its contents, a minimum of 18 hours shall elapse prior to cleaning.

(2) Burned or unburned items found during cleanup may be picked up and prepared for the next burn. Fuzed items which may have internally damaged components should not be moved but destroyed in place.

(3) Material awaiting disposal shall remain in the stockpile area during cleaning of the trench.

(4) The trench shall be cleaned of all scrap from previous burns before loading trench for next burn.

b. Load trench with dunnage.

(1) Operators shall, when loading trench with excelsior, wood or similar flammable material, pay attention not to overload the trench so as to nullify the effects of the earthen barricades. However, there should be sufficient quantity to sustain a hot fire for a minimum of 30 minutes in the bottom of the trench.

(2) Operators may soak dunnage with oil to aid in producing a hot fire. However, the oil should be applied uniformly.

c. Prepare items for burning.

(1) Operators shall remove items from metal containers. Pyrotechnic items shall not be burned in sealed metal containers.

(2) The operators shall be instructed in the increased hazards of pyrotechnics as they age, deteriorate or become damaged, and how to protect pyrotechnics against shock.

d. Load trench with items.

(1) The maximum pounds of explosive allowed per trench is limited to two times the area in square feet of the trench. For example, a trench measuring 4-feet wide by 50-feet long equals 200 square feet; the explosive limit for this trench is 400 pounds.

(2) When burning aircraft parachute flares, place them in a single row, side by side, a minimum of 1-foot apart. The explosive content of trench shall not exceed the explosive limits given above.

(3) The trench shall be filled no more than within 2 feet of the top.

(4) Larger items shall be placed in a single layer.

(5) Material to be burned shall be spread evenly over the burning trench and smaller items shall not be piled more than 1-foot deep.

e. Prepare and ignite the ignition train in accordance with instructions provided in SW060-AA-MMA-010 (series).

f. After the burn, and the last indication of smoke or flames, a 60-minute waiting period is required before the burning trench is approached. The supervisor shall perform the inspection of the trench.

g. Metal parts remaining after burning should be salvaged for scrap if quantities warrant. If salvage is conducted, extreme care must be exercised to ascertain that no unburned rounds are present.

h. When tracer mix and other pyrotechnic mixtures are to be burned, the burning shall be accomplished in the same manner as that for bulk high explosives (paragraph 13-6.2.1) except that not more than 50 pounds shall be burned at one time.

13-16.3. ITEMS REQUIRING SPECIFIC NAVSEASYSCOM INSTRUCTIONS. Because they are designed, upon ignition, to eject canisters, burning signals, grenades, or similar material, some pyrotechnics cannot be destroyed by burning. Specific disposal instructions shall be requested from NAVSEASYSCOM. These include items containing photoflash or illuminating compositions, detonation devices, expelling or propelling charges.

13-17. DISPOSAL OF DEMOLITION AND MISCELLANEOUS EXPLOSIVES AND AMMUNITION ITEMS

Disposal instructions for explosive materials used in the Navy for demolition and other purposes are contained in the following paragraphs.

13-17.1. DYNAMITE. Unopened boxes of exuding dynamite to be destroyed should be burned on a bed of combustible material without being opened. Precautions must be taken to protect personnel and property from possible detonation. Individual cartridges may be burned in a single layer not greater in width than the length of one cartridge, on a bed of combustible material. Dynamite awaiting destruction shall be shielded from the sun. Frozen dynamite is more likely to detonate during burning than normal cartridges. Destruction of dynamite by detonation may be accomplished where the location will permit this method of destruction. Care in priming to assure complete detonation of the quantity must be taken.

NOTE

> Additional information on the handling and disposition of dynamite and blasting accessories is contained in the "Blaster's Handbook," published by E.I. du Pont de Nemours Co., Wilmington, DE.

13-17.2. AIRCREW ESCAPE ITEMS PROPULSION SYSTEMS AND CARTRIDGE ACTUATED DEVICES. AEPS and CAD items shall be disposed of in accordance with SPCCINST P8010.12 (series).

13-17.2.1. Disposal of Damaged/Deteriorated/Hazardous AEPS/CAD Items. Disposal of AEPS and CAD items found in a hazardous, deteriorated, or damaged condition is the responsibility of EOD personnel. EOD personnel shall be notified as soon as an unsafe condition is discovered. Disassembly in order to render a device safe may be performed only by EOD personnel. In the absence of EOD personnel, disposition may be accomplished by competent ordnance personnel certified for disposal operations. Pending disposition, such devices shall be separated from serviceable materials and clearly identified as damaged/unserviceable. Disposition of disassembled devices shall be requested from Naval Warfare Support Center, Indian Head Detachment (Attn: Code 51/DAPML).

13-18. SALE, SALVAGE, AND DISPOSITION OF INERT MATERIAL

The following paragraph describes requirements for the sale, salvage, and disposition of inert materials.

13-18.1. GENERAL REQUIREMENTS. All inert items intended for disposition, such as empty projectiles, cartridge cases, rocket warhead containers, and all inert materials shall be rigidly inspected for the presence of any explosive material prior to salvage, offer for sale, or delivery as a result of sale. All cavities of items submitted for sale shall be opened and thoroughly inspected. These cavities shall not be closed after the inspection. Whenever any doubt exists whether the cavities are free from explosives, the cavities shall be thoroughly washed and steamed until cleanliness is assured. If considered necessary, the components should be flashed with fire using a safe method in a safe location and neutralized using the proper agents, to ensure that they are free from explosives. The commanding officer shall take all necessary precautions to assure that the items are inert. Whenever thorough decontamination of the items is not possible or cannot be definitely assured, disposition instructions shall be requested from NAVSEASYSCOM.

NOTE

All containers that previously were used for ammunition, explosives, and dangerous articles shall be subjected to a 100% inspection prior to shipment to other activities for storage, reuse, or salvage. Such inspections shall both ensure that the containers are empty and determine whether the containers are serviceable and/or economically repairable before shipment. All previous markings from empty containers must be removed.

13-18.2. INERT-LOADED AMMUNITION. Inert-loaded ammunition shall be completely disassembled. All tracer composition, if present, and all inert fill shall be removed prior to sale or other disposition of inert-loaded ammunition as scrap.

13-18.3. CARTRIDGE CASES. Cartridge cases shall be deprimed by positive methods and thoroughly washed and inspected prior to disposition as scrap. Expended small-arms cartridges cases will not be deprimed. Refer to appendix A for definition of small-arms ammunition.

13-8.4. AIRCRAFT STORES RELEASE CARTRIDGES. Aircraft stores release cartridges (including chaff and flare cartridges) that can be readily identified and certified as fully expended can be released for disposition without depriming or other decontamination treatment after certification. Cartridges that can be readily identified and certified are listed in NAVAIR 11-100-1.3. Unfired or partially fired cartridges and cartridges not listed in NAVAIR 11-11-1.3 as being readily identifiable/certifiable as fully expendable (such as cartridge actuated initiators in sonobuoys) shall be stored as unserviceable ammunition and reported per SPCCINST P8010.12 (series).

SECTION E

GROUNDWATER MONITORING

Groundwater has not been used as the drinking water supply for the civilian population of Vieques Island since 1979. Since then, water has been piped in from Puerto Rico to supply these inhabitants. However, Camp Garcia, which is located approximately 10 miles from the OB/OD units, presently utilizes groundwater wells as a source of drinking water.

The groundwater monitoring requirements of 40 CFR 264.90 through 94 are addressed in Section L of this application.

40 CFR 264.98 is a subsection of *Subpart F — Releases From Solid Waste Management Unit* which is only applicable for SWMUs from which there are releases. However, no SWMUs have been identified at the facility (See Section K), and no evidence of any releases at either unit has been detected. Therefore, 40 CFR 264.98 is not yet in effect.

SECTION F

PREPAREDNESS AND PREVENTION PLANS

This section describes the procedures and structures at AFWTF Vieques which have been created to prevent and/or mitigate hazards associated with the thermal treatment of reactive hazardous wastes. The information is submitted in accordance with 40 CFR 270.14(b)(4), (5), (6), (8), and (9). This section includes general security procedures, inspection schedules, preventive procedures, and procedures for the management of reactive hazardous wastes.

F-1 SECURITY [40 CFR 270.14(b)(4)]

24-HOUR SECURITY SYSTEM

The Air Impact Area (AIA) is visually monitored 24 hours a day from the OP-1 tower. The location of OP-1 is indicated on the topographic map (Figure B-2). During treatment and routine range operations, all roads entering the area are manned by guards. Vehicles entering the area are manned by EOD Detachment Two personnel; no additional vehicles are allowed within the facility. Overall security of the AIA is the responsibility of AFWTF Range Control. All vehicles entering the AIA must be cleared through Range Control prior to entry.

BARRIER AND MEANS TO CONTROL ENTRY

Guards are used to keep unauthorized personnel from dangerous areas during OB/OD procedures. Overall monitoring of the impact area and the Caribbean Sea is performed from OP-1.

WARNING SIGNS

Signs reading *Danger — Unauthorized Personnel Keep Out* are posted at the access roads to the facility. In addition, signs reading *No Smoking* are also posted at the access roads. All signs are legible from a distance of 25 feet and are written in English and Spanish.

WAIVER

A waiver of the requirements of 40 CFR 264.14(a)(1) and (2) regarding injury to intruders and violation by intruders is not required for the AFWTF.

F-2 INSPECTION SCHEDULE [40 CFR 270.14(b)(5)]

The facility will be inspected only when it is in use for equipment deterioration and/or operator error, and discharges which may cause or lead to (1) a release of hazardous waste constituents to the environment or (2) a threat to human health. The operator at the facility will conduct these inspections to identify problems and correct them before they harm human health or the environment. In order to perform more frequent inspections, inspectors would be required to enter the impact range. A major range clearance operation would be required to allow access to the facility without jeopardizing inspection personnel. Since no equipment or structures are located at the site when not in use, there is in actuality nothing to inspect except the burning pans.

The only structures associated with the facility are the burning pans and the earthen pits which require virtually no inspection or repair. The area around the pits will be inspected after each burning and detonation operation to ensure that all unburned ordnances or any "pop outs" are collected and included in the next treatment. In addition, any solid waste materials such as metal fragments shall be picked up and disposed of as solid waste. Since there are no structures at the facility due to the ordnance training activities, it is impossible to maintain records or documents at this location. However, copies of the inspection schedule are maintained at OP-1, the range observation tower. This is the nearest structure where such records can be maintained. A copy of a sample inspection schedule is included as Table F-1.

In addition, the facility is inspected only when the facility is in use. In order to perform more frequent inspection, inspectors would be required to enter the impact range. A major range clearance operation would be required to allow access to the facility without jeopardizing inspection personnel. Since no equipment or structures are located at the site when not in use, there is in actuality nothing to inspect. Therefore, more frequent inspections do not appear to be warranted.

Daily inspections shall be conducted on motor vehicles used at the OB/OD facility when the facility is in use to ensure that: (1) fire extinguishers are present and serviceable, (2) electric wiring is in good condition and properly attached, (3) fuel tanks and piping are secure and not leaking, (4) brakes, steering, and other equipment are in good condition, (5) the exhaust system is not exposed to accumulation of grease, oil, gasoline, or other fuels, and has ample clearance from fuel lines and other combustible materials, (6) the radios in the vehicle are functioning properly, and the first-aid kits are available in the vehicles and are adequately supplied. The list of safety and emergency equipment maintained by EOD Detachment Two is presented in Table F-2.

No records of inspections have been maintained in the past. However, such records will be prepared and maintained by EOD Detachment Two in the future. Such records will be stored at the EOD Detachment Two headquarters at U.S. Naval Station Roosevelt Roads (in close

Table F-1
OB/OD Facility
Inspection Schedule

	ITEM	PROBLEM	FREQUENCY
Safety and Emergency Equipment			
☐	Recovery drums	Out of stock, structural damage	Monthly
☐	Eyeglasses/face shields	Out of stock	Monthly
☐	Gloves	Missing, holes	Monthly, after use
☐	Radio	Dead batteries	Monthly
☐	First aid kit	Out of stock, inoperative	Monthly, after use
☐	Burning trays	Damaged from heat, intact	Before & after use
☐	Cover	Damaged from heat, intact	Before & after use
☐	Ash screen	Damaged from heat, intact	Before & after use
☐	Dry Chemical Fire Extinguisher	Fully charged, operational	Monthly, after use
Security Systems			
☐	Warning signs	Damaged, missing	Weekly
☐	HW labels	Improper identification, date missing	Weekly
☐	Containers	Corrosion, leakage, structural defects	Weekly
☐	Pallets	Damaged	Weekly
☐	HW manifest	Missing	Weekly

Table F-2
OB/OD Equipment List

Shovel		(2 each)
E-Tool		(2 each)
Pick Ax		(2 each)
Screwdriver, Flat Tip		(2 each)
Wrench, Crescent 12 Inch		(2 each)
Pliers		(2 each)
Hammer, Claw		(1 each)
Pry Bar		(2 each)
Band Cutters		(1 each)
MK 663		(2 each)
Binoculars		(1 each)
Camera, Polaroid W/Film		(1 each)
Tape, Electrical		(12 rolls)
Tape, Survey Red/Yellow		(1 case/color)
Paint, Fluorescent Int Orange		(2 cases)
Water Cooler, 5 gallon		(1 each)
Personal Demo Equipment:	Knife, MK3 Knife, Folding Pliers, Linemen's Crimpers Canteen Sun Screen Mini Mag Light	(Per Individual)
SAFETY EQUIPMENT PER VEHICLE		
First Aid Kit, Large		
Fire Blanket		
Dry Chemical Fire Extinguisher		

proximity to the facility). In addition, copies of inspection records will be maintained at AFWTF Range Control headquarters at OP-1.

No untreated ordnance is stored or accumulated at either the OD or OB units. Due to the nature of the materials treated by open burning as well as performance criteria from other facilities, no unburned materials are expected to remain in the unit following treatment other than ash residues. Since no liquids are treated at the facility, in the event of a release, any spilled or dropped ordnance or residue is collected and retreated as soon as it is safe to re-enter the facility.

Regarding open detonation, any spilled or dropped ordnance is either detonated in place or moved within the unit for immediate treatment. The decision as to whether to detonate in place or move the ordnance is made by onsite EOD personnel based upon safety concerns. Should any ordnance remain untreated following a detonation, the materials are collected and retreated as soon as it is safe to re-enter the OD area.

F-3 WAIVER OF PREPAREDNESS AND PREVENTION REQUIREMENTS [40 CFR 270.14(b)(6)

The AFWTF Vieques does not request a waiver of the preparedness and prevention requirements of 40 CFR, Subpart C. Documentation of compliance with these requirements is contained below and in Sections D and G.

INTERNAL COMMUNICATIONS

To the extent that this is applicable to the facility, internal communications shall be by voice command and hand signals. To prevent undue risk to human health, SOPs require that at no time shall any person conduct treatment operations alone. This will ensure that at least one other person will be available to notify emergency response personnel in the event of an emergency situation. Two-way radios will also be used for internal communication.

EXTERNAL COMMUNICATIONS

Communications with the Range Control Officer at OP-1 will be maintained at all times with hand-held radios. The Range Control Officer will maintain radio communication with all offsite emergency personnel.

EMERGENCY EQUIPMENT

Emergency equipment in the form of shovels, portable fire extinguishers and first-aid kits will be on each vehicle used in operations at the facility. Emergency equipment is not maintained at the facility because it could be destroyed during normal range activities. Therefore, emergency equipment shall be taken to the facility only when treatment operations are to be conducted. Due to the nature of the impact range, it is not feasible for fire-fighting vehicles to enter the range.

Communication lines are confirmed prior to operations. Each department is responsible for ensuring that any equipment used during an emergency is cleaned and restored to pre-emergency and fully operational conditions. If the equipment cannot be restored to fully operational conditions, it shall be replaced with new equipment.

WATER FOR FIRE CONTROL

Due to the inherent dangers involved, as well as the natural fire breaks the area offers, any fires which result from range activities are simply allowed to burn out. It is not feasible for safety reasons for fire-fighting equipment, including pumpers, to enter the AIA. During normal training activities, range fires occur regularly. For these reasons, no attempts to extinguish a fire will be made, and water for fire control will not be provided.

F-4 PREVENTATIVE PROCEDURES, STRUCTURES AND EQUIPMENT [40 CFR 270.14(b)(8)

LOADING/UNLOADING OPERATIONS

Specific requirements for the loading and unloading of waste PEPs are described in *NAVSEA OP5*. General guidelines for the loading and unloading of waste PEPs are provided in this section as follows:

1. Appropriate fire symbol and chemical hazard symbols shall be displayed so that they are easily visible from all roads of approach to the munitions storage bunkers and the OB/OD facility.

2. All loading and unloading areas shall be maintained in a neat and safe condition.

3. All tools required for such operations shall be in good condition and shall be non-sparking, when appropriate.

4. Each vehicle operator will have in his possession a valid operator's permit for the particular piece of equipment to be operated.

5. Explosives-loaded ammunition, packaged ammunition or bulk explosives shall not be handled roughly, thrown about, tumbled, dropped, or carried over other explosives or

ammunition. Large ammunition items, packaged in DOT-approved containers designed to permit dragging, rolling or towing, may be so moved when necessary during handling for storage and transportation.

6. Leather gloves and steel-toed shoes shall be worn by all personnel involved in the loading and unloading of waste PEPs.

7. Explosive materials shall be unloaded by hand or forklift as appropriate. Personnel operating the forklift(s) shall be fully trained in the handling of explosive materials and possess a valid forklift operator's license.

8. Trucks transporting explosive materials to burning grounds shall meet the requirements of *NAVSEA OP5* and the Explosive Drivers Handbook (NAVSEA OP-2239). No more than two people shall ride in the cab.

9. Upon arriving at a burning or demolition ground, trucks may distribute explosive items to be treated at sites where treatment is to take place. As soon as all items have been removed, trucks shall be withdrawn from the burning or demolition area to a safe location until treatment is concluded.

10. When materials being processed at the OB/OD facility are to be handled by gasoline or diesel powered forklift truck, the requirements of *NAVSEA OP5* will be observed. All such material handled will be properly packaged and must not be contaminated with explosives.

11. When loading/unloading motor vehicles, the brake must be set. In addition, when on a grade, at least one wheel must be chocked.

12. When a motor vehicle approaches within 25 feet of the doors of a structure through which a shipment is to be moved, the doors must be kept closed until the motor has been switched off unless the exhaust system is equipped with a spark-arresting device or no exposed explosives are present. Exposed explosives exclude finished ammunition and explosives packaged for shipment per DOT regulations.

13. No explosives shall be loaded into or unloaded from motor vehicles while their motors are running. Motors may be kept running when required to provide power to vehicle accessories such as mechanical handling equipment used in loading and unloading the vehicles, provided:

    a. The accessory is an integral part of the vehicle.

b. The exhaust gases from the motor are emitted at least 6 feet from the point at which the loading operations are conducted and are directed away from this point.

c. The exhaust pipe is equipped with a spark arrestor.

d. Materials being loaded or unloaded which may involve flammable vapors are enclosed in tightly fitting containers.

14. Trucks with end-operating platforms or pedals shall be equipped with platform guards of heavy channel iron and heavy steel plate or materials of equal strength. The guards should be at least 18 inches high on the sides and should extend a sufficient distance beyond the platform or pedal to protect the operator. Overhead guards are required for forklift trucks of all types. Lift trucks shall be designed to prevent the sudden dropping of the load in the event of a power failure.

15. Transportation and/or moving fused ammunition on the forks of lift trucks without skids or pallets is prohibited unless such containers are designed so they can be safely carried in this manner. Loaded unfused bombs may be carried directly on the forks of lift trucks. Boxes of finished ammunition may be carried directly on the forks when they are long enough to be firmly supported on both forks.

16. Loads on tines of forklifts must not extend more than one-third of the height of the top tier of containers above the load-back rest. When handling two low-profile unitized loads together, because of low overhead clearance in the storage magazines, the package guard must extend to at least one-third the height of the top of the load.

17. The method and sequence of unloading the ammunitions and explosives should be considered before loading a truck, particularly if hoisting equipment is used. Blocks should be used to separate sections of the load to permit easy fastening of slings at the unloading point. If selective stacking is required at the unloading end, the material should be loaded on the truck in proper sequence. Trucks should not be loaded to a height that will obstruct visibility in both directions unless at least two personnel are assigned to move the truck. Loads shall be placed to prevent tipping, shifting, or falling. Due to the inherent nature of the facility, there are no engineered unloading ramps or docks at the OB/OD facility.

RUNON/RUNOFF CONTROL STRUCTURES

Open detonation operations are conducted in earthen pits. These pits direct the force of the blast in a vertical direction, and prevent potentially contaminated storm water runoff from exiting the unit. Open detonation operations are not conducted under adverse weather conditions. Due to the inherent nature of treatment, no additional types of engineered control devices can be used to prohibit precipitation runon or contaminated runoff. The logistics behind this operational parameter is that such devices would be destroyed under normal treatment operations and extruded fragments would create a safety hazard to military personnel.

Open burning operations are conducted in burning pans equipped with secondary containment. The burning pans are kept covered when not in use, and all ash and residue is removed following each treatment event. Therefore, in the event of a storm event, there would be no hazardous waste at the open burning grounds and the threat of contaminated runoff and runon is minute. Burning pans remain at the unit between treatment evolutions. Should a pan be damaged during the treatment operation or by range ordnance activities, the pan will remain at the facility for later removal as contaminated hazardous waste debris during the facility closure.

WATER SUPPLIES

The complete combustion of the waste results in no reactive waste left upon completion of treatment. This is assured by collecting any unburned kickouts or undetonated explosives. No groundwater wells are located within eight miles of the facility. There is only a remote possibility that the wells have been impacted from the operations. Section L discusses the potential for groundwater impact in greater detail.

EQUIPMENT AND POWER FAILURE

There is no requirement for offsite electrical power sources at the facility. Therefore, a power outage will not affect treatment operations. Equipment failures shall be reported immediately as specified in the SOPs. Faulty equipment shall be repaired or replaced as appropriate.

PERSONNEL PROTECTION EQUIPMENT

Waste explosives shall be handled in a manner that minimizes contact with the waste. All handling operations and requirements for protective clothing shall be in accordance with SOPs. At a minimum, protective clothing shall include but not be limited to the following: flight jackets, safety goggles, helmet and gloves.

F-5 PREVENTION OF THE REACTION OF IGNITABLE, REACTIVE AND INCOMPATIBLE WASTES [40 CFR 270.14(b)(9)]

MANAGEMENT OF IGNITABLE AND REACTIVE WASTE

All hazardous materials handled at the demolition range shall be assumed to be reactive due to their inherent physical characteristics. As such, personnel must take appropriate measures to prevent reactions which:

1. Generate extreme heat or pressure, fire or explosions, or violent reactions.

2. Produce uncontrolled toxic mists, fumes, dusts, or gases in sufficient quantities to threaten human health or the environment.

3. Produce uncontrolled flammable fumes or gases in sufficient quantities to pose a risk of fire or explosion.

4. Damage the structural integrity of the device or facility.

5. Through other like means threaten human health or the environment.

PROCEDURES

The means to accomplish the aforementioned criteria are provided through the establishment of safety guidelines implemented through the guidelines established in *NAVSEA OP5*. The safety guidelines include, but are not limited to, the following:

1. *No Smoking* signs shall be posted at the demolition range.

2. Ignition sources shall be prohibited at the demolition site.

3. Spark-producing equipment and tools shall be prohibited from use near explosive materials unless specifically authorized.

4. Incompatible materials shall not be treated or stored in the same locations.

5. Supervisors shall perform inspections of hand tools and mechanical devices to ensure that they have not become unsafe for use as designated either to the item or to the operator.

6. Motor vehicles used to transport waste explosives, ammunition, or other material to the destruction site shall meet the requirements of *NAVSEA OP5*.

7. Thermal treatment operations shall not be conducted during electrical storms.

MANAGEMENT OF IGNITABLE OR REACTIVE WASTES IN CONTAINERS

The facility is a treatment unit only. Therefore, no containers of reactive or ignitable wastes are stored or handled at this facility at this time. However, should future operations require that explosive materials be handled in containers at this facility, it is clear from the base master plan map that the facility is greater than 50 feet from the facility's property line.

MANAGEMENT OF INCOMPATIBLE WASTES IN CONTAINERS

Incompatible wastes are not treated at the facility. In addition, containers of explosive material are destroyed after use and will not be used to contain other waste PEPs.

SECTION G

CONTINGENCY PLAN FOR HAZARDOUS WASTE EMERGENCIES

This section of the Hazardous Waste Permit Application includes the Hazardous Waste Contingency Plan for AFWTF Vieques as required by 40 CFR 270.14(b)(7) and Subpart D of 40 CFR 264. The Contingency Plan is written as an independent document and included here in its entirety. Because it is an independent document, the Contingency Plan may be reproduced and distributed separately as necessary.

Although they are located on Vieques Island, AFWTF and NAF are tenant commands of the Naval Station Roosevelt Roads. Naval Station is essentially self-contained for emergency response to fires, explosions, and spills on Vieques.

HAZARDOUS WASTE CONTINGENCY PLAN
ATLANTIC FLEET WEAPONS TRAINING FACILITY
VIEQUES ISLAND, PUERTO RICO

1-0 GENERAL INFORMATION

This document is the Hazardous Waste Contingency Plan for the Atlantic Fleet Weapons Training Facility (AFWTF) located on the eastern portion of Vieques Island, Puerto Rico. A vicinity map depicting AFWTF Vieques with respect to Naval Station (NAVSTA) Roosevelt Roads is presented in Figure 1. The Atlantic Fleet Weapons Training Facility is located on the eastern side of Vieques Island.

Naval training exercises on Vieques are conducted within an area known as the Inner Range, which includes approximately 14,000 acres on the eastern half of Vieques, and encompasses the area extending to a limit of three miles from the shoreline. Within the Inner Range, the Atlantic Fleet's ships, aircraft and marine forces carry out training in all aspects of naval gunfire support, air-to-ground ordnance delivery, air-to-surface mine delivery, amphibious landings, small arms, artillery and tank fire, and combat engineering.

Two facilities comprise the Inner Range: the Atlantic Fleet Weapons Training Facility and the Eastern Maneuver Area which is west of the AFWTF. The AFWTF occupies roughly 3,600 acres on the eastern tip of the island (Figure 2). The AFWTF is tasked with providing facilities and scheduling naval gunfire support and air-to-ground ordnance delivery training for Atlantic Fleet ships, NATO ships, air wings, and smaller air units from other allied nations and the Puerto Rican National Guard. In addition, AFWTF operates other military facilities which are not located on Vieques.

The Eastern Maneuver Area occupies approximately 11,000 acres adjacent to and to the west of the AFWTF. Fleet Marine Force, Atlantic, conducts training for Marine amphibious units, battalion landing teams and combat engineering units on the Eastern Maneuver Area. On occasion, other allies having a presence in the Caribbean and the Puerto Rican National Guard also utilize the Eastern Maneuver Area.

Ammunition storage occurs at the Naval Ammunition Facility which occupies approximately 8,000 acres on the western tip of Vieques Island. Operated by the Weapons Department of the Naval Station Roosevelt Roads, its mission is to receive, store and issue all ordnance authorized by Naval Station Roosevelt Roads for support of the Atlantic Fleet units.

These three facilities constitute approximately 22,000 acres of the 33,000 acres of Vieques Island. The remainder of the island is owned by the Commonwealth of Puerto Rico or private individuals. The activities of the AFWTF, the Eastern Maneuver Area, and the Naval

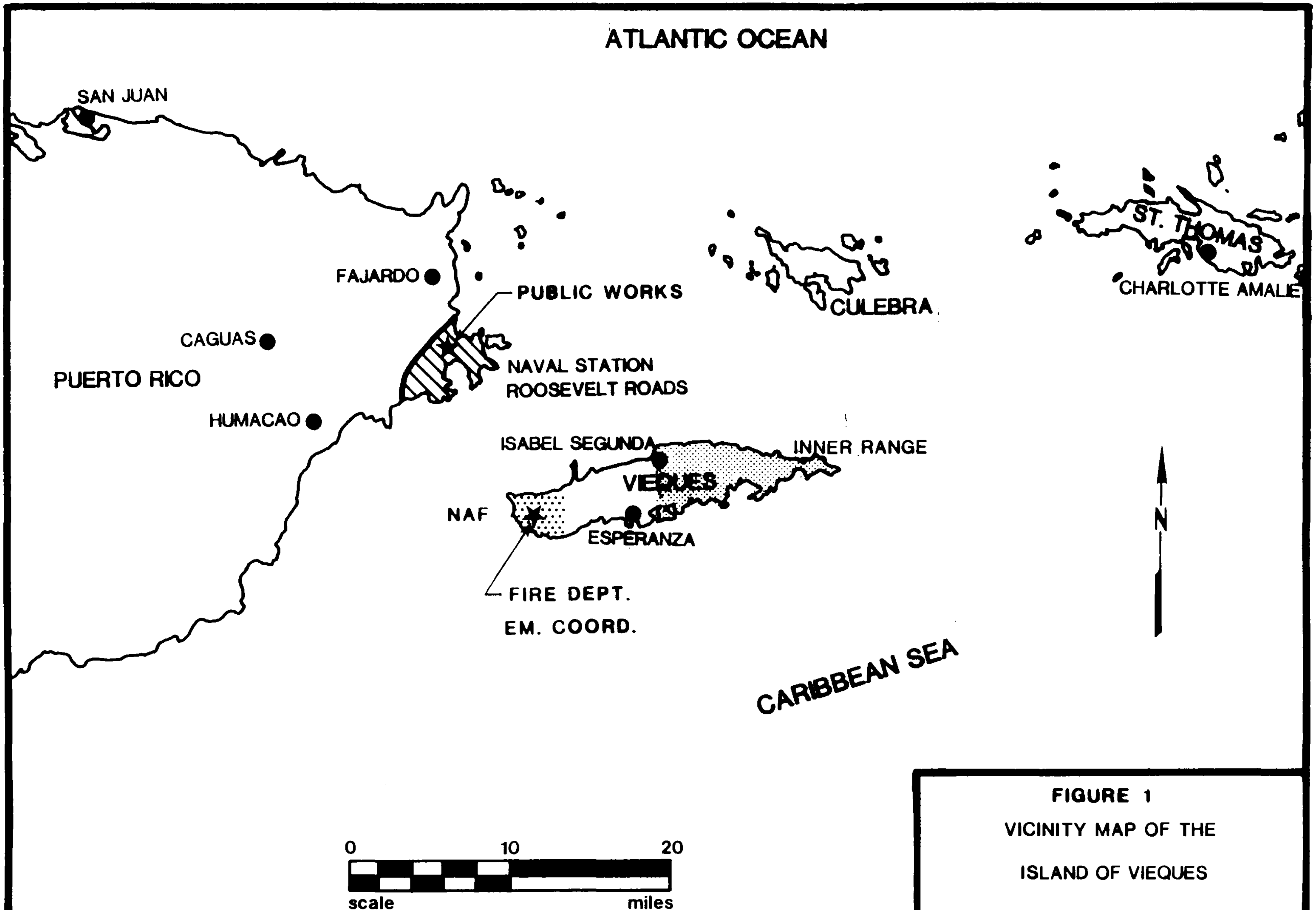


FIGURE 1

VICINITY MAP OF THE ISLAND OF VIEQUES

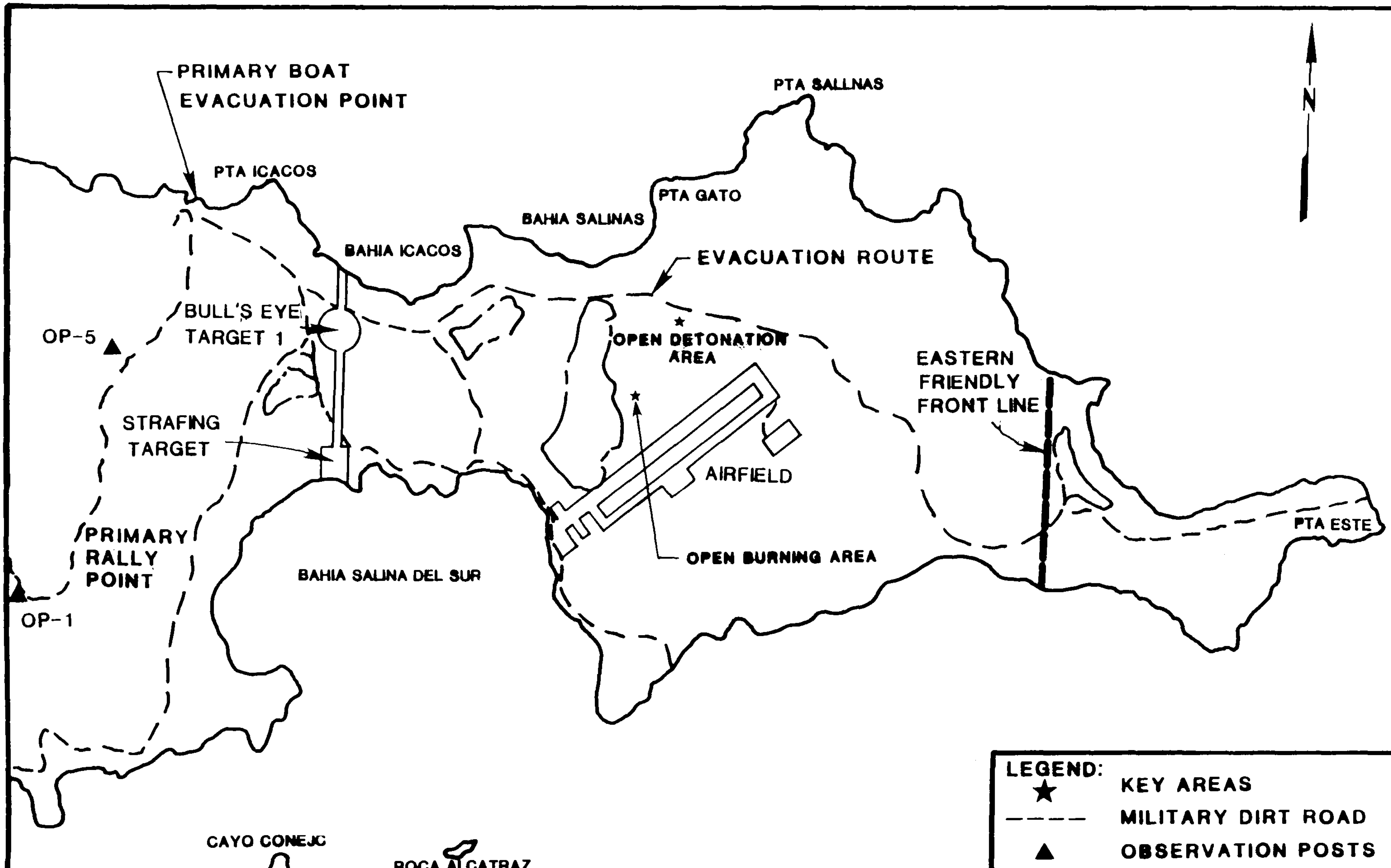


FIGURE 2
LAY-OUT OF AIR IMPACT AREA

Ammunition Facility function under the consolidated command of Commander Fleet Air Caribbean and Naval Forces Caribbean, whose headquarters are at Naval Station Roosevelt Roads. The commanding officer of AFWTF has jurisdiction over the scheduling of all naval exercises in the Inner Range.

This Contingency Plan presents procedures and equipment maintained by AFWTF Vieques for response to hazardous waste ordnance situations related to the treatment of reactive and toxic hazardous waste ordnance at the OB/OD treatment location and the entire Inner Range Air Impact Area.

Response to emergencies involving hazardous waste ordnance will be supervised by the Emergency Coordinator, who will have the ultimate authority and responsibility for the following actions:

- Determining if the emergency involves a spill of a hazardous substance reportable quantity (40 CFR 117).
- Assessing the immediate threat to human health and/or the environment beyond the boundaries of AFWTF Vieques.
- Determining when to initiate notification procedures to local, state, and/or federal agencies.
- Ensuring proper cleanup equipment and procedures are available and followed, respectively.
- Providing assistance, personnel, and equipment for spill response.

AFWTF Vieques units responsible for emergency response are identified in this Plan and include Explosive Ordnance Disposal (EOD) Detachment II, AFWTF Range Control, and AFWTF Security. Specific methods of response to spills, fires, and explosions and emergency and protective equipment are also described. Due to the facility location and restricted access, no arrangements with local civilian authorities exist.

This Contingency Plan shall be reviewed and immediately amended whenever any of the following occur:

- The facility permit is revised.
- The Plan fails in an emergency.
- The list of emergency coordinators changes.

- The list of emergency equipment changes.

- The treatment location and accumulation magazines design, construction, operation, maintenance, or other circumstances change to increase the potential for fires, explosions, or releases of hazardous waste ordnance or its constituents, or changes the response necessary in an emergency.

2-0 PURPOSE

The purpose of this document is to develop a written procedure for AFWTF Vieques emergency response units, listed herein, to follow during incident responses involving hazardous waste ordnance. This Contingency Plan explains the responsibilities of each unit responding to an emergency incident and lists each units emergency response equipment and equipment storage locations.

3-0 EMERGENCY COORDINATOR

In the event of an emergency at the open burning/open detonation facility, the discoverer (i.e. EOD Detachment II, AFWTF Range Control, or AFWTF Security personnel) should contact the following by radio and/or phone:

EMERGENCY COORDINATOR

Name:	Lt. Diaz Rolando	
Address:	Melendez S-33	
	Fajardo, Puerto Rico	
	Office telephone:	(809) 835-5230/5231
	Home telephone:	(809) 833-0629

ALTERNATE COORDINATOR

Name:	Lt. John Wack	
Address:	24 Monterrey	
	Ceiba, Puerto Rico	
	Office telephone:	(809) 835-5230/5231
	Home telephone:	(809) 865-0521

The Emergency Coordinator and the Alternate Coordinator may be reached using the office telephone number between 7 a.m. and 11 p.m. After 11 p.m. the Officer of the Day must contact the Emergency Coordinator (or Alternate Coordinator) at his home number.

The Emergency Coordinator(s) has authority to commit necessary AFWTF resources to implement the Contingency Plan and has been trained in emergency response. The authority to commit resources is delegated from the Commanding Officer.

In the event of an unplanned fire, explosion, and/or spill of hazardous waste ordnance, the person(s) responsible or familiar with the incident or hazardous waste ordnance, or discoverer, shall follow the release notification procedures in Section 5.1.

The Emergency Coordinator will make federal, state, local, and Navy-required official notifications, if necessary, after assessing the situation. The Emergency Coordinator will also notify the Commanding Officer and the Environmental Engineering Division Director at NAVSTA Roosevelt Roads. Emergency response and notification telephone numbers are presented in Table 1. EOD personnel act as the Emergency Response Team for incidents involving ordnance. AFWTF Police and Fire Department units cannot enter the AIA.

Table G-1
Emergency Telephone Listings

Organization	Listings
Public Works Department	809-865-4152
EOD Detachment, NAVSTA Roosevelt Roads	809-865-4316/4241
NAVSTA Roosevelt Roads Hospital	809-865-4133
NAVSTA Roosevelt Roads Emergency Room	809-865-3200
Environmental Engineering Div. Director	809-865-4429
COMFAIRCARIB[a]	809-865-4301
National Response Center	800-424-8802

Note:

[a] Commanding Officer Caribbean Air Forces

4-0 CONTINGENCY PLAN IMPLEMENTATION CRITERIA

4-1 Identification of Hazardous Waste

The Emergency Coordinator will determine the types of wastes involved or threatened in the emergency, the exact source, amount and aerial extent of released materials by reviewing the storage log and/or by observation if the area can be approached safely. Identification will be possible by use of Navy stock numbers (NSN) in conjunction with DoD form 1348-1 which will accompany each shipment and which identifies each material by description and NSN. Hazardous wastes treated at AFWTF Vieques include rejected munitions and munitions components.

4-2 Hazard Assessment

The Emergency Coordinator will determine whether the emergency poses a major threat sufficient to activate the Contingency Plan, considering the implementation requirements of this section. In particular, he must consider both direct and indirect effects of the release, fire, or explosion, including the possibility of toxic fumes and gases, contamination and runoff of fire fighting water, and exposures of nearby buildings/personnel.

The Contingency Plan must be implemented whenever a hazardous waste ordnance release results in the following:

(1) Fire/Explosion
- a. Fire causes release of toxic fumes.
- b. Fire spreads beyond area of ignition.
- c. Fire threatens offsite areas.
- d. Fire fighting agents result in contaminated runoff.
- e. Imminent threat of an explosion.

(2) Spills/Leaks
- a. Fire hazard exists due to spilled material.
- b. Toxic fume hazard exists.
- c. Groundwater may be threatened.
- d. Spill threatens offsite property.
- e. Spill threatens navigable water.

Additional guidance relating to fires and spills is contained in the following paragraphs.

Assessments by the Emergency Coordinator and the EOD Officer in Charge of an emergency incident involving hazardous waste ordnance may commence five and 30 minutes following a burn or detonation emergency, respectively.

4-3 Fire/Explosion

The Emergency Coordinator must be notified in the event of any fire. These notifications will be made via the AFWTF Range Control Officer or EOD Officer in Charge as discussed in Section 3.0. In the event of a fire at the open burning/open detonation facility, all personnel will evacuate to OP-1, the Primary Rally Point (See Figure 2), and await further instruction from the Emergency Coordinator. Fire control will be limited to extinguishing small grass fires within the Air Impact Area.

The open burning/open detonation area will be re-entered only after the Emergency Coordinator and the EOD Officer in Charge agree that the emergency situations have subsided (i.e. ordnance material removed and deactivated or placed in a manner to prevent unsudden release of energy) and have given an "all-clear" signal over the two-way radio to all groups involved in the treatment operation or potentially affected by the incident (including non-military personnel).

Vehicular fires involving transportation of hazardous waste explosives within the AFWTF Vieques Inner Range may require evacuation of the immediate and surrounding areas. The evacuation will be determined by the Emergency Coordinator and the EOD Officer in Charge and shall be dependent both on:

- Amount and type of waste exposed to the fire.
- Proximity to occupied buildings.

The evacuation may be as a far as one-half mile radius from the emergency incident event.

Should an explosion occur involving a hazardous waste ordnance, the Emergency Coordinator will determine the munitions involved in the explosion and review the Navy specifications for those munitions. The high explosive present in the largest quantity will be used as an indicator in determining the presence of contamination. This determination will be made using the analytical methods developed by DoD for military high explosives. Three grab soil samples will be collected from the crater of the explosion, composited to form one sample, and analyzed for the indicator explosive. In addition, three grab soil samples will be collected from the debris mound, composited to form one sample, and analyzed for the indicator explosive. Section C, Waste Characteristics, should be referred to for further information regarding analytical methods.

If none of the indicator explosive is detected, the soil will be considered uncontaminated and the site will be regraded and seeded.

If residues of the indicator explosive are detected, soil will be considered contaminated. One foot of soil will be excavated, containerized (metal containers) and transported to a permitted hazardous waste treatment, storage, or disposal facility. Following the excavation, a confirmation sample will be collected from the underlying soils and analyzed for the indicator explosive. If that sample is contaminated, an additional 1-foot soil layer will be excavated. The excavation and sampling will continue until uncontaminated soil is reached. After excavation has been completed, the site will be backfilled to original grade with uncontaminated soil and seeded.

4-4 Spills/Leaks

The most probable emergencies involving hazardous waste ordnance include:

- Spills or leaks caused by accidents during unloading of ordnance at the OB/OD treatment location, respectively.
- Spills or leaks as a result of a vehicular accident during ordnance transport within the AFWTF Inner Range.
- Spills or leaks of reactive powder, propellants, and/or explosives.

After notification of a spill, the Emergency Coordinator and EOD Officer in Charge will immediately assess the degree of hazard posed by the spill. This assessment will include the type of material spilled and the threat of fire or explosion. Based on this assessment, the Emergency Coordinator will initiate one or more of the following actions:

(1) If the dropped item(s) is shock-sensitive, he will request that the EOD Detachment II team handle spilled or dropped munitions.

(2) If the dropped item(s) is not shock-sensitive but falls further than the specified drop distance, he will request that an EOD Detachment II team handle spilled or dropped munitions.

(3) If the dropped item(s) is not shock-sensitive and has been dropped a distance which is less than the specified drop distance, EOD personnel will return item(s) to the transport vehicle or the storage facility.

Only EOD personnel adequately trained in safety procedures and the use of emergency equipment will respond to emergencies in the open burn/open detonation area. After the immediate emergency, the Emergency Coordinator will ensure that all equipment is cleaned, decontaminated, and re-stored for immediate use.

All hazardous waste ordnance transporting and unloading operations are conducted under the direct supervision of a trained EOD Technician. All EOD Technicians are trained in emergency response and are thoroughly familiar with all aspects of munitions handling. Therefore, a trained and qualified person will always be immediately available under the most probable spill scenarios.

The OB/OD treatment location does not perform thermal treatment on liquid hazardous waste. Therefore, if a hazardous waste ordnance spill or release did occur, it would not be of liquid phase. Most likely, the spilled or released material (black powder or similar reactive solid material) would require dry removal, along with the removal of the top 1 foot of soil with the use of a scoop or shovel if contamination was discovered following laboratory analysis. Spill and release material shall be containerized, when applicable, and directly transported to the OB/OD treatment location for immediate treatment.

In the event of an accident in which the hazardous waste ordnance material cannot be successfully removed from the accident location, the material will be thermally treated in place assuming the spill has occurred at the OB/OD treatment area. If a spill occurs outside the OB/OD treatment area, the spill material will be remediated under the direct supervision of an EOD Technician thoroughly trained in the safe removal and treatment of explosive material. All EOD personnel involved in the operation must be properly certified per the EOD Mobile Unit Detachment Unit II qualification/certification program. After the spilled hazardous waste ordnance has been removed, the material, depending on its properties, may be washed down with water to render any residue inert. This activity will be accomplished by EOD Detachment II personnel under the direct supervision of the Emergency Coordinator and EOD Officer in Charge and shall be implemented only when the material would not be considered a hazardous waste. If the material would be considered a hazardous waste, it shall be contained following wash-down procedures.

5-0 CONTINGENCY PLAN IMPLEMENTATION

In the event a release of hazardous waste ordnance (leak, spill, fire, etc.) occurs during transportation, unloading, or treatment, the following procedure must be initiated by personnel responsible for the ordnance at the time of the release.

5-1 Initial Release Notification

Personnel in custody of hazardous waste ordnance during a release incident must immediately notify the AFWTF Vieques Emergency Coordinator or his Alternate. Notification to the Emergency Coordinator must include the following information:

(1) Location of accident.
(2) Hazardous waste/unserviceable ordnance name and/or type released.
(3) Amount and size of release.

(4) Type of release (leak, spill, fire, etc.).
(5) Hazard properties of the hazardous waste/unserviceable ordnance (toxic, reactive, etc.).

Additional information shall be communicated to the Emergency Coordinator and responding unit(s), upon their arrival, by those persons familiar with the incident and/or the hazardous waste ordnance materials involved. Incident responsible persons, unless requiring immediate medical attention, shall not leave the incident scene until response persons arrive to ensure communication of relevant incident information.

If the Emergency Coordinator determines that the facility has had a release, fire, or explosion which could threaten human health or the environment outside the facility, he must report his findings as follows:

(1) If his assessment indicates that evacuation of local areas may be advisable, he must immediately notify appropriate local authorities. He must be available to help appropriate officials decide whether local areas should be evacuated.

(2) He must immediately notify the National Response Center (using their 24-hour toll free number 800/424-8802). This report must include:

a. Name and telephone number of reporter.
b. Name and address of facility.
c. Time and type of incident (e.g., release, fire).
d. Name and quantity of material(s) involved, to the extent known.
e. The extent of injuries, if any.
f. The possible hazards to human health or the environment outside the facility.

(3) He must notify the Regional Administrator and appropriate state and local authorities before operations are resumed in the affected areas of AFWTF Vieques that waste incompatible with the released material will not be treated, stored, or disposed of until remediation procedures are completed and all emergency equipment listed herein is cleaned and fit for its intended purpose. At this point, operations maybe resumed.

5-2 Release Response

After being notified of a hazardous waste ordnance release, the Emergency Coordinator shall proceed to the incident scene. Upon arriving at the incident scene, EOD personnel, under the direction of the Emergency Coordinator, will establish a command post while trying to obtain additional information from those persons involved or familiar with the incident. Once the Emergency Coordinator has collected all information relevant to the release, he will assess, with assistance from EOD and Range Control personnel, the possible direct and indirect human health and/or environmental hazards that may, or may have, resulted from the incident.

Depending on the location and size of the incident, the Emergency Coordinator may summon the assistance of AFWTF Security to aid in evacuation procedures of military and non-military personnel.

5-3 EOD Response Coordination

Upon determining the nature of the incident, EOD personnel will *control and contain* the release under the guidance of the Emergency Coordinator and the EOD Officer in Charge. Control and contain includes:

(1) Rescuing injured personnel.
(2) Establishing *Hazard* and *Evacuation* zones.
(3) Applying water to fires.
(4) Establishing berms around spill material.
(5) Evacuating surrounding populations.

Control and contain does not include handling or removing hazardous waste ordnance spill contents or residue.

5-4 Hazardous Waste Ordnance Incident Removal Operations

EOD personnel are responsible for removal of hazardous waste ordnance from the incident scene under the direction of the Emergency Coordinator and the EOD Officer in Charge. Removal operations involving hazardous waste ordnance are divided into two areas: emergency and non-emergency. Both removal actions are conducted by EOD Detachment II.

Emergency Removal Operations

Emergency removal operations are required when situations involving hazardous waste ordnance present, or may present, a serious hazard to those persons responsible for implementing non-emergency removal operations (i.e. use of shovel, rake, hands, etc.). Only EOD personnel will undertake emergency removal operations. Upon completion of emergency removal operations, EOD personnel shall inform the Emergency Coordinator that conditions are safe for non-emergency removal operations to commence. All evacuated soils and debris will be stored at the unit until sampled and analyzed per the facility Waste Analysis Plan. Should the materials be classified as a hazardous waste, the wastes will be shipped to a permitted hazardous waste treatment/disposal facility for appropriate disposition.

Non-Emergency Removal Operations

Non-emergency removal operations of hazardous waste ordnance are also handled by EOD Technicians. EOD Technicians shall commence non-emergency removal operations (1) after the

EOD Officer in Charge has surveyed the area and determined it safe for entry, and (2) after the Emergency Coordinator authorizes EOD Technicians to begin non-emergency removal operations. Non-emergency removal operations may include ordnance repackaging, scrap removal, sweeping, shoveling, raking, etc. All evacuated soils and debris will be stored at the unit until sampled and analyzed per the facility Waste Analysis Plan. Should the materials be classified as a hazardous waste, the wastes will be shipped to a permitted hazardous waste treatment/disposal facility for appropriate disposition.

5-5 Evacuation Procedures

Since the OB/OD units are in a bombing area (Inner Range Air Impact Area), the area is already evacuated except for military personnel authorized by the AFWTF Range Control Officer. The area is also under constant surveillance from the observation tower at OP-1 (Figure 2).

The Emergency Coordinator and the EOD Officer in Charge are responsible for determining whether evacuations are necessary in the event of an emergency. If an evacuation is necessary, the signal will be transmitted by two-way radio, by voice command, and/or by common hand signals familiar to ATWTF personnel. Further, the Emergency Coordinator will relay any information which will identify the preferred evacuation route. No alarm systems are present at the AIA due to the routine bombing activities.

The primary rally point will be the observation tower command post OP-1 (Figure 2) via the preferred road (shown in Figure 2) route established by the Emergency Coordinator. If the island is to be evacuated, the rally point for departure by boat will be PTA Icacos (Figure 2). To ensure that all personnel have evacuated the area, security personnel will assist by searching the area.

An evacuation of all personnel in the vicinity of an emergency must be made when toxic fumes or gases are released (or a release is imminent), an explosion has occurred (or is imminent), and/or access for emergency responders must be provided.

If the Emergency Coordinator determines it necessary to evacuate non-essential personnel from areas of AFWTF Vieques following a hazardous waste ordnance incident, communication of evacuation orders/procedures will be by voice or radio:

In all instances, emergency personnel will alert respective persons of the reason to evacuate and where. Evacuation routes will depend on wind direction and the location of the incident. It will be the responsibility of the Emergency Coordinator and the EOD Officer in Charge to determine the best evacuation route following an incident resulting in an emergency. At the time of evacuation, all personnel will be directed where to evacuate. Evacuation assembly areas will be staffed by medical personnel (NAVSTA Hospital EMTs and Physicians) to attend to those persons exposed to potentially dangerous materials. Emergency backup transportation is maintained in the OP-1 area during all OB/OD treatment operations to ensure adequate removal of personnel from the treatment area following an emergency incident. An emergency helicopter is also on call to transport personnel requiring immediate medical attention.

5-6 Decontamination Procedures

Three types of decontamination procedures may be required during hazardous waste ordnance removal operations:

(1) Site.
(2) Equipment.
(3) Personnel.

Site and equipment decontamination procedures during and following removal operations may include the removal and containerizing of spilled hazardous waste ordnance from the environment and emergency and personal protective equipment (PPE). All personal protective and emergency equipment is decontaminated at the incident scene and then transported from the scene to storage locations. Appropriate decontamination procedures are described in Section I of this application.

The final type of decontamination involves persons injured during the incident or while participating in the removal operations. As required by NAVSTA Hospital Roosevelt Roads, chemically contaminated injured persons requiring medical attention must be decontaminated by trained personnel, at the site before transporting to the hospital.

5-7 Incident Investigation

At the conclusion of all incident responses or near-misses involving hazardous waste ordnance, the party responsible for the ordnance at the time of the incident must immediately notify the Public Works Department. Notification shall include all information required by the Emergency Coordinator in Section 5.1, and should also include all actions leading to the incident. Responsibilities of the Public Works Departments are limited to hazardous waste ordnance releases or near-miss investigations into the incident's cause and future prevention. Public Works will not be directly involved in emergency response activities.

The duration of investigations will vary depending on factors such as location and accessibility, EOD availability, complexity of the incident, etc. However, the investigation will be completed in as timely a manner as possible.

5-8 Post-Release Notification

In addition to the initial verbal notification to be initiated by the Emergency Coordinator to the National Response Center (See Section 5.1), a written followup report must also be prepared. As required per 40 CFR 264.56(j), all emergencies which require the implementation of the Contingency Plan will be reported in writing within 15 days to the Administrator, EPA Region II and the Environmental Quality Board (EQB) of the Commonwealth of Puerto Rico. The report will detail:

(1) Name, address, and telephone number of the facility.
(2) Name, address, and telephone number of facility owner/operator.
(3) Date, time, and type of incident.
(4) Type and quantity of material involved.
(5) Assessment of the impact on human health and the environment.
(6) Quantity and disposition of material released.

5-9 Prevention of Recurrence or Spread of Fires, Explosions, or Releases

To avoid the spread of fires and explosions during the transportation, unloading, and treatment of hazardous waste ordnance, all EOD Technicians are adequately trained in the specifics of the above phases of hazardous waste ordnance treatment.

EOD Technicians utilize detailed SOPs to avoid an emergency incident during the process of preparing for hazardous waste treatment operations. These SOPs include items such as:

(1) Segregating components of ordnance on separate transport vehicles to avoid having incompatibilities during transport.

(2) Properly packaging ordnance for transportation according to DOT and Navy regulations including tying all packagings to the transport vehicle.

(3) Unloading operations utilize mechanical devices (i.e. forklift).

(4) Emergency equipment easily accessible to treatment operations.

NAVSEA OP5, Volume 1, 5th Revision is utilized to ensure adequate safety procedures are always employed to prevent recurrence of fires, explosions, or releases.

5-10 Storage and Treatment of Released Material

The Emergency Coordinator will order all spilled material, cleanup debris, and contaminated soil to be containerized and stored for later treatment and/or disposal. Munitions components will be detonated at the AFWTF open detonation area. The area is policed upon re-entry of the area for unexploded ordnance and reactive materials. This occurs as soon as it is safe to re-enter the OB/OD area, based upon established DoD criteria. All excavated soils and debris will be stored at the unit until sampled and analyzed to determine its status as a hazardous waste. Any materials which are determined to be hazardous wastes are shipped offsite to a permitted hazardous waste TSD facility for proper disposition.

5-11 Incompatible Wastes

Although compatibility between ordnance is not a problem, ordnance compatibility with other chemical or physical materials may be. EOD personnel under the direction of EOD Officer in Charge and the Emergency Coordinator will ensure that released material, incompatible with other waste, is segregated during temporary storage and that incompatible wastes are not accidentally mixed during cleanup actions. Remediated spill residues and the containers in which they are placed shall be segregated according to compatibility groups at the scene of the incident to avoid further problems. The Emergency Coordinator, with assistance from the EOD Technician, shall coordinate temporary container staging areas, prior to transport from the incident scene.

5-12 Post-Emergency Equipment Maintenance

After an emergency event, all emergency equipment will be cleaned so that it is suitable for reuse or it will be replaced. Equipment used to excavate explosives-contaminated soil will be cleaned by scraping and/or brushing solids from the blades and tires which contacted the contaminated soil. The scrapings will be handled and disposed of as hazardous waste. Before operations are resumed, an inspection of all safety equipment will be conducted by persons to whom the equipment belongs. The Emergency Coordinator, or his designee, shall notify EQB authorities that post-emergency equipment maintenance has been performed and that treatment operations will be resumed.

6-0 EMERGENCY AND PERSONAL PROTECTIVE EQUIPMENT

Responding to emergency releases of hazardous waste requires the skills of many different response units. Each response unit has specific equipment which may be used during an emergency response incident. All emergency response equipment shall be maintained in working condition at all times or immediately replaced with working equipment of identical function.

Table G-2 is a list of emergency response equipment maintained by EOD. Emergency response equipment includes PPE, monitoring equipment, communication equipment, decontamination equipment, manual equipment (shovels, rakes, brooms, etc.), and fire-fighting equipment. All emergency equipment, following use, is properly decontaminated and removed from the OB/OD

Table G-2
Emergency Response Equipment

Shovel	(2 each)
E-Tool	(2 each)
Pick Ax	(2 each)
Screwdriver, Flat Tip	(2 each)
Wrench, Crescent 12 Inch	(2 each)
Pliers	(2 each)
Hammer, Claw	(1 each)
Pry Bar	(2 each)
Band Cutters	(1 each)
MK 663	(2 each)
Binoculars	(1 each)
Camera, Polaroid W/Film	(1 each)
Tape, Electrical	(12 rolls)
Tape, Survey Red/Yellow	(1 case/color)
Paint, Fluorescent Int Orange	(2 cases)
Water Cooler, 5 gallon	(1 each)
Personal Demo Equipment: Knife, MK3 Knife, Folding Pliers, Linemen's Crimpers Canteen Sun Screen Mini Mag Light	(Per Individual)
SAFETY EQUIPMENT PER VEHICLE	
First Aid Kit, Large	
Fire Blanket	
Dry Chemical Fire Extinguisher	

treatment area or Inner Range. No emergency equipment is left at the units during ordnance training activities.

7-0 COORDINATION AGREEMENTS

The AFWTF Vieques Contingency Plan will be distributed to and coordinated with the NAVSTA Roosevelt Roads Hospital, NAVSTA Roosevelt Roads Environmental Engineering Division Director, and the NAVSTA Roosevelt Roads EOD Detachment. Emergency units from offbase are not expected to respond to hazardous waste emergencies at AFWTF Vieques. Local offsite emergency response groups are not prepared to handle emergencies involving munitions at Vieques but will receive a copy of this Plan and shall be informed in the event migration of an emergency incident occurs within populated areas requiring evacuation.

Local civilian police authorities are not allowed access to the AIA for both safety and security reasons. EOD personnel serve as emergency response personnel and have been provided with copies of the contingency plan. Should evacuation of personnel from the AIA in emergency situations be required, helicopter medivac units would be utilized.

8-0 REQUIRED REPORTS

In addition to the verbal notifications to be initiated by the Emergency Coordinator, written followup reports will be prepared as stated within Section 5.8 of this Plan.

The time, date and details of any incident that requires implementation of the Contingency Plan will also be noted in the operating record. After an emergency, the Emergency Coordinator will review the Contingency Plan for effectiveness and make changes as appropriate.

9-0 TRAINING

All EOD Technicians receive training in the proper handling, transportation, and treatment of military ordnance. (See Section H) This training provides each individual with the knowledge required to determine the hazard state, if present, of a military ordnance and treat a hazardous waste ordnance using the proper OB/OD method.

AFWTF Vieques requires all individuals (EOD Technicians) involved in the OB/OD treatment operation to receive annual training in the OB/OD of hazardous waste ordnance. Those individuals not receiving training on a particular ordnance are prohibited from participating in permitted OB/OD treatment activities involving the particular ordnance until training is received. Section H outlines the initial training requirements of all EOD Technicians and establishes the training required for EOD Technicians to maintain permitted OB/OD training certification. Training records for EOD personnel involved in hazardous waste ordnance OB/OD treatment operations are maintained by their respective commands.

SECTION H

PERSONNEL TRAINING

The following section details the training programs required for personnel at AFWTF Vieques that handle explosive hazardous wastes as required by 40 CFR 270.14(b)(12) and 40 CFR 264.16.

H-1 OUTLINE OF TRAINING PROGRAM

The EOD personnel must successfully complete the training for explosives handling personnel which is conducted at Indian Head Maryland and is a joint effort by the U.S. Navy, Army, and Air Force. This training class is specifically designed to train personnel in all phases of explosives handling and destruction operations. The course is one year in length.

The course teaches EOD personnel ordnance chemistry, ordnance terminology, the mechanisms for detonating propellants, explosives and projectiles (PEP), how to safely detonate PEP, how to safely defuse or detonate ordnance in emergency situations, and how to conduct open burning and open detonation of waste ordnance per military procedures. Further, all hazardous waste personnel have received appropriate hazardous waste handling training per OSHA/RCRA regulations.

In addition, an annual qualification/certification program is conducted for EOD Detachment II personnel. A copy of the COMNAVSURFLANT qual/cert program and the EOD Detachment II qual/cert program are included in Appendices H-1 and H-2. These programs describe the explosive ordnance family types, annual training procedures, certification procedures and board member requirements, etc. Monthly training on individual ordnance types is also performed to maintain familiarity with procedures, explosive characteristics, etc.

Annual and monthly training is conducted via hands-on training, using both live and inert ordnance, and in a classroom or lecture format, in which training aids such as mock-ups, pictures, manuals, exploded views, films, etc. are used.

Appendices H-1 and H-2 provide a much more detailed description of the qual/cert and training programs.

H-2 JOB TITLES AND DESCRIPTION

The following personnel have responsibilities for open burning/open detonation operations. Note that military personnel change installation location assignments continually, and therefore, the names below are subject to frequent change. A full and current list can be obtained by EPA or EQB upon request at any future date by making a request to the Officer in Charge of EOD at NAVSTA Roosevelt Roads.

Name:	Jose F. Santana
Rank:	LT
Job Title:	Officer In Charge, EOD Detachment Roosevelt Roads
Job Description:	Qualified EOD Technician responsible for detection, identification, rendering safe, evaluation and disposal of the entire spectrum of explosive ordnance — both foreign and domestic — nuclear weapons, chemical munitions and biological agents.
Training:	Naval School, Explosive Ordnance Disposal, Indian Head, Maryland, 52—week course

Name:	Dewey W. Thedford
Rank:	WTCM
Job Title:	Assistant Officer in Charge
Job Description:	Qualifies EOD Technician responsible for detection, identification, rendering safe, evaluation and disposal of the entire spectrum of explosive ordnance - both foreign and domestic - nuclear weapons, chemical munitions and biological agents.
Training:	Naval School, Explosive Ordnance Disposal, Indian Head, Maryland, 52—week course

Name:	Clifton R. Ancelet
Rank:	TMCS
Job Title:	Leading Chief Petty Officer
Job Description:	Qualified EOD Technician responsible for detection, identification, rendering safe, evaluation and disposal of the entire spectrum of explosive ordnance — both foreign and domestic — nuclear weapons, chemical munitions and biological agents.
Training:	Naval School, Explosive Ordnance Disposal, Indian Head, Maryland, 52—week course

Name: Todd L. Enders
Rank: GMG1
Job Title: Leading Petty Officer
Job Description: Qualified EOD Technician responsible for detection, identification, rendering safe, evaluation and disposal of the entire spectrum of explosive ordnance — both foreign and domestic — nuclear weapons, chemical munitions and biological agents.
Training: Naval School, Explosive Ordnance Disposal, Indian Head, Maryland, 52—week course

Name: Christopher M. Ritacco
Rank: GMG1
Job Title: Supply Petty Officer
Job Description: Qualified EOD Technician responsible for detection, identification, rendering safe, evaluation and disposal of the entire spectrum of explosive ordnance — both foreign and domestic — nuclear weapons, chemical munitions and biological agents.
Training: Naval School, Explosive Ordnance Disposal, Indian Head, Maryland, 52—week course

Name: James R. Wilder
Rank: BM2
Job Title: Administrative Petty Officer
Job Description: Qualified EOD Assistant Technician responsible for detection, identification, rendering safe, evaluation and disposal of the entire spectrum of explosive ordnance — both foreign and domestic — nuclear weapons, chemical munitions and biological agents.
Training: Naval School, Explosive Ordnance Disposal, Eglin, Florida, 26—week course

Name: Brian M. Coleson
Rank: AO2
Job Title: Supply Petty Officer
Job Description: Qualified EOD Assistant Technician responsible for detection, identification, rendering safe, evaluation and disposal of the entire spectrum of explosive ordnance — both foreign and domestic — nuclear weapons, chemical munitions and biological agents.
Training: Naval School, Explosive Ordnance Disposal, Eglin, Florida, 26—week course

Name:	James D. Adams
Rank:	OS3
Job Title:	EOD Assistant Technician
Job Description:	Qualified EOD Assistant Technician responsible for detection, identification, rendering safe, evaluation and disposal of the entire spectrum of explosive ordnance — both foreign and domestic — nuclear weapons, chemical munitions and biological agents.
Training:	Naval School, Explosive Ordnance Disposal, Eglin, Florida, 26—week course

H-3 MONTHLY TRAINING CONTENT

The hazardous waste training program for facility personnel consists of onsite treatment instruction, as well as classroom instruction. This supplements the 52-week EOD training courses taken by all EOD Technicians. In addition, all personnel involved in handling and treatment operations shall be fully capable of performing the following operations:

1. Be able to identify, assemble, disassemble, prepare, and successfully use all tool sets in each of their inherent modes.

2. Be able to identify, render safe, recover and dispose of all conventional ordnance.

3. Be able to perform the procedures to safely remove any AEH's involving ejection systems.

4. Know all the procedures to follow in fragmentation, identification and ordnance exploitation.

5. Be familiar with all of the current trends in and countermeasure improvised explosive devices (IEDs).

6. Be able to successfully identify, decontaminate, render safe, package, and dispose of chemical munitions and be able to detect, neutralize, decontaminate and dispose of chemical agents.

7. Be able to identify, render safe and package components of all weapons utilized by the United States Army and be familiar with all special weapons utilized by other services.

8. Be able to perform all administrative and logistical tasks inherent to the AFWTF mission.

9. Be able to handle emergency situations involving explosive ordnance, including fires, unplanned detonations, and other mishaps.

10. Be knowledgeable of all standard communications equipment, hand signals, terminology, evacuation procedures, and emergency and monitoring equipment and procedures.

Since all materials treated at the OB and OD facilities, no groundwater incident training is included in the EOD training program. Any spills or leaks are in a solid form which is cleaned up immediately such that the probability of groundwater contamination is minimal. Further information concerning groundwater issues are addressed in Section L.

H-4 TRAINING DIRECTOR

All training is conducted under the direct supervision of a person knowledgeable in all aspects of hazardous waste management activities pertinent to operations at the open burning/open detonation unit. The EOD training school in Indian Head, Maryland, is considered the best such facility in the world. In addition, the personal qualification/certification program includes requirements for a Qual/Cert Board to ensure that personnel are fully qualified to perform EOD duties, observe and evaluate proficiency, review existing and proposed training plans, review minor and major explosive device safety infractions, and make recommendations for corrective action whenever appropriate.

H-5 IMPLEMENTATION OF THE TRAINING PROGRAM

All new personnel will complete the 52-week training program prior to becoming an EOD Technician. Training will continue monthly at a minimum. All personnel must complete the qualification/certification program annually.

Training records are currently kept in each employee's personnel file. These include records of formal schools completed, classroom type lectures received, on-the-job training accomplished, and a record of all completed Personal Qualification Standards (PQS). Individual's training records are transferred with him/her to prevent retraining with like explosive devices by subsequent commands. The EOD OIC shall be responsible for maintaining training records. In addition, training records shall be kept for a minimum of three years for all personnel involved in treatment operations OP-1, the closest structure to the OB/OD facility. Sample copies of training records are included in Appendix H-3.

APPENDIX H-1

COMNAVSURFLANT/COMNAVSURFPAC EXPLOSIVES HANDLING QUALIFICATION AND CERTIFICATION PROGRAM

DEPARTMENT OF THE NAVY
Commander, Naval Surface Force
United States Atlantic Fleet
Norfolk, Virginia 23511-6292
AND
Commander, Naval Surface Force
United States Pacific Fleet
San Diego, California 92155-5035

COMNAVSURFLANTINST 8023.4F/
COMNAVSURFPACINST 8023.5B
N57
03 July 1991

COMNAVSURFLANT INSTRUCTION 8023.4F/COMNAVSURFPAC INSTRUCTION 8023.5B

Subj: EXPLOSIVES HANDLING PERSONNEL QUALIFICATION AND CERTIFICATION (QUAL/CERT) PROGRAM

Ref: (a) OPNAVINST 8023.2C
(b) CINCLANTFLT/CINCPACFLTINST 8023.5A
(c) OPNAVINST 3591.1B
(d) OPNAVINST 5102.1C
(e) NAVEDTRA 43202B
(f) NAVEDTRA 10061-AR

Encl: (1) Families of Explosive Devices
(2) Work Task Code Definitions
(3) Certification Level Qualification Standards
(4) Record of Certification
(5) OJT/Professional training record sheet (A
(6) Qual/Cert program checklist (A

1. **Purpose**. To establish and maintain a standard Qualification/Certification program within NAVSURFLANT and NAVSURFPAC per references (a) and (b).

2. **Cancellation**. COMNAVSURFLANTINST 8023.4E/COMNAVSURFPACINST 8023.5A. (R

3. **Background**. Improper processing, handling, loading, or testing of explosive devices have caused mishaps which resulted in injury, loss of life, or damage to property, as well as causing reduced operational effectiveness of both fleet and shore activities. A major source of mishaps with explosive devices has been shown by investigations to be personnel error. Analysis of mishaps clearly caused by personnel error indicates that the following reasons are most commonly encountered:

a. Lack of effective use of available training or lack of knowledge on the part of individuals and teams who handle explosive devices.

b. Lack of necessary and effective leadership and supervision by supervisory personnel (both military and civilian) directly responsible for operations involving explosive devices, both ashore and afloat.

c. High tempo operations, during which explosive safety can be degraded as a result of fatigue, short cuts or complacency stemming from rapid, repeated, and often monotonous tasks.

d. During certain evolutions, the temporary assignment of personnel to perform ordnance related tasks for which they are not specifically qualified.

e. Failure to follow or maintain current, standard operating procedures (SOP) which have been established for specific evolutions involving explosive devices.

4. **Scope**

a. Applicability. The provisions of this instruction apply to:

(1) All military, civilian, and contractor personnel who in the course of their duties are required to perform an operation involving any explosive device defined in enclosure (1).

R) (2) All operators of explosive tools and line cutters using cartridges as a propelling charge.

(3) See paragraph 5a(1)(a) through 5a(1)(c) below for further detailed description.

b. Non-Applicability. The following personnel are exempt from the provisions of this instruction:

(1) U.S. Marine Corps Air Combat element personnel embarked on NAVSURFLANT/NAVSURFPAC ships when qualified and certified by MCO 8023.2. U.S. Marine Corps personnel permanently assigned to a Naval activity will be qualified and certified under the provisions of this instruction.

(2) Composite Helicopter and Helicopter Anti-Submarine (Light) squadron detachments embarked on NAVSURFLANT/NAVSURFPAC ships when qualified and certified by COMNAVAIRLANT/COMNAVAIRPAC directives.

(3) Explosive Ordnance Disposal (EOD) personnel only for those explosive devices employed in their specialized mission areas and for which formal training has been successfully completed.

(4) Personnel required to bear small arms in the course of their duties when qualified by reference (c). Other weapons not covered by reference (c) and required for ship's self-defense including .50 caliber gun crews shall be qualified and certified according to this instruction.

(5) Lookouts and other underway watches required to handle, prepare and launch marine markers or fire signaling devices. They must have received thorough indoctrination and completed the appropriate fundamental section of reference (e) on the markers, pyrotechnic pistol/projector and signals. Training shall be conducted by an individual who has been qualified and certified to the minimum certification level of TL for the device and work task area per the provisions of this instruction.

(6) Personnel whose sole contact with explosives is when assigned to a working party to supplement other qualified and certified personnel such as ammunition onload, off-load, or replenishment. When non-certified personnel are used for working parties, the Officer in Charge of the evolution shall provide all working party personnel with a thorough safety brief before the start of the operation and assign working party personnel to the direct and constant supervision of an individual qualified and certified to the minimum certification level of TL for the explosive device and operation per this instruction. Non-certified working party personnel shall be prohibited from handling any type of explosive device except under the direct and constant supervision of the assigned supervisor.

(7) Personnel who conduct tests or inspections of magazine sprinkler systems provided they have been qualified and certified by other means; i.e., PQS or satisfactory completion of an approved course of instruction. (R

(8) Aircrew personnel whose only association with explosive devices is during logistics transport by aircraft and the delivery/handling of ordnance in flight. They must, however, have received appropriate training for these duties. Aircrew personnel who use personal survival devices (pen flares, distress signals, etc.) and who have previously trained in the use of these devices. (A

5. **Qual/Cert Program and Procedures**. The intent of the Qual/Cert program is to make sure that before performing any task involving any explosive device, each person within the scope of this instruction is qualified and formally certified by the command to which assigned as having satisfactorily demonstrated the qualifications to properly and safely perform all required functions and tasks involving the explosive device. The certification process consists of first achieving the qualifications for the explosive device and work task to be accomplished, a recommendation to the Certification Board by the division officer that the individual is qualified in all respects and ready for certification, and finally, a formal determination for final certification by the Certification Board.

a. Qualification

(1) Personnel requiring qualification and certification. In addition to and in amplification of paragraph 4, the following personnel require qualification and certification:

R) (a) Personnel, including Explosives Ordnance Disposal (EOD) when involved in non-mission related functions, whose duties require that they individually handle, inspect, package, unpack, assemble, disassemble, test, fuze, load or download, stow, arm, or de-arm explosive devices shall be qualified and certified for such tasks. Also requiring qualification and certification are personnel assigned as safety observers for explosive operations and those personnel who inspect explosive operations/system repairs for quality assurance purposes. Supervisors of explosive operations and members of the command appointed certification boards shall also be certified to the equivalent certification level or higher for the evolutions which they may supervise or observe for certification purposes. The only exception to this provision is that supervisors of explosives handling teams involved in handling explosives/hazardous materials with power-operated handling equipment need not themselves be qualified as operators. The supervisor must, however, be certified as a supervisor for the explosive operation being conducted.

R) **NOTE**: For the purposes of clarification, powered mobile handling equipment includes, but is not limited to, the following: electric/diesel forklifts, pallet transporters, and electric pallet trucks. Powered non-mobile handling equipment includes, but is not limited to, the following: underway replenishment hoists and winches, ship's installed hoists and cranes, floating cranes, weapons/cargo elevators, package conveyers, and pallet conveyers.

R) 1 Powered Mobile Handling Equipment (MHE). Basic qualifications shall be achieved through classroom and on-the-job training. Licensing shall be according to NAVSEA OP 4098. If formal classroom training for licensing is not available, commanding officers may develop and implement an on board training program as an alternative. A government driver's license (SF46) and a physical examination by a doctor are required instead of qualification/certification under the provisions of this instruction.

NOTE: Personnel shall be qualified/certified for Handling the ammunition involved.

R) 2 Powered Non-Mobile Equipment. Operators shall be qualified and certified as "Equipment Operators" as well as "Handling and/or Stowage" for the ammunition involved. Training records will reflect training on the equipment with the associated ordnance materials.

3 Transporting. For over-the-road vehicles used for transporting and/or handling explosives, operators must be trained and licensed according to NAVSEA OP 2239 before certification per this instruction.

(b) Contractor personnel performing functions within the scope of this instruction at a Naval activity must demonstrate their proficiency and qualification/certification before performing such functions. Commanding officers shall make sure that all contracts, when issued and/or renewed, dealing with explosives and explosive operations will have as one of the contract's provisions that personnel used for explosive-type operations must be qualified and certified per the provisions of this instruction. The contractor must provide the Commanding Officer with documentation to verify the qualification and certification of his/her personnel.

(c) Families of explosives are defined in enclosure (1). Work task codes are defined in enclosure (2). Certification level qualification standards are defined in enclosure (3). The record of certification to be used is shown in enclosure (4).

(2) Qualification skills incident to certification are achieved through a variety of training mediums including formal schools, locally prepared lesson guides, on-the-job training, and Personnel Qualification Standards (PQS). Training requirements and procedures are discussed in Paragraph 5c below.

(3) Personnel must be knowledgeable with respect to all types of explosive devices with which they may be required to work. Accordingly, qualification will be necessary for each separate operation and each explosive device not in the same family type as outlined in enclosures (1) and (2).

(4) Qualification of personnel shall be at the following levels: <u>Team Member (TM)</u>, <u>Individual/Team Leader (I/TL)</u>, <u>Quality Assurance (QA)</u>, or <u>Safety Observer</u> as defined in enclosure (3). (R

NOTE: Only TM, I/TL and QA are interrelated and only the higher level need be annotated on the qualification/certification form (the qualifications of the lower is incorporated into the higher when assigned).

(5) To prevent the necessity for qualification on every type of bomb, missile, projectile, mine, flare, etc., and the several types of guns and devices from which these weapons may be launched, and in consideration of the multitude of weapon fuzings and loading configurations that are possible, explosive devices are segregated into representative "family types." When doubt exists as to the association of an item with a family of devices, the item should be considered a separate family and qualification and certification action performed accordingly. The use of family groupings shall be understood to encompass only evolutions of a general nature; i.e., stowage and handling. Family groups shall be reduced to specific items whenever the operations include testing, assembly/disassembly, arming/de-arming or loading/downloading of explosive devices. Families and specific items of explosive devices are listed in enclosure (1). When family groupings are used, specific training by nomenclature for each individual explosive device within that family shall be documented in individual training records. (R

(6) Qualification shall be verified through proficiency demonstrations before a member of the certification board for each evolution to be performed (assembly, testing, fuzing, etc.) with the specific explosive device, represented by a family type device,

if appropriate. Knowledge and competent use of applicable documentation such as technical, assembly, and maintenance manuals; ordnance publications; and knowledge of ordnance safety precautions and procedures shall be demonstrated to the extent considered necessary for ensuring compliance with sound handling practices and safety precautions.

b. Qual/Cert Board shall be appointed by name, in writing, by the Commanding Officer/Officer in Charge of all NAVSURFLANT/NAVSURFPAC activities whose mission includes any operation associated with explosive devices. The Board Composition shall be organized as follows:

(1) Board Chairman. The Board Chairman shall be the Commanding Officer/Officer in Charge. The duties of the Board Chairman may be delegated to the cognizant head of department at the discretion of the Commanding Officer/Officer in Charge. The Board Chairman himself/herself need not be qualified/certified per this instruction unless his/her duties include the supervision of any work tasks associated with explosive devices. The Board Chairman is tasked with overseeing the command Qual/Cert program and making sure that the provisions of this instruction are carried out. The Board Chairman shall set standard policy for qualification criteria and the local methodology and procedures for determining final certification.

(2) Certification Board Members. The Certification Board Members are tasked with learning the qualifications of each individual proposed for certification and recommending final certification to the Board Chairman. Board Members should, therefore, be the most qualified individuals within the activity. The Board will consist of not less than one individual (E-6 or senior) in addition to the Board Chairman. No limit can be established for the total number of Board Members since the mission of some activities is highly diversified, but all members shall be an E-6 or above; Care should be taken to make sure the appointed board members possess the professional qualifications to justify certification in the explosive device(s) and work task(s). In small units, when assignment of an E-6 or senior to the board may not be possible due to manpower authorization limits or when board augmentation from an outside command is not possible, a waiver request shall be submitted to the TYCOM via the chain of command with appropriate justification. The appropriate immediate unit commander shall make every attempt to provide outside augmentation to assist the activity in gaining the required board composition before a waiver request is submitted. The immediate unit commander's endorsement will include appropriate comments on the inability to provide outside augmentation. The Certification Board's responsibilities include:

(a) Function with the objective of making sure that applicable incumbent personnel are fully qualified for certification in work tasks required for accomplishment of the command mission.

(b) Observe and evaluate the proficiency of personnel being nominated for certification and make recommendations to the Chairman. Inform the division officer or other cognizant supervisor when personnel who are nominated for certification require additional training or experience before certification can be accomplished.

(c) Review existing and proposed local training plans and make appropriate recommendations.

(d) Review minor and major explosive device safety infractions and make recommendations to the Commanding Officer/Officer in Charge concerning corrective action.

(e) Make sure qualification/certification level of personnel involved in any explosive mishap is reported per reference (d) (Appendix B (Part Foxtrot)).

(3) Initial Certification of Board Members. Activities with established certification programs must make sure that qualified and certified Board Members are kept on board at all times. Adequate preplanning incident to the transfer of key Board Member(s) will eliminate problems with non-qualified Board Members. However, those activities who are assigned a new weapon/system or have a new or major modification to a handling/storage capability must initially certify a Board Member for this new capability to permit subsequent certification of those personnel whose duties include the new capability. In addition, newly commissioned ships must certify Board Members when the Qual/Cert program is initiated. Initial certification of Board Members to cover new capabilities will be accomplished after a careful review of records of past training and experience to identify the most qualified individual to serve in this capacity, with a written memorandum of recommendation from the Division Officer/Head of Department to the Board Chairman. For newly commissioned ships, this recommendation will be sent to the Commanding Officer. When approved, the Board Chairman/Commanding Officer/Officer in Charge shall enter the word "INITIAL" on the certification sheet in the "board observer" column and affix his/her signature in the "Board Chairman" column. Use of INITIAL certification shall be limited to one Board Member per explosive device. Review of Fleet programs has shown that many commands have been unable to properly maintain the Qual/Cert Program due to extended PMA/SRA/Overhaul periods or unexpected loss of key Board Members. To give the Commanding Officer the opportunity to correct their program deficiencies, a request may be submitted to COMNAVSURFLANT (N5) or COMNAVSURFPAC (N8) to "INITIAL" certify one Board Member per weapon type to preclude unnecessary (A
delays for approval of requests, formal schooling, prior certification levels, OJT and all other training qualifications must be included in request. The most qualified crewmember (E-6 or above) shall be used in this capacity. Each request will be handled on a case basis. It is not intended for this to be a blanket waiver for any command that may have neglected their program. The basic guidelines for "Initial" Certification of Board Members apply. Reestablishment of a Board Member position, when there is no Board

Member currently assigned, for any reason other than those identified, will require assistance from outside the command. If an outside Board Member is used, that person shall be temporarily assigned, and appointed in writing, to the board of the command requiring the board member.

c. Training. The Qual/Cert Program at each command consists of a training plan to qualify the individual and a command appointed Certification Board that will review the qualification, observe the skills and finally certify the individual to perform a work task with an explosive device.

R) (1) Training Plan. A training plan will be formulated to provide the basic qualification criteria incident to final certification of an individual. An individual training jacket will be maintained for all program members to demonstrate that appropriate training has been accomplished to qualify the individual for the task codes assigned. Depending upon the degree of complexity of tasking, these training records may include records of related formal schools completed, classroom type lectures received, on-the-job training accomplished, and a record of all completed Personnel Qualification Standards (PQS). The degree to which an individual must be trained will obviously vary with the complexity of the explosive device and task codes involved and, even further, with the ability of each individual to learn and perform. The team leader (TL) of assembly operations will naturally require more extensive training than will a team member (TM) for a simple handling or stowage operation. The judgment must be made by the program managers in each case. The final end result being removal of any and all doubt as to the qualification of the individual to properly perform the task in question. The individuals training record shall be transferred with him/her to prevent retraining with like explosive devices by the receiving command. Enclosure (5) is provided to consolidate records of local training conducted which is related to the Qual/Cert program.

(2) Inert Ordnance. Only inert ordnance is to be used for drill or training purposes. However, situations may arise which make universal application of this principle impractical, such as limited supply or local non-availability of an inert training device or the fact that some explosive devices have no inert model. To the maximum extent practicable, a family type inert device (enclosure (1)), which is as closely related as possible to the explosive device for which certification is being considered, shall be used for training. Training aids such as mock-ups, pictures, manuals, exploded views, films, etc., may also be used. When the use of either a family type device or training aid is not considered to be a viable alternative for hands-on training, and all safety factors have been carefully weighed, COMNAVSURFPAC or COMNAVSURFLANT, as appropriate, may authorize hands-on training with explosive devices, but only under qualified supervision. Send requests for use of live ordnance for training to the TYCOM via the chain of command with appropriate justification; e.g., back-ordered requisition for inert items devices, inadequate stowage

provisions for inert devices, non-development of a facsimile inert device, etc.

d. <u>Certification Procedures</u>

(1) The procedures to be followed for the certification process are a command function; however, these procedures shall be standardized and approved by the Commanding Officer/Officer in Charge, but need not be in writing.

(2) The qualification/certification procedure begins with the identification of all billets that require certification and a determination of the explosive devices, <u>certification level</u> and <u>work task codes</u> required of each billet.

(3) A qualification process is initiated to provide the necessary requisite training to achieve final certification.

(4) Upon determination by the division officer that the individual is fully qualified and recommended for certification, the Board Chairman shall be notified. In making a determination for certification, the board may use oral quizzes and written examinations in addition to on-the-job demonstrations of qualification, or, a combination thereof. Training records shall be closely reviewed by the Board Chairman to make sure that all elements of the training process have been completed. If certification is to be granted, enclosure (4) will be signed in all appropriate blocks. Certification is valid only after the certification form has been signed and dated by the Board Chairman.

NOTE: Board members must possess equal or greater certification than that which they sign on the Certification Record (enclosure (4)). This includes family, device, work task, and certification level.

(5) The Board Chairman shall keep the original of all completed certification forms. A copy will be kept by the Division Officer in the individual's training record.

(6) Certification, unless revoked for cause, will be valid for a maximum of 12 months from date of certification. A renewal of the certification, whether issued at the time of expiration or later, shall be granted only after the individual has been validated by the certification board. Whenever possible, complete requalification should be accomplished before renewal of certification. The record of recertification will be entered in the appropriate portion of the Certification Record shown in enclosure (4). (R

(7) <u>Transfer of Certification</u>. For military personnel transferred to or received from another activity, the reciprocal acceptance of certification related to an explosive device will be at the discretion of the Commanding Officer or Officer in Charge. The transferring activity shall insert the original of the certification sheet on the left side of the member's personnel

service record before transfer. Civilian employees who transfer to another activity shall be recertified before being allowed to handle any explosive devices. If transferring to another function within the same activity, civilian employees must be certified for the new function, unless they currently hold a valid certification for that function.

R) (8) Revocation of Certification. Commanding Officers and Officers in Charge are responsible for revocation of individual certification whenever such action is considered to be in the best interest of safety. Revocation of certification for individuals is mandatory if an explosive mishap is caused by failure to follow authorized procedures. Flagrant disregard of safety precautions, reckless operation of equipment used to handle explosive devices, or other behavior indicating incompetence or unreliability (including drug abuse and alcoholism) shall also be cause for mandatory revocation of certification for cause. In this regard, you must recognize that ordnance incidents/accidents can and do happen through inadvertent acts, carelessness, and minor rule infractions as well as through deliberate acts, negligence, and major rule infractions. Personnel whose certification has been revoked shall be retrained, requalified and recertified if the Commanding Officer considers such action appropriate. If, however, the demonstrated behavior of an individual shows that such retraining may be ineffective, assign the individual other tasks not involving explosive devices. Revocation of certification of military personnel for cause requires an entry in the appropriate portion of the individual's service record stating the specific reason for revocation. (See MILPERSMAN 5030420.3 concerning derogatory entries.) For civilian personnel, prepare a letter rescinding the previously issued certification and enter in the individual's civilian personnel jacket, and revoke the individual's certification letter/card.

6. **Action**

a. Commanding Officers/Officers in Charge shall initiate, maintain, and monitor a dynamic program for compliance with the Qual/Cert Program as provided for above. Each command shall make sure that training and briefings will contribute enough knowledge for personnel to attain qualification and certification. Maximum use of formal schools is encouraged; however, they may not in themselves qualify an individual for certification. The training process for qualification is usually conducted by a division or work center. Additional qualifications may be required when an individual changes job assignments, new equipment is installed, assigned equipment is modified, or when the individual is designated to perform other tasks. These qualifications may consist of a review of previous qualifications, and or written test conducted by the command. Practical demonstration to be observed by a designated Board Member shall be accomplished before any certification.

R) b. To ensure complete implementation of the certification program at all levels, immediate individual unit commanders shall inspect each activity under their cognizance at least once during each deployment cycle and report the findings to the appropriate Type Commander (enclosure (6) may be used as a guide). Assign only personnel who are qualified and thoroughly knowledgeable of the program requirements to perform these inspections. If desired, conduct the inspection concurrently with other inspections. If a unit is found unsatisfactory, send a letter report to the appropriate activity with the requirement for immediate corrective action and reinspection.

c. The final authority and responsibility for safety rests with the Commanding Officer; however, all hands are responsible for ensuring a safe and viable explosive safety program within each command. When properly implemented, the Qual/Cert Program provides the Commanding Officer the means to achieve desired goals in explosive safety.

7. **Review**. All personnel associated with the Qual/Cert program will be required to review the contents of this directive upon certification and annually upon recertification.

8. **Amplifying Directives**. This directive is considered adequate in scope and depth to properly formulate and administer the Qual/Cert Program at all levels within NAVSURFLANT/NAVSURFPAC. Amplifying directives are neither required nor desired.

9. **Administrative Recertification**. Activities with active certification programs on the effective date of this instruction are not required to administratively recertify personnel under the revised requirements of this instruction until recertification is required, or unless new families, certification levels or work task codes must be added.

10. **Forms**. Certification forms (enclosure (4)) and training sheets (Enclosure(5)) shall be reproduced locally as needed.

11. COMNAVSURFLANT (N57) and COMNAVSURFPAC (N821) shall review the contents of this directive at least annually. COMNAVSURFLANT is tasked with the maintenance of this instruction.

H. E. SELFRIDGE
Deputy and
Chief of Staff
COMNAVSURFPAC

G.W. ZWIRSCHITZ
Chief of Staff
COMNAVSURFLANT

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26000	Mobile Training Team
28B2	Cruiser-Destroyer Group PAC
28C2	Surface Group and Force Representative PAC
28D2	Destroyer Squadron PAC
28E2	Surface Squadron PAC
28G2	Mine Group and Division PAC
28J2	Combat Logistics Group, Squadron and Support Squadron PAC
28L2	Amphibious Squadron PAC
29A2	Guided Missile Cruiser PAC (CG) (CGN)
29E2	Destroyer PAC (DD), 963 Class
29F2	Guided Missile Destroyer PAC (DDG)
29H2	Frigate PAC (FF), less 1040/1097 Class
29K2	Frigate PAC (FF), 1052/1077 Class
29L2	Frigate PAC (FF), 1078/1097 Class
29R2	Battleships PAC (BB)
29AA2	Guided Missile Frigate PAC (FFG), 7 Class and Fleet Introduction Team
29BB2	Guided Missile Destroyer (DDG) 993 Class PAC
30A2	Minesweeper, Ocean (Non-magnetic), PAC (MSO)
31A2	Amphibious Command Ship PAC (LCC)
31B2	Amphibious Cargo Ship PAC (LKA)
31G2	Amphibious Transport Dock PAC (LPD)
31H2	Amphibious Assault Ship PAC (LHA) (LPH)
31I2	Dock Landing Ship PAC (LSD) 41 Class
31J2	Dock Landing Ship PAC (LSD)
31M2	Tank Landing Ship PAC (LST)
32A2	Destroyer Tender PAC (AD)
32C2	Ammunition Ship PAC (AE)
32G2	Combat Store Ship PAC (AFS)
32H2	Fast Combat Support Ship PAC (AOE)
32N2	Oiler PAC (AO)
32Q2	Replenishment Oiler PAC (AOR)
32S2	Repair Ship PAC (AR)
32X2	Salvage Ship PAC (ARS)
32GG2	Fleet Ocean Tug PAC (ATF)
32QQ2	Salvage and Rescue Ship PAC (ATS)
36A2	Auxiliary Repair Dry Dock (ARD) (AFDM), PAC (STEADFAST only)
39E2	Amphibious Construction Battalion PAC
42T2	Tactical Air Control Group and Squadron PAC (VTC)
42KK	Lamps MK III Fleet Introduction Team
FB21	Amphibious Base PAC
FT35	Amphibious School (Coronado only)
FT43	Surface Warfare Officers School Command
FT106	Surface Warfare Officers School Command Pacific

COMNAVSURFPAC REP Long Beach

FAMILIES OF EXPLOSIVE DEVICES

1. Each major heading below shall be considered a family grouping. Within each family is a list of specific items requiring separate certification per paragraph 5a of the basic instruction.

a. Gun ammunition

(1) Propelling Charges

(a) Bag Charges

(b) Cartridge cases

(2) Projectiles (separate loading) (R
(See chemical ammunition for WP projectiles)

(3) Fixed Ammunition (CIWS through 3") (R

(4) Small Arms (through 20MM TP) (R

b. Rockets

(1) RBOC/SRBOC

(2) Warhead, 2.75"

(3) Warhead, 5.0"

(4) Fuzes, nose

(5) Motor, 2.75" (MK 4/MK 40/MK66)

(6) Motor, 5.0" (MK 16/MK 71/MK 72)

(7) Smokey Sam Simulator rocket and ignitor.

c. Bombs

(1) HE (MK 80 Series)

(2) Cluster Bomb Units (CBU)

(3) Mechanical nose fuzes

(4) Electric fuzes

(5) Practice bombs

(6) Laser guided bombs (LGB)

(7) Fire bombs

d. Torpedoes

(1) Warshot tube launch

(2) Exercise tube launch

(3) Warshot (helo launch)

(4) Exercise (helo launch)

(5) ASROC

e. Guided Missiles

(1) Tartar (RIM-24)

(2) Terrier (RIM-2)

(3) Standard ER (RIM-66)

(4) Standard ER (RIM-67)

(5) Tomahawk (BGM-109)

(6) Harpoon (RGM-84)

(7) Sidewinder (AIM-9)

(8) TOW (BGM-71)

(9) Sparrow (RIM-7)

A) (10) Maverick (AGM-65)

A) (11) Hellfire (AGM-114)

A) (12) Stinger (RIM-92)

A) (13) Shrike (AGM-45)

A) (14) Harm (AGM-88)

A) (15) Penguin (AGM-119)

A) (16) Sidearm (AGM-122)

f. Demolition explosives and components; e.g., primacord, time fuzes, caps, explosive bolts, initiating devices, bulk explosives and cable cutter device(s).

g. Pyrotechnics

R) (1) Parachute flares (MK-45/LUU-2B/B)

(2) Smoke grenades (M18)

(3) MK 58 Marine Location Marker

(4) MK 25 Marine Location Marker

(5) Very pistol signals

h. Chemical

(1) Thermite grenades

(2) Red phosphorus grenades

(3) White phosphorus projectiles/warheads

(4) CS grenades

i. Aircraft Gun Ammunition

(1) 25MM

(2) 20MM (Not CIWS ammunition)

j. Cartridges and "Cartridge Actuated Devices"

k. Underwater Sound Signals (MK-61/MK-64)

l. Cargo and Landing force (LFORM) ammunition

m. Aircrew Escape Propulsion System (AEPS) devices

n. Grenades (other than as listed above). (R

WORK TASK CODE DEFINITIONS

1. Stowage - The physical act of stowing explosives in designated and approved magazines and ready service lockers.

2. Handling - The physical act of moving explosive devices manually or with powered equipment within the confines of the ship or within an area authorized for handling ashore.

3. Assembly/Disassembly - Physically mating/unmating explosive device components to form a complete round including torpedo banding. This work task code is used only when assembly/disassembly of the explosive device is authorized at the fleet level.

4. Load/Download - The physical act of installing/removing (R explosive devices including cartridge actuated devices into/from the vehicle from which initiation is/was intended; e.g., launchers, projectors, racks, gun barrels, etc. Work task code "Handling" will be used when loading/downloading is accomplished with an automated loading system.

5. Arm/De-Arm - The physical act of rendering explosive devices from a safe condition to the ready for initiation/returning explosive devices from the ready for initiation state to a safe condition.

6. Magazine Inspection - The act of detecting improperly secured (R stowage, unsatisfactory packaging, unusual fumes or odors and any other abnormal conditions as defined in NAVSEA OP 4/NAVSEA OP 5 and appropriate Maintenance Requirement Cards (MRC) in explosive devices stowage spaces, magazines, and lockers.

7. Equipment Operator - Individuals who operate non-mobile powered handling equipment (hoist, winches, cranes, elevators, conveyers/transporters, etc.) for handling explosive devices. See Paragraph 5b(2) of the basic instruction.

8. Testing - The physical act of conducting tests on explosive/ firing devices; e.g., AIM-9 umbilical tests, continuity tests on SUU-25/44 flare dispensers and LAU 61/68/10 rocket launchers.

CERTIFICATION LEVEL QUALIFICATION STANDARDS

TEAM MEMBER (TM)	BASIC QUALIFICATION. Personnel are aware of basic safety precautions relative to the work task and explosive devices concerned, have received formal and/or on-the-job training, and have been recommended by their immediate supervisor. May not work with ordnance unless supervised by (I/TL). (R **NOTE:** TM certified personnel will perform in team concept only under supervision of a certified team leader (TL).
INDIVIDUAL/TEAM LEADER (I/TL)	1. Same as for team member (TM) 2. Has sufficient knowledge and has demonstrated the proficiency to perform certain work tasks alone and/or direct the performance or training of others in safe and reliable operations. **NOTE:** Working alone is restricted to those areas where the work to be done must be done alone due to physical restrictions; i.e., installing A/C fire extinguisher cartridges.
QUALITY ASSURANCE (QA)	1. Same as individual/team leader (I/TL) above. 2. Must have detailed knowledge and ability to perform as well as train others in applicable explosive device/systems inspection criteria and be able to decide that the necessary assembly or installation procedures have been completed per applicable directives. Any person who completes final preparation for use type inspections will be qualified/certified at the (QA) level. **NOTE:** Only TM, I/TL and QA are interrelated. Certification at the QA level automatically assumes the individual has all knowledge and skill levels required of the TM and I/TL member.

SAFETY OBSERVER (SO)

1. Must have sufficient knowledge of safety procedures and the functioning of safety devices to decide subsequent reaction when safety procedures or devices are not properly used.

2. Certification at the SO level does not require prior certification at any other level.

NOTE: This certification level is not restricted to the most senior within a unit. A junior who possesses the foregoing standards and demonstrated maturity may likewise be certified.

RECORD OF CERTIFICATION

CERTIFICATION RECORD
SURFGEN 8023/1 (REV 11/89)

COMNAVSURFLANTINST 8023.4F
COMNAVSURFPACINST 8023.5B

SHIP OR STATION

CERTIFICATION LEVELS	WORK TASK CODES	
TM TEAM MEMBER	1. STOWAGE	6. MAGAZINE INSP. (R
I/TL INDIVIDUAL/TEAM LDR	2. HANDLING	7. EQUIP. OPERATOR
QA QUALITY ASSURANCE	3. ASSEMBLY/ DISASSEMBLY	8. TESTING
SO SAFETY OBSERVER	4. LOAD/DOWNLOAD	
	5. ARM/DEARM	

EXPLOSIVE DEVICE	CERT. LEVEL/ WORK TASK	INDIVIDUAL SIGNATURE	CERT BOARD OBSERVER	BOARD CHAIR	VALID DATE

NOTE: All corrections will entail lining out the old line entry and a new line entry made. Line-outs will be initialed by the Board Chairman. (R

RECERTIFICATION ONLY

Individual Being Recertified (Signature and Date)	Board Chairman (Signature and Date)	
NAME	GRADE	BRANCH/CLASS

NOTE: 1. Items not required for recertification shall be lined out and initialed by the individual and Board Chairman.

2. Certification has been reviewed and recertified as per dates and signatures indicated and are effective for 12 months.

RECORD OF CERTIFICATION

1. This form will be used to record certification except as noted in paragraph 10 of the basic instruction.

2. Forms shall be prepared in duplicate and the following information provided:

a. CERT LEVEL/WORK TASK - Enter the applicable certification level in enclosure (3). Enter the work task codes as defined in enclosure (2).

b. INDIVIDUAL SIGNATURE - Signature of the person being certified. Signing acknowledges certification level and work task for explosive device/family group for which certified; therefore, a signature is required for each line entry.

c. CERT BOARD OBSERVER - Signature of certified board member who actually OBSERVED the individual being certified performing the task under consideration; therefore, a signature is required for each line entry.

d. BOARD CHAIRMAN - Signature of commanding officer/officer in charge or department head designated as Board Chairman. Collective signature is authorized.

e. VALIDATION DATE - Date signed by the Board Chairman. This is the date that actual certification becomes valid.

3. **Recertification**. Recertification may be accomplished using the space provided. Once the individual being recertified and the Board Chairman sign and date the form, certification shall be valid for 1 year except as noted in paragraph 5d(7) of the basic instruction.

COMNAVSURFLANT/COMNAVSURFPAC (A

OJT/PROFESSIONAL TRAINING RECORD SHEET

TRAINING LEVELS	WORK TASK CODES
IT IN TRAINING	1. STOWAGE · 7. EQUIPMENT OPERATOR
TM TEAM MEMBER	2. HANDLING · 8. TESTING
I INDIVIDUAL	3. ASSEM/DISASSEM
TL TEAM LEADER	4. LOAD/DOWNLOAD
QA QUALITY ASSURANCE	5. ARM/DEARM
SO SAFETY OBSERVER	6. MAGAZINE INSP

SPECIFIC EXPLOSIVE DEVICE	TRAINING LEVEL/ WORK TASK	LECTURE	INSTRUCTOR	DATE OF TRAINING	ENTERED BY/DATE

NAME: SSN: RANK/RATE

(Reverse Blank)

**EXPLOSIVES HANDLING PERSONNEL
QUALIFICATION AND CERTIFICATION PROGRAM
CHECK LIST** (A

Note: The Board Chairman (if other than the Commanding Officer) and Board members may be appointed by letter, ship's notice or instruction, providing the assignment is by name (not position) and the notice/instruction is signed by the Commanding Officer/ Officer in Charge.

( ) Has the CO/OIC delegated and appointed in writing, a Board Chairman for the Qualification Certification Board?

( ) Is the appointed Board Chairman a department head?

( ) Are the Certification Board members appointed, in writing, by the CO/OIC?

( ) Does the Board Chairman personally keep the original copies of all certifications; are copies kept in each individual training record?

( ) Are members of the Certification Board E-6 or above and certified to the same level or greater than those personnel for whom the Board Member will be recommending certification? Only TM, I, TL, and QA are interrelated and the senior qualification is inclusive of the lower qualification; i.e., a TL posses the skills and qualifications of a TM and I; a QA posses the qualifications of a TM, I, TL and a QA. Only the highest qualification level needs to be annotated on the qualification/ certification form. Safety Observer (SO) is an independent qualification. A Board Member that is solely qualified and certified as a SO may only recommend certification for other individuals that will be only SO qualified. For those individuals that will be qualified as a T/SO, I/SO, TL/SO or QA/SO, a Board Member with an equivalent or higher identical type qualification/certification; i.e., TM/SO, QA/SO, etc., must sign the certification form as the Board Observer. (R

( ) Do the Certification Board Member's individual certification level and work task codes cover all tasks under consideration?

( ) If enough technical expertise in any given area is not available from within the command, has outside assistance been requested/obtained?

( ) Do Certification Board members understand the qualifications required before certification as QA, TL, I, or TM?

( ) Are QAs assigned as required? QAs must have detailed knowledge and ability to train others in applicable explosive device/ system inspection criteria and be able to decide that the necessary assembly or installation procedures have been completed per applicable directives.

( ) Are operators of power operated handling equipment certified in the movement of explosives using the equipment? Training records must reflect training with the equipment and explosive devices used together.

( ) Are there individual training records for all members under the provisions of the qualification/certification program? Do the records reflect adequate training to substantiate certification? (Officers are to be included).

( ) Are certifications documented using the definitions and explosive family groupings described in TYCOM directives?

( ) Are approved certification forms, according to TYCOM directives, being used to document certifications?

( ) Are applicable certification levels/work tasks indicated?

( ) Did the individual being certified sign the form where indicated to acknowledge his/her certification level?

( ) Did the certified Board Member actually observe the task(s) under consideration and sign where indicated as the certification Board Observer?

( ) Did the Board Chairman sign and date the form as the certifying official? (Board Chairman may use a collective signature.)

( ) Is the date of the certification/recertification valid (within 12 months)?

( ) If recertification has been accomplished, did the individual being recertified and the Board Chairman sign and date the form?

( ) Is there a procedure established to include the Board Chairman's copy (original) of a transferring person's qualification/certification form in that person's service record (left side) upon transfer?

( ) Have any certifications been revoked or revoked for cause? If for cause, was the revocation documented as a page 13 service record entry?

APPENDIX H-2

EOD GROUP II NON-NUCLEAR ORDNANCE/EXPLOSIVES HANDLING QUALIFICATION AND CERTIFICATION PROGRAM

DEPARTMENT OF THE NAVY
COMMANDER
EXPLOSIVE ORDNANCE DISPOSAL GROUP TWO
NAVAL AMPHIBIOUS BASE, LITTLE CREEK
NORFOLK, VIRGINIA 23520-5320

COMEODGRUTWOINST 8023.2B
N6:KLB-34
15 APRIL 1991

COMMANDER, EXPLOSIVE ORDNANCE DISPOSAL GROUP TWO INSTRUCTION 8023.2B

Subj: NON-NUCLEAR ORDNANCE/EXPLOSIVES HANDLING QUALIFICATION AND CERTIFICATION PROGRAM

Ref: (a) OPNAVINST 8023.2C — ON SHELF
(b) COMNAVSURFLANTINST 8023.4E/COMNAVSURFPACINST 8023.5A

Encl: (1) Families of Explosive Devices
(2) Work Task Code Definitions
(3) Certification Level Qualification Standards
(4) Record of Certification

1. **Purpose**. To provide a standard qualification and certification within EODGRU TWO in accordance with guidelines set forth in references (a) and (b). This instruction which supplements and must be used in conjunction with reference (b), specifically addresses EOD personnel.

2. **Cancellation**. EODGRUTWOINST 8023.2A.

3. **Background**

a. Reference (a) established the requirement for a qualification and certification program for all Navy personnel whose duties and tasks include working with explosive devices. Reference (b) directs COMNAVSURFLANT commands to initiate, maintain and monitor a dynamic program that complies with the spirit and intent of the non-nuclear explosive ordnance handling qualification and certification program. Each of these instructions specifically identifies EOD personnel as requiring qualification and certification when involved in non-mission related functions.

b. The requirement for qualification and certification is not applicable to EOD personnel..."for those explosive devices employed in their specialized mission areas and for which formal training has been successfully completed"...reference (b) refers. Qualification and certification are not required for those EOD procedures:

(1) As taught at NAVSCOLEOD.,

(2) As taught at EOD Training and Evaluation Units.

(3) As covered in 60 Series Publications or the EOD PQS program.

c. At the unit/detachment level, each man must be qualified and certified to safely carry out ordnance related functions other than those specified in paragraph 3.b. above. Each individual is required to be certified as an explosive driver or as an ordnance handling safety observer prior to performing these functions.

d. All unit/detachment personnel must be thoroughly familiar with the requirements related to magazine stowage, general demolition and burn procedures in accordance with OP 5, Vol I, SW060-AA-MMA-010 and applicable base requirements. The CO/OIC of each unit/detachment must determine the particular training and certification required, enclosures (1) through (3), and design a program that fits those requirements. Upon completion of the appropriate training, enclosure (4) will be used to record the certification.

e. Shipboard detachment personnel who get involved as shipboard ordnance handling safety observers must meet all the qualification requirements established by ship's instructions.

4. Non-Nuclear Ordnance/Explosives Handling Certification Board. The board shall be appointed by the Commanding Officer/Officer in Charge as per reference (b). The board shall be organized as follows:

a. Board Chairman. The Board Chairman shall be the Commanding Officer/Officer in Charge. The Commanding Officer may delegate these duties to the cognizant department head. The Board Chairman is tasked with overseeing the Command Non-Nuclear Ordnance/Explosive Handling Qualification and Certification Program and making sure that the spirit, intent, and provisions of this instruction are carried out; reference (b) refers.

b. Board Members. Board membership shall consist of not less than one individual, E-6 or above, in addition to the Board Chairman. The board member(s) should be the most qualified individuals within the activity. Each board member shall be fully qualified and certified for every explosive device and work task under consideration. Reference (b) contains provisions for initial certification of board members and a list of certification board responsibilities.

c. Certification Procedures. The Commanding Officer/Officer in Charge shall approve certification procedures for his/her own command. These do not have to be promulgated in writing. Enclosures (1) through (4) are provided for use in documenting the qualification and certification of personnel. Certifications are good for one year from the date they are granted and must be renewed annually. Accepting transferred certification of newly reported personnel is left to the discretion of the Commanding Officer/Officer in Charge. Outgoing detachment OIC's will certify incoming OIC's prior to being relieved.

d. Revocation of Certification. Commanding Officers/Officers in Charge are responsible for revocation of certification whenever such action is in the best interest of safety.

5. **Action**. Each command and detachment within EODGRU TWO will institute a qualification and certification program pursuant to references (a) and (b) using enclosures (1) through (4) as a guide. The Commanding Officer, EODTEU TWO is designated as coordinator for local programs and will assist detachments as necessary. Detachment Officers in Charge are tasked to develop the subject program and incorporate into the host command's program using enclosure (4) where possible. Detachment personnel assisting the host command in explosive transfers must be qualified by the host command as required by reference (b).

T M Ligon

T. M. LIGON
By direction

Distribution: (COMEODGRUTWOINST 5216.1P)
Lists I, II & III

FAMILIES OF EXPLOSIVE DEVICES

1. Each major heading below shall be considered a family grouping. Within each family is a list of specific items requiring separate certification per paragraph 5a of the basic instruction.

a. Gun ammunition

(1) Propelling charges
(a) Bag charges
(b) Cartridge cases

(2) Projectiles (separate loading)

(3) Fixed ammunition (through 76MM)

(4) Fixed ammunition (3" and above)

(5) Saluting charges

b. Rockets

(1) CHAFROC

(2) RBOC/SRBOC

(3) Warhead, 2.75"

(4) Warhead, 5.0"

(5) Fuzes, nose

(6) 2.75" motors (MK 4/MK 40/MK 66)

(7) 5.0" motors (MK 71/MK 72)

(8) 5.0" rocket launcher (LAU-10)

(9) 2.75" rocket launcher (LAU 61B/A and LAU 68C/A)

(10) 2.75" rocket launcher (LAU 61C/A and LAU 68D/A)

(11) Smokey Sam Simulator rocket and ignitor

c. Bombs

(1) HE (MK 80 Series) with conical fin

(2) HE (MK 80 Series) with Snakeye fin

(3) CBU (MK 20 Rockeye/CBU-59 APAM/CBU-72 FAE

(4) Mechanical nose fuzes

(5) Mechanical tail fuze

(6) Electrical fuzes

(7) Practice bombs (MK76/MK 106/BDU-33/BDU-48/BDU-45)

(8) Laser guided bombs (MAU-157/MAU-169)

d. Torpedos

(1) Warshot tube launch

(2) Exercise tube launch

(3) Warshot (airlaunch)

(4) Exercise (airlaunch)

(5) ASROC

e. Guided missiles

(1) Tartar (RIM-24)

(2) Terrier (RIM-2)

(3) Standard ER (RIM-67)

(4) Standard MR (RIM-66)

(5) Tomahawk (BGM-109)

(6) Harpoon (RGM-84)

(7) Sidewinder (AIM-9)

(8) TOW (BGM-71)

(9) Sparrow (RIM-7)

(10) Dragon

(11) Stinger

f. Demolition explosives and components, e.g. primacord, time fuzes, caps, explosive bolts, initiating devices, bulk explosives and cable cutter device

g. Pyrotechnics

(1) Dispensers (SUU-44/SUU-25)

(2) Parachute flares (MK-45/LUU-2B/B)

(3) Smoke grenades (M18)

(4) M118 smoke grenade dispenser

(5) MK 58 Marine Location Marker

(6) MK 25 Marine Location Marker

(7) Very pistol signals

h. Chemical

(1) Thermite grenades

(2) Red phosphorus grenades

(3) White phosphorus projectiles/warheads

(4) CS grenades

i. Aircraft Gun Ammunition

(1) 25MM

(2) 20MM (M50 Series)

(3) 30MM ADEN

(4) 50 Cal.

(5) 7.62MM

j. Cartridges and Cartridge Actuated Devices

k. Underwater Sound Signals (MK 64)

l. Small Arms and Landing Force (LFORM) ammunition

m. Aircrew Escape Propulsion System (AEPS) devices

WORK TASK CODE DEFINITIONS

1. Stowage - The physical act of stowing explosive devices in designated and approved magazines and ready service lockers.

2 Handling - The physical act of moving explosive devices manually or with powered equipment within the confines of the ship or within an area authorized for handling ashore..

3. Assembly/Disassembly - Physically mating/unmating explosive device components to form a complete round including torpedo banding. This work task code is used only when assembly/disassembly of the explosive device is authorized at the fleet level.

4. Load/Download - The physical act of installing/removing explosive devices including cartridge actuated devices into/from the vehicle from which initiation is/was intended, e.g., launchers, projectors, racks, gun barrels, etc..

5. Arm/De-Arm - The physical act of rendering explosive devices from a safe condition to the ready for initiation/returning explosive devices from the ready for initiation state to a safe condition.

6. Explosive Driver - An individual who operates self-propelled material handling equipment to transport explosive devices either ashore or afloat. Must meet all requirements of NAVSEA OP 4098/NAVSEA OP 2239 as a qualification standard before certification.

7. Magazine Inspection - Capability of detecting improperly secured stowage, unsatisfactory packaging, unusual fumes or odors and any other abnormal conditions as defined in NAVSEA OP 4/NAVSEA OP 5 and appropriate Maintenance Requirement Cards (MRC) in explosive devices stowage spaces, magazines, and lockers.

8. Missile System Cycling/Maintenance - Physical act of conducting cyclic operational tests, troubleshooting, repair, and performance of periodic maintenance of GMLS.

9. Gun System Cycling/Maintenance - Physical act of conducting cyclic operational tests, troubleshooting, repair, and performance of periodic maintenance of gun systems.

10. Torpedo system Cycling/Maintenance - Physical act of conducting cyclic operational tests, troubleshooting, repair, and performance of periodic maintenance of torpedo systems.

11. Equipment Operator - Individuals who operate non-mobile powered handling equipment (hoist, winches, cranes, elevators,

conveyors/transporters, etc.) for handling explosive devices. See paragraph 5a(6)(b) of the basic instruction.

12. Testing - The physical act of conducting tests on explosive/firing devices, e.g., AIM-9 umbilical tests, continuity tests on SUU-25/44 flare dispensers and LAU 61/68/10 rocket launchers.

13. Sprinkler System - The physical act of maintaining, troubleshooting, testing, flushing, and operating shipboard sprinkler systems (wet or dry as applicable).

NOTE: This work task code need only be shown in the certification level/work task column of enclosure (4) following a typical missile (explosive device) for wet type systems and a typical family (non-missile) group for dry type systems. the sprinkler systems work task code need not be entered for each family group/missile.

NOTE: This certification level is not restricted to the most senior with a unit. A junior who possesses the foregoing standards and demonstrated maturity may likewise be certified.

CERTIFICATION LEVEL QUALIFICATION STANDARDS

CERTIFICATION LEVEL	QUALIFICATION STANDARD
IN TRAINING (IT)	1. Incumbent is receiving on-the-job training on explosive devices not represented by inert training rounds before conducting evolutions with live material. 2. Incumbent is receiving training on newly introduced explosive devices for which inert training devices are not available. 3. Incumbent shall not work with explosives unless supervised by (TL) or (I). 4. This level of certification is temporary until such time full qualification justifies certification at a higher level, e.g., TM, I, etc.
TEAM MEMBER (TM)	BASIC QUALIFICATION. Personnel are aware of basic safety precautions relative to the work task and explosive devices concerned, have received formal and/or on-the-job training, and have been recommended by their immediate supervisor. May not work with ordnance unless supervised by (TL) or (I). **NOTE:** TM certified personnel will perform in team concept only under supervision of a certified team leader.
INDIVIDUAL (I)	1. Same as for Team Member (TM) above. 2. Has sufficient knowledge and has demonstrated the proficiency of the work task alone in safe and reliable operations.

	3. Capable of interpreting the requirements, applicable checklists, SOP, and assembly/operating manuals.
TEAM LEADER (TL)	1. Same as for Team Member (TM) and Individual (I) above. 2. Has sufficient knowledge and has demonstrated the proficiency to direct the performance of others in safe and reliable operations.
QUALITY ASSURANCE (QA)	1. Same as Individual (I) or Team Leader (TL) above. 2. Must have detailed knowledge of applicable explosive device/systems inspection criteria and be able to decide that the necessary assembly or installation procedures have been completed per applicable directives. 3. Must be appointed Quality Assurance Inspector per NAVSEA/NAVAIR QAP 100. **NOTE:** Only TM, I, TL, and QA are interrelated. Certification at the QA level automatically assumes the individual has all knowledge and skill levels required of the TM, I, and TL member.
SAFETY OBSERVER (SO)	1. Must have sufficient knowledge of safety <u>procedures</u> and the <u>functioning</u> of <u>safety devices</u> to decide subsequent reaction when safety procedures or devices are not properly used. 2. Certification at the SO level does not require prior certification at any other level.

RECORD OF CERTIFICATION.

CERTIFICATION RECORD
SURFGEN 8023/1

SHIP OR STATION

CERTIFICATION LEVELS		WORK TASK CODES	
IT	IN TRAINING	1. STOWAGE	8. MISSILE SYSTEM CYCLING/MAINT
TM	TEAM MEMBER	2. HANDLING	9. GUN SYSTEM CYCLING/MAINT
I	INDIVIDUAL	3. ASSEMBLY/DISASSEMBLY	10. TORPEDO SYSTEM CYCLING/MAINT
TL	TEAM LEADER	4. LOAD/DOWNLOAD	11. EQUIPMENT OPERATOR
QA	QUALITY ASSURANCE	5. ARM/DEARM	12. TESTING
SO	SAFETY OBSERVER	6. EXPLOSIVE DRIVER	13. SPRINKLER SYSTEM TEST
		7. MAGAZINE INSPECTION	14. SPRINKLER INSPECTOR

EXPLOSIVE DEVICE	CERT. LEVEL/ WORK TASK	INDIVIDUAL SIGNATURE	CERT. BOARD OBSERVER	BOARD CHAIRMAN	VALIDATION DATE

SAMPLE

NOTE: All corrections must be lined out and initialed by the individual and the board chairman and a new line entry incorporated.

RECERTIFICATION ONLY

INDIVIDUAL BEING RECERTIFIED (Signature and Date)	BOARD CHAIRMAN (Signature and Date)

NAME	GRADE	BRANCH/CLASS

NOTE: 1. Items not required for recertification shall be lined out and initialed by the individual and board chairman.

2. Certifications have been reviewed and recertified as per dates and signatures indicated and are effective for twelve months.

RECORD OF CERTIFICATION

1. This form will be used to record certification except as noted in paragraph 10 of the basic instruction.

2. Forms shall be prepared in triplicate and the following information provided:

a. EXPLOSIVE DEVICE - Enter the specific explosive device for which being certified. May be of the family grouping in enclosure (1) for evolutions involving stowage and handling only.

b. CERT LEVEL/WORK TASK - Enter the applicable certification level in enclosure (3). Enter the work task codes as defined in enclosure (2).

c. INDIVIDUAL SIGNATURE - Signature of the person being certified. Signing acknowledges certification level and work task for explosive device/family group for which certified; therefore, a signature is required for each line entry.

d. CERT BOARD OBSERVER - Signature of certified board member who actually observed the individual being certified performing the task under consideration; therefore, a signature is required for each line entry.

e. BOARD CHAIRMAN - Signature of commanding officer/officer in charge or department head designated as Board Chairman. Collective signature is authorized.

f. VALIDATION DATE - Date signed by the Board Chairman. This is the date that actual certification becomes valid.

3. Recertification. Recertification may be accomplished using the space provided. Once the individual being recertified and the Board Chairman sign and date the form, certification shall be valid for 1 year except as noted in paragraph 5d of the basic instruction.

APPENDIX H-3

SAMPLE TRAINING RECORD

RECORD OF CERTIFICATION

CERTIFICATION RECORD
SURFGEN 8023/1

HIP OR STATION EODGRU TWO DET ROOSEVELT RDS

CERTIFICATION LEVELS		WORK TASK CODES	
IT	IN TRAINING	1. STOWAGE	8. MISSILE SYSTEM CYCLING/MAINT
TM	TEAM MEMBER	2. HANDLING	9. GUN SYSTEM CYCLING/MAINT
I	INDIVIDUAL	3. ASSEMBLY/DISASSEMBLY	10. TORPEDO SYSTEM CYCLING/MAINT
TL	TEAM LEADER	4. LOAD/DOWNLOAD	11. EQUIPMENT OPERATOR
QA	QUALITY ASSURANCE	5. ARM/DEARM	12. TESTING
SO	SAFETY OBSERVER	6. EXPLOSIVE DRIVER	13. SPRINKLER SYSTEM TEST
		7. MAGAZINE INSPECTION	14. SPRINKLER INSPECTOR

EXPLOSIVE DEVICE	CERT. LEVEL/ WORK TASK	INDIVIDUAL SIGNATURE	CERT. BOARD OBSERVER	BOARD CHAIRMAN	VALIDATION DATE
A - M	QA / SO - 1-7	G. M Ferris	J Conway	G. M Ferris	20 OCT 91

NOTE: All corrections must be lined out and initialed by the individual and the board chairman and a new line entry incorporated.

RECERTIFICATION ONLY

INDIVIDUAL BEING RECERTIFIED (Signature and Date)	BOARD CHAIRMAN (Signature and Date)
G. M Ferris 20 OCT 92	G. M Ferris 20 OCT 92

NAME	GRADE	BRANCH/CLASS
FERRIS, GEORGE M.	LT	USN

NOTE: 1. Items not required for recertification shall be lined out and initialed by the individual and board chairman.

2. Certifications have been reviewed and recertified as per dates and signatures indicated and are effective for twelve months.

RECORD OF CERTIFICATION

1. This form will be used to record certification except as noted in paragraph 10 of the basic instruction.

2. Forms shall be prepared in triplicate and the following information provided:

a. EXPLOSIVE DEVICE - Enter the specific explosive device for which being certified. May be of the family grouping in enclosure (1) for evolutions involving stowage and handling only.

b. CERT LEVEL/WORK TASK - Enter the applicable certification level in enclosure (3). Enter the work task codes as defined in enclosure (2).

c. INDIVIDUAL SIGNATURE - Signature of the person being certified. Signing acknowledges certification level and work task for explosive device/family group for which certified; therefore, a signature is required for each line entry.

d. CERT BOARD OBSERVER - Signature of certified board member who actually observed the individual being certified performing the task under consideration; therefore, a signature is required for each line entry.

e. BOARD CHAIRMAN - Signature of commanding officer/officer in charge or department head designated as Board Chairman. Collective signature is authorized.

f. VALIDATION DATE - Date signed by the Board Chairman. This is the date that actual certification becomes valid.

3. Recertification. Recertification may be accomplished using the space provided. Once the individual being recertified and the Board Chairman sign and date the form, certification shall be valid for 1 year except as noted in paragraph 5d(7) of the basic instruction.

SECTION I

CLOSURE, POST-CLOSURE, FINANCIAL REQUIREMENTS

This section is submitted in accordance with the requirements of 40 CFR 270.14(b)(13), 264 Subpart G, and 264.178. This plan identifies all the steps necessary to completely close the facility at the end of its intended operating life. The design of the hazardous waste treatment facility is not conducive to partial closure; therefore, no partial closure is intended. A post-closure plan is not required because this is not a disposal facility and all wastes will be removed at closure.

AFWTF Vieques will maintain onsite at their headquarters in NAVSTA Roosevelt Roads a copy of the approved closure plan and all revisions to the plan until the certification of closure completeness has been submitted and accepted by EPA Region II and EQB. AFWTF Vieques will notify the Regional Administrator at least 180 days prior to the date final closure is expected to begin. Upon completion of closure, AFWTF Vieques will submit to the Regional Administrator and to EQB a certification by an independent, registered professional engineer that the facility has been closed in accordance with the specifications in the approved closure plan. The date for closure of the hazardous waste treatment facility is anticipated to be 30 years after the approval of the closure plan. The Environmental Officer at NAVSTA Roosevelt Roads is responsible for storing and updating the facility's copy of the closure plan. The plan will be updated if operations or conditions at the OB/OD facility change such that the plan would no longer be effective. The Environmental Officer will routinely examine operations at the facility in order to determine whether the plan should be updated.

I-1 CLOSURE PLAN

I-1(a) Closure Performance Standards

The owner, by implementing the closure plan, will:

- Minimize the need for further maintenance.
- Control, minimize or eliminate, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.
- Comply with 40 CFR 264 Subpart G and § 264.197.

This closure plan meets these criteria by calling for removal of all sources of potential contamination which will eliminate the possibility of future contamination of groundwater, surface water, or the atmosphere. This will fully protect human health and the environment from the effects of the hazardous constituents. All work performed during the closure will be in accordance with all relevant OSHA guidelines to protect the health of workers at the facility.

Until final closure is completed and certified in accordance with § 264.115, the Environmental Officer will furnish a written copy of the approved plan and all approved revisions to the Director of the United States Environmental Protection Agency.

I-1(b) Partial Closure and Final Closure Activities

Closure will consist of removal of contaminated soils surrounding the open burning and open detonation areas. There will be no partial closure.

The soil surrounding the unit will be sampled and analyzed for contamination. All soil found to be contaminated will be excavated, and the underlying area will be sampled and analyzed. These steps will be repeated until all contaminated soil is removed and replaced with clean soil. Excavated soils will be stored at the individual units until removal to a treatment or disposal facility. Soils will be encased in plastic sheeting and bermed to prevent dispersal via wind or storm water.

I-1(c) Maximum Waste Inventory

The maximum hazardous waste inventory is assumed to be the maximum planned single day disposal since that is the maximum amount of waste ever onsite. Only the amount that is to be treated that day will be on location. That amount is 5,000 pounds (net explosive weight) of explosive per detonation and 5,000 pounds of explosive per burn.

All excavated soils will be handled as hazardous waste. The excavated contaminated soil will be sampled and analyzed to determine if the material meets the criteria established under 40 CFR 268, Subpart D to determine if the soil can be landfilled. If so, the material will be transported by truck from the individual units out of the AIA; it will then be transported by appropriate means to an acceptable sanitary landfill. If not acceptable for landfilling, the material will be transported to a properly permitted hazardous waste treatment facility.

The rinse water generated during decontamination of equipment is expected to contain only trace contaminants of organic material. All rinse waters will be drummed, labeled, manifested, and shipped to Naval Station Roosevelt Roads. DRMO will perform sampling and analysis to determine if decontamination is complete. These analyses will also be used to determine if the rinse water is a hazardous waste. If it is not a hazardous waste, the rinse water will be removed and fed to the Naval Station Roosevelt Roads water treatment plant. If it is a hazardous waste, the water will still be sent to the water treatment plant if it will not cause violations of the plant's NPDES permit. That decision must be deferred until that time. If the Roosevelt Roads water treatment plant cannot be used, the water will be shipped offsite for disposal at a properly permitted hazardous waste TSD facility.

I-1(d) Schedule for Closure

The regulations under 40 CFR Subpart G require closure to commence within 90 days of approval of the plan and to be completed within 180 days of approval unless an extension is approved. Because military appropriations are lengthy and deliberate, an extension is being requested for the closure initiation to begin within 150 days of approval and for closure to be completed within 240 days after approval (Figure I-1). Final closure will be supervised and certified by an independent registered professional engineer, in addition to the owner or operator.

I-1(e) Inventory Disposal, Removal or Decontamination of Equipment

There is no processing equipment associated with open burning/open detonation treatment, so there will be no cleaning required for equipment. In addition, the burn pans will be flashed at the open burning facility where they are used. Normal operating procedures require all explosive hazardous waste items to burned or detonated until all reactive properties are gone. Hazardous waste is stored at the facility only on those days of treatment. Therefore, no hazardous waste removal is contemplated.

I-1(f) Procedures for Cleaning Equipment and Removing Contaminated Soils

The majority of equipment is decontaminated and removed from the facility following each treatment event. This includes hand tools, protective clothing and vehicles. Therefore, no decontamination of this equipment during closure is required. Burn pans, debris, and any contaminated soils, which, based upon the previously described criteria, are determined to exceed background levels, will be excavated and/or decontaminated, and then removed from the facility.

Decontamination will occur in a temporarily constructed containment structure. The decontamination area will be constructed immediately adjacent to each unit, in an area capable of supporting heavy equipment. A 20' by 30' area will be graded with at least a 2 percent slope toward one corner. The area will drain to an in-ground container consisting of a steel drum or polyethylene bucket. The equipment will be driven onto the plastic sheeting where it will be steam cleaned. Rinsate and other waste generated in this process will be placed in drums. The containment structure will be constructed with sand bags and a polyethylene liner.

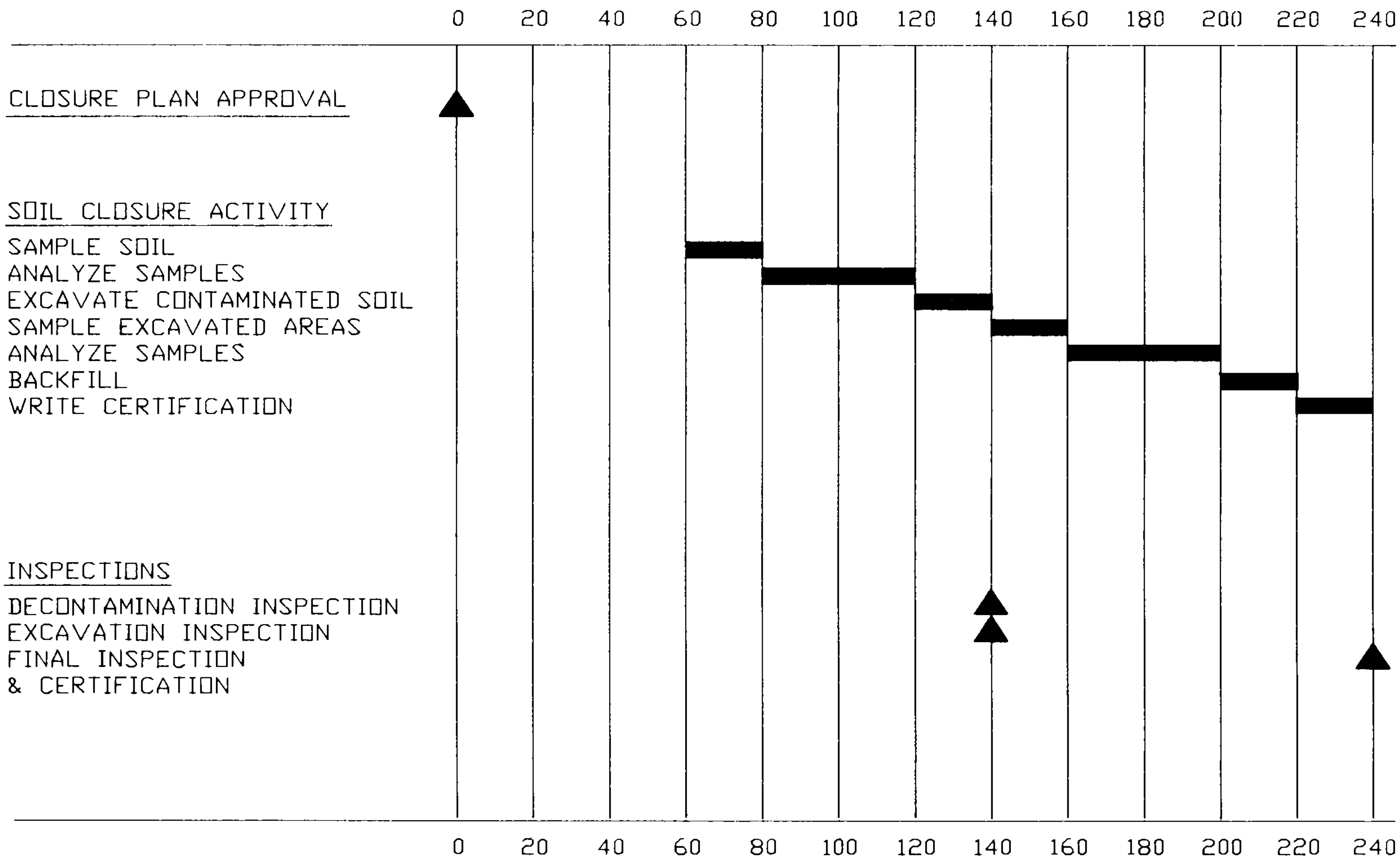

FIGURE I-1 CLOSURE SCHEDULE FOR AFWTF VIEQUES OB/OD FACILITY

VIEQCLS1

After decontamination, the containment liner will be inspected for leaks. If a leak is discovered the affected underlying soils will be analyzed in accordance with Section 264.114. If the soil is determined to be contaminated, the area will be manually excavated to a 6-inch depth and 3-foot radius. The contaminated soils will analyzed for the characteristic of reactivity and TCLP metals. Should the soils be determined to be hazardous wastes, they will be disposed in an approved TSD facility. Should the soils not be considered hazardous, they will be disposed of in an approved sanitary landfill.

A background sample of unused rinse water, a sample of the final rinsate, and composite sample of rinsate will be collected for analysis. Rinsate will be analyzed for the TCLP constituents previously described. Decontamination will be considered complete when the levels of contaminants are nondetectable in the final rinsate. If the resulting rinsate is contaminated, the rinsate and other waste generated in the decontamination process will be disposed of in a permitted facility for disposal.

I-1(g) Methods for Sampling and Testing Surrounding Soils at the Open Burning and Open Detonation Facilities

All sampling and analysis will be done in accordance with the procedures in the USEPA Publication SW-846, *Test Methods for Evaluating Solid Waste*, Fourth Edition. Soil sampling will be by method 5030. Atomic absorption methods 7081, 7130, 7190, 7420 and 7471 will be used to determine the TCLP toxicity of barium, cadmium, chromium, lead and mercury, respectively. The presence of reactive material will be determined by the use of the U.S. Bureau of Mines standard tests (Gap Test or Detonation and Deflagration Test). The soil at the open burning and open detonation areas will be sampled and analyzed to determine the presence of contaminated soil. Four soil samples, 20 feet apart, will be taken at each unit. At each sample location, a 6-inch sample will be cored from the first foot of soil.

Due to the nature of the impact range, residual compounds from ordnance training activities are present throughout the site. It is therefore proposed that during closure, soil samples from outside the OB/OD area, but still within the impact range, be collected and analyzed to determine actual background levels of pertinent contaminants. During closure, soils within the OB/OD units, which comprise a very small portion of the training range area, will be remediated to this established background level.

It is possible that unexploded ordnance may be encountered during the sampling activities and any subsequent remedial activities. Therefore, prior to any subsurface excavating or drilling, the entire area will be scanned with a magnetometer or similar device capable of detecting subsurface metallic materials. Naval EOD personnel will be onsite during this investigation, and any detected materials will be noted for further investigation and/or removal by EOD personnel. No subsurface soil samples will be taken from any areas noted to contain possible unexploded ordnance.

During installation of all soil borings and/or monitoring wells, EOD personnel will be onsite throughout the activity. Care will be taken during any boring or drilling activities to note any obstructions which could potentially be unexploded ordnance. Should any subsurface obstruction be encountered, the boring/drilling activities at that site shall be immediately terminated, and the location marked for later evaluation by EOD personnel. Should any detonations of buried ordnance occur, all sampling activities will be secured; EOD personnel shall then take appropriate emergency and/or corrective actions.

During any excavation activities associated with remediation of contaminated soils, EOD personnel shall remain onsite during the entire operation. Any excavation activities in areas previously noted to contain subsurface metallic objects or obstructions shall be under the control of EOD personnel, and appropriate safety measures shall be taken. Should any buried ordnance be encountered, all remediation activities shall be immediately secured. All remedial workers will evacuate the area and EOD personnel shall evaluate the uncovered ordnance and arrange for proper disposal (removal, detonation in place, etc.). Remedial activities will not be resumed until the uncovered ordnance has been properly treated or disposed of. All EOD personnel assigned to this operation must meet the training requirements and adhere to the personal protective equipment requirements.

I-1(h) Criteria for Determining the Extent of Contamination at the Open Burning and Open Detonation Facilities

The presence or extent of metals (barium, cadmium, chromium, lead and mercury) contamination in soil samples and rinse water samples with respect to a quantified reference will be made for each analysis. The set of samples will consist of three soil or water samples representing known uncontaminated background conditions with a fourth similar sample being evaluated for contamination. The arithmetic mean of the test analyses for the background samples will be compared to the test analysis for the sample in question. If the analysis for the sample in question is less than 10 times the mean of the background analyses, the material in question will be considered clean.

Soil samples will be tested for reactivity using either the U.S. Bureau of Mines Detonation to Deflagration Transition Test or the U.S. Bureau of Mines Gap Test. If the sample is not reactive, the soil will be considered uncontaminated.

At each sample location which is a source of contamination, an area extending a minimum of 10 feet beyond the sampling point will be excavated a minimum depth of 1 foot. The excavated soil will be transported offsite for disposal as a hazardous waste. Following excavation of the contaminated soil, the excavated area will be randomly sampled at three locations to a depth of 6 inches. These samples will be analyzed for the contaminants found in the analyses of the composite sample.

If the remaining soil in the excavated area is shown to be clean, no further excavation at that area will be needed. If not, the excavation and analytical procedures will be repeated until clean soil is reached or until the owner determines that clean closure cannot be achieved based on equipment and excavation limitations which occur during the impact area closure (i.e., difficulty picking up fragments, etc.), unexpected discovery of unexploded ordnance, etc. After all contaminated soil has been excavated, the excavated areas will be backfilled with clean soil per established geotechnical criteria.

Clean closure will be that point at which concentrations of hazardous constituents are at or below health-based standards published by either the Puerto Rican Environmental Quality Board (EQB) or the USEPA. If no such health-based standards exist, background levels will be utilized to establish clean closure. If soil removal operations are determined to be necessary, conventional erosion and sediment control measures will be implemented to minimize runon and runoff of stormwater. Due to the extensive bombing of the AIA during normal training activities, the land can never be used for human habitation even if the OB/OD units achieve clean closure.

I-1(i) Safety Precautions

All hazardous materials handled at the burning and demolition range are known to be reactive due to their inherent physical characteristics. As such, personnel must take appropriate measures to prevent accidental ignition or detonation of any waste materials remaining on the site. The most prominent threat arises from external ignition sources such as open flames, sparks, etc. NAVSEA OP 5, along with current Naval SOPs, dictate a number of safety guidelines which are strictly enforced to ensure that accidental ignition does not result. These guidelines include, but are not limited to, the following:

- *No Smoking* signs shall be posted at the subject area.
- Ignition sources shall be prohibited in the subject area.
- Spark-producing equipment and tools shall be prohibited from use near known or suspected explosive materials unless specifically authorized.
- No potentially incompatible materials found at the subject site shall be treated or stored in the same locations.
- Supervisors shall perform inspections of hand tools and mechanical devices to ensure that they have not become unsafe for use as designated either to the item or to the operator.
- Motor vehicles used to transport any waste explosives, ammunition, or other potentially explosive material found at the subject site shall meet all applicable safety standards.
- No operations shall be conducted during electrical storms.

I-1(j) Other Activities

No need for groundwater monitoring or leachate collection is anticipated during closure. The runon and runoff controls that will be employed during closure include: encasing excavated soils and related debris within plastic sheeting and constructing a berm around all soil collection areas to prevent runoff of storm water.

I-1(k) Preliminary Risk Assessment

A risk assessment will be performed which uses existing data, DoD test data and fate and transport computer models. The risk assessment will be used to determine whether treatment activities at the facility are impacting human health or the environment, including air, soils, and surface waters. The procedures and rationale for this assessment are described in Section L-9 of this application.

Previous monitoring activities at the site have provided information about soils and surface water contamination. This information was collected pursuant to the EQB administrative NODs and the facility NPDES permit; a discussion of this information is provided in Section L of this application.

I-2 POST-CLOSURE PLAN

Post-closure plans are not required for the types of hazardous waste units to be permitted at AFWTF.

I-3 NOTICES REQUIRED FOR DISPOSAL FACILITIES

Open burning and open detonation are considered to be treatment and not disposal. Therefore, the requirements do not apply.

I-4 CLOSURE COST ESTIMATES

Under 40 CFR 264.140(c), the Federal Government is exempt from 40 CFR Subpart H, *Financial Requirements*. AFWTF is owned and operated by the Federal Government.

I-5 FINANCIAL ASSURANCE MECHANISM FOR CLOSURE

Under 40 CFR 264.140(c), the Federal Government is exempt from 40 CFR Subpart H, *Financial Requirements*. AFWTF is owned and operated by the Federal Government.

I-6 POST-CLOSURE COST ESTIMATE

Under 40 CFR 264.140(c), the Federal Government is exempt from 40 CFR Subpart H, *Financial Requirements*. AFWTF is owned and operated by the Federal Government.

I-7 FINANCIAL ASSURANCE MECHANISM FOR POST-CLOSURE COST

Under 40 CFR 264.140(c), the Federal Government is exempt from 40 CFR Subpart H, *Financial Requirements*. AFWTF is owned and operated by the Federal Government.

I-8 LIABILITY REQUIREMENTS

Under 40 CFR 264.140(c), the Federal Government is exempt from 40 CFR Subpart H, *Financial Requirements*. AFWTF is owned and operated by the Federal Government.

I-9 STATE FINANCIAL MECHANISM

Under 40 CFR 264.140(c), the Federal Government is exempt from 40 CFR Subpart H, *Financial Requirements*. AFWTF is owned and operated by the Federal Government.

SECTION J

CORRECTIVE ACTION FOR SOLID WASTE MANAGEMENT UNITS

The Department of the Navy developed the Navy Assessment and Control of Installation Pollutants (NACIP) Program to identify and control environmental contamination from past use and disposal of hazardous substances at Navy and Marine Corps installations. The NACIP Program is part of the Department of Defense Installation Restoration Program, and is similar to the Environmental Protection Agency's Superfund Program authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

In the first phase of the NACIP Program, a team of engineers and scientists conducted an Initial Assessment Study (IAS). The IAS team collected and evaluated evidence of contamination that may pose a potential threat to human health and the environment. The IAS included a review of archival and activity records, interviews with activity personnel, and an onsite survey of the activity. During that study, no solid waste management unit on the Atlantic Fleet Weapons Training Facility was designated for a confirmation study. A copy of the IAS report is included as Appendix J-1.

The second phase of the NACIP Program has been initiated for NAVSTA Roosevelt Roads, Puerto Rico, including the military installations on Vieques Island. Because the AFWTF was not identified in the IAS, no further investigation was performed on the AIA.

A RCRA Facility Assessment (RFA) was performed in 1988. No areas of the AFWTF were identified as Solid Waste Management Units (SWMUs). A copy of the RFA report is included as Appendix J-2.

APPENDIX J-1

INITIAL ASSESSMENT STUDY (IAS)

September 1984

INITIAL ASSESSMENT STUDY OF NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

NEESA 13-051

NAVAL ENERGY AND ENVIRONMENTAL
SUPPORT ACTIVITY
Port Hueneme, California 93043

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INITIAL ASSESSMENT STUDY
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

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OF INSTALLATION POLLUTANTS (NACIP) DEPARTMENT
Naval Energy and Environmental Support Activity (NAVENENVSA)
Port Hueneme, California 93043

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Wallace Eakes, NAVENENVSA

EXECUTIVE SUMMARY

This report presents the results of the Initial Assessment Study (IAS) conducted at Naval Station (NAVSTA), Roosevelt Roads, Puerto Rico. The purpose of an IAS is to identify and assess sites posing a potential threat to human health or to the environment due to contamination from past hazardous waste operations.

Based on information from historical records, aerial photographs, surface and aerial surveys, and personnel interviews, 20 sites were identified at NAVSTA Roosevelt Roads as significant. Each site was assessed with regard to contamination characteristics, migration pathways, and pollutant receptors. The study concludes that while none of the sites investigated pose an immediate threat to human health or the environment, 16 sites were determined to warrant further study under the NACIP Program. The sites for which further investigation has been recommended are listed in priority order below:

Site 9, PCB Disposal, Dry Dock Area
~~Site 7, Station Landfill~~
Site 18, Pest Control Shop and Surrounding Area
Site 12, Two Way Road Fuels Farm
Site 15, Substation 2
Site 11, Building 145
Site 10, Building 25 Storage Area
Site 3, IRFNA/MAF-4 Disposal Site, Vieques
Site 13, Tanks 210 to 217
Site 14, Ensenada Honda Shoreline and Mangroves
Site 16, Old Power Plant, Building 38
Site 2, Mangrove Disposal Site, Vieques
Site 5, Army Cremator Disposal Area
Site 6, Langley Drive Disposal Site
Site 1, Quebrada Disposal Site, Vieques
Site 8, Drone Washdown

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FOREWORD

The Department of the Navy developed the Navy Assessment and Control of Installation Pollutants (NACIP) Program to identify and control environmental contamination from past use and disposal of hazardous substances at Navy and Marine Corps installations. The NACIP Program is part of the Department of Defense Installation Restoration Program, and is similar to the Environmental Protection Agency's Superfund Program authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

In the first phase of the NACIP Program, a team of engineers and scientists conducts an Initial Assessment Study (IAS). The IAS team collects and evaluates evidence of contamination that may pose a potential threat to human health or the environment. The IAS includes a review of archival and activity records, interviews with activity personnel, and an on-site survey of the activity. This report documents the findings of an IAS at Naval Station (NAVSTA) Roosevelt Roads, Puerto Rico.

Confirmation Studies under the NACIP Program were recommended at 16 sites at NAVSTA Roosevelt Roads and on Vieques Island. Atlantic Division, Naval Facilities Engineering Command (LANTNAVFACENGCOM) will assist NAVSTA Roosevelt Roads, Puerto Rico, in implementing these recommended Confirmation Studies.

Questions regarding this report should be referred to Naval Energy and Environmental Support Activity (NAVENENVSA), Code 112N, at AUTOVON 360-3351, FTS 799-3351, or commercial 805-982-3351. Questions concerning Confirmation Studies or other follow-on efforts should be referred to LANTNAVFACENGCOM, Code 114, at AUTOVON 564-9566, FTS 954-9566, or commercial 804-444-9566.

W. L. Nelson

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The Initial Assessment Study team commends the support, assistance, and cooperation provided by personnel at the Naval Energy and Environmental Support Activity (NAVENENVSA); the Atlantic Division, Naval Facilities Engineering Command (LANTNAVFACENGCOM); Ordnance Environmental Support Office (OESO); and Public Works Department, Naval Station (NAVSTA) Roosevelt Roads, Puerto Rico.

In particular, the efforts of the following people who assisted in coordinating and carrying out this study are acknowledged:

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Pilots and Crewmen of VC-8
NAVSTA Roosevelt Roads

Dr. Elaine Everly
National Archives, Washington, D.C.

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CHAPTER 1. INTRODUCTION

1.1 PROGRAM BACKGROUND. Past hazardous waste disposal methods, although acceptable at the time, have often caused unexpected long-term problems through the release of hazardous pollutants into the soil and ground water. In response to increasing national concern regarding these problems, Congress directed the U.S. Environmental Protection Agency (EPA) to develop a comprehensive national program to manage past disposal sites. The program is outlined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of December 1980.

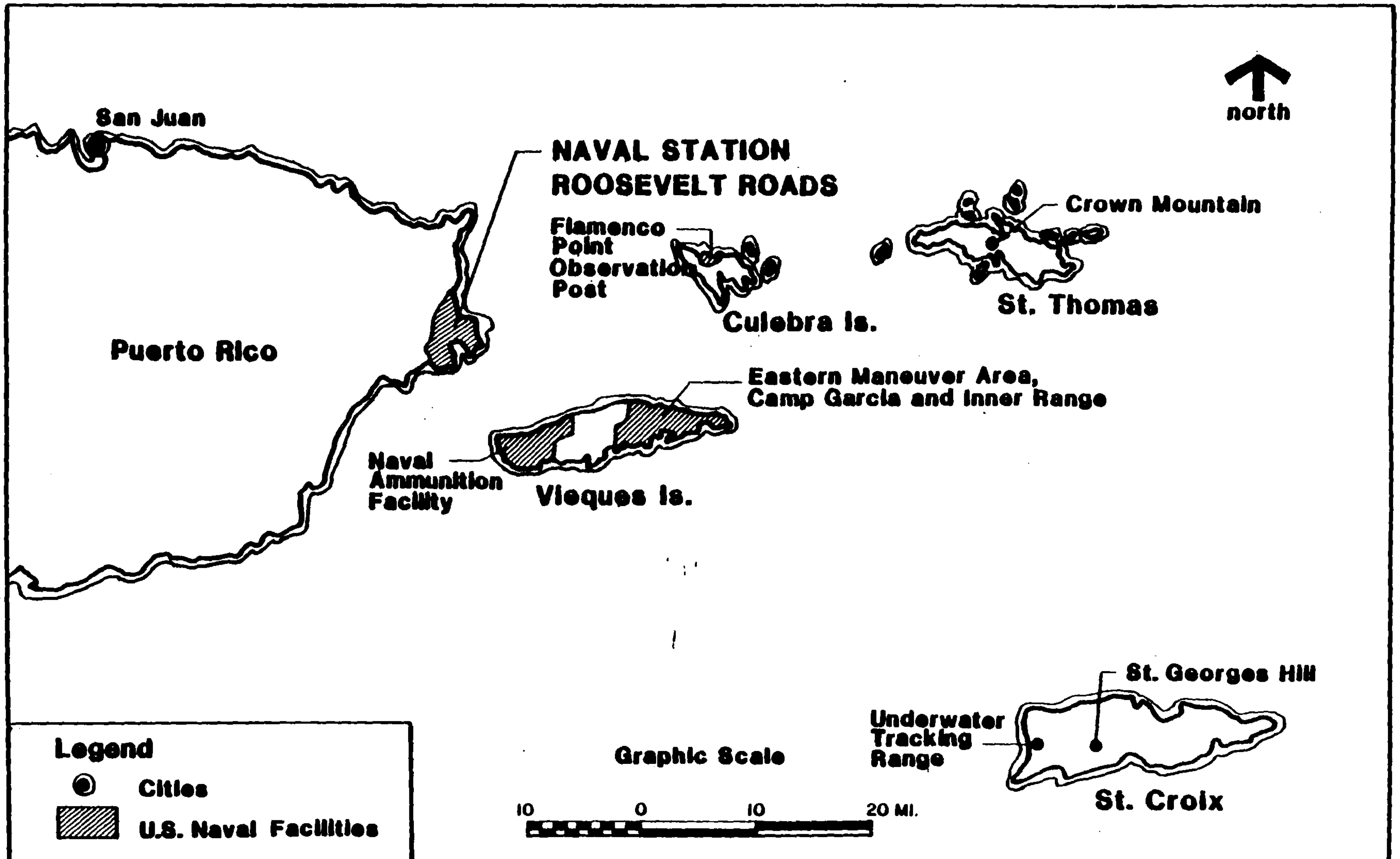
1.1.1 Department of Defense (DOD) Program. DOD efforts in this area preceded the nationwide CERCLA program. In 1975 the U.S. Army developed for DOD a pilot program to investigate past disposal sites at military installations. DOD defined the program as the Installation Restoration Program in 1980, and instructed the services to comply with program guidelines.

1.1.2 Navy Program. The Navy manages its part of the program, the Navy Assessment and Control of Installation Pollutants (NACIP), in three phases. Phase one, the Initial Assessment Study (IAS), identifies potential threats to human health or to the environment caused by past hazardous substance storage, handling, or disposal practices at Naval activities. Phase two, the Confirmation Study, analyzes contaminants present at sites of concern and determines their migration paths. Phase three, Remedial Action, provides the required corrective measures to mitigate or eliminate confirmed problems.

1.2 AUTHORITY. The Chief of Naval Operations (CNO) initiated the NACIP Program in OPNAVNOTE 6240 of 11 September 1980; superseded by OPNAVINST 5090.1 of 26 May 1983. Commander, Naval Facilities Engineering Command (COMNAVFACENGCOM) manages the program within the existing structure of the Naval Environmental Protection Support Service (NEPSS), which is administered by the Naval Energy and Environmental Support Activity (NAVENENVSA). NAVENENVSA conducts the program's phase one IASs in coordination with COMNAVFACENGCOM Engineering Field Divisions (EFDs). Activities are selected for an IAS by CNO, based on recommendations by COMNAVFACENGCOM, the EFDs, and NAVENENVSA. CNO specifically approved Naval Station Roosevelt Roads, Puerto Rico, as well as all outlying facilities on the islands of Vieques, Culebra, St. Thomas, St. Croix, and Puerto Rico for an IAS by CNO letter 451/391407 of 31 March 1982 (see Figure 1-1).

1.3 SCOPE.

1.3.1 Past Operations. The NACIP Program focuses attention on past hazardous materials storage, use, and disposal practices on Navy property. Current practices are regularly surveyed for conformity to state and federal regulations and, therefore, are not included in the scope of the NACIP Program. The IAS report addresses operating non-hazardous disposal and storage areas only if they were hazardous waste disposal or storage areas in the past. Similarly, current operations are investigated solely to ascertain what types and quantities of chemicals were used and what disposal methods were practiced in the past.



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

Figure 1-1. Location of Naval Station Roosevelt Roads and Adjacent Island Installations

1.3.2 Results. An IAS recommends, if necessary, mitigating actions to be performed by the activity or EFD, or sampling and monitoring (Confirmation Studies) to be administered by the EFD under the NACIP Program. Based on these recommendations, COMNAVFACENGCOM schedules Confirmation Studies for those sites determined by scientific and engineering judgment to be potential hazards to human health or to the environment.

1.4 INITIAL ASSESSMENT STUDY (IAS).

1.4.1 Records Search. The IAS begins with a records search at various government agencies, including EFDs, national and regional archives and records centers, and U.S. Geological Survey offices. In this integral step, study team members review records to assimilate information about the activity's mission, industrial processes, waste disposal records, and known environmental contamination. Typical examples of records include activity master plans and histories, environmental impact statements, historical records, and aerial photographs. Appendix A lists the agencies contacted during this study.

1.4.2 On-Site Survey. After the records search, the study team conducts an on-site survey to complete documentation of past operations and disposal practices and to identify potentially contaminated areas. With the assistance of an activity point of contact, the team inspects the activity during ground and aerial tours, and interviews long-term employees and retirees. The on-site survey for Naval Station Roosevelt Roads and other facilities mentioned above was conducted from 15 January to 10 February 1984. Information in this report is current as of those dates.

Information obtained from interviews is verified by data from other sources or corroborating interviews before inclusion in the report. If information for certain sites is conflicting or inadequate, the team may collect a limited number of samples to provide additional clarification. For this study, the IAS team collected a number of samples from closed containers at Site 11, Building 145.

1.4.3 Confirmation Study Ranking System. With the information collected during the study, team members evaluate each site for its potential hazard to human health or to the environment. A two-step Confirmation Study Ranking System (CSRS), developed at NAVENENVSA, is used to systematically evaluate the relative severity of potential problems. As the first step, a flowchart based on type of waste, type of containment, and hydrogeologic characteristics, eliminates innocuous sites from further consideration. If the flowchart indicates a site has potential contamination, a ranking model is applied. The ranking model assigns a numerical score from 0 to 100 to each site. The score reflects the characteristics of the wastes, the potential migration pathways from the site, and possible contaminant receptors on and off the activity.

1.4.4. Site Ranking. After ranking a site, engineering judgment is applied to determine the need for a Confirmation Study or an immediate mitigating action. At sites recommended for further work, CSRS scores are used to develop a priority list for scheduling projects. For a more detailed description, refer to the NAVENENVSA Confirmation Study Ranking System (NEESA 20.2-042).

1.4.5 Confirmation Study Criteria. A Confirmation Study is recommended on for sites at which (1) sufficient evidence exists to indicate the presence of contamination, and (2) the contamination poses a potential threat to human health or to the environment.

1.5 CONFIRMATION STUDY. The EFD conducts the Confirmation Study, which has two phases--verification and characterization. In the verification phase, short-term analytical testing and monitoring determines whether specific toxic and hazardous materials, as identified in the IAS, are present in concentrations considered to be hazardous. If required, a characterization phase, using longer term testing and monitoring, provides more detailed information concerning the horizontal and vertical distribution of contamination migrating from sites, as well as site hydrogeology. If sites require remedial actions or additional monitoring programs, the Confirmation Study includes the necessary recommendations, including design parameters.

1.6 IAS REPORT CONTENTS. In this report, the significant findings and conclusions from the IAS are presented in Chapter 2. Recommendations are presented in Chapter 3. Chapter 4 describes general activity information, history, physical features, and biology. Chapters 5 through 8 trace the use of chemicals and hazardous materials, from storage and transfer, through manufacturing and operations, to waste processing and disposal. Chapters 5 through 8 also provide detailed information to support the findings and conclusions in Chapters 2 and 3.

2. SIGNIFICANT FINDINGS AND CONCLUSIONS

2.1 INTRODUCTION. This chapter summarizes the significant findings and conclusions developed by the Initial Assessment Study (IAS) team for Naval Station (NAVSTA) Roosevelt Roads and the outlying Naval facilities on Vieques, Culebra, St. Thomas, St. Croix, and Puerto Rico. Fourteen sites at NAVSTA Roosevelt Roads and six sites on Vieques were identified where hazardous materials were potentially disposed or spilled. These sites are shown on Figure 2-1 (rear pocket) for NAVSTA Roosevelt Roads and Figure 2-2 for Vieques.

Section 2.2 is a summary of the migration potential of contaminants from disposal and spill areas. Migration potential is related to the characteristics of the disposal sites, the physical and chemical properties of the waste, the soils, and the ground water system in the vicinity of the site. Section 2.3 is a discussion of sites recommended for Confirmation Studies. Section 2.4 is a discussion of the sites not recommended for Confirmation Studies. For each site, the evidence is summarized supporting or refuting the presence of a potential threat to human health or to the environment. More detailed site discussions are presented in Chapter 8.

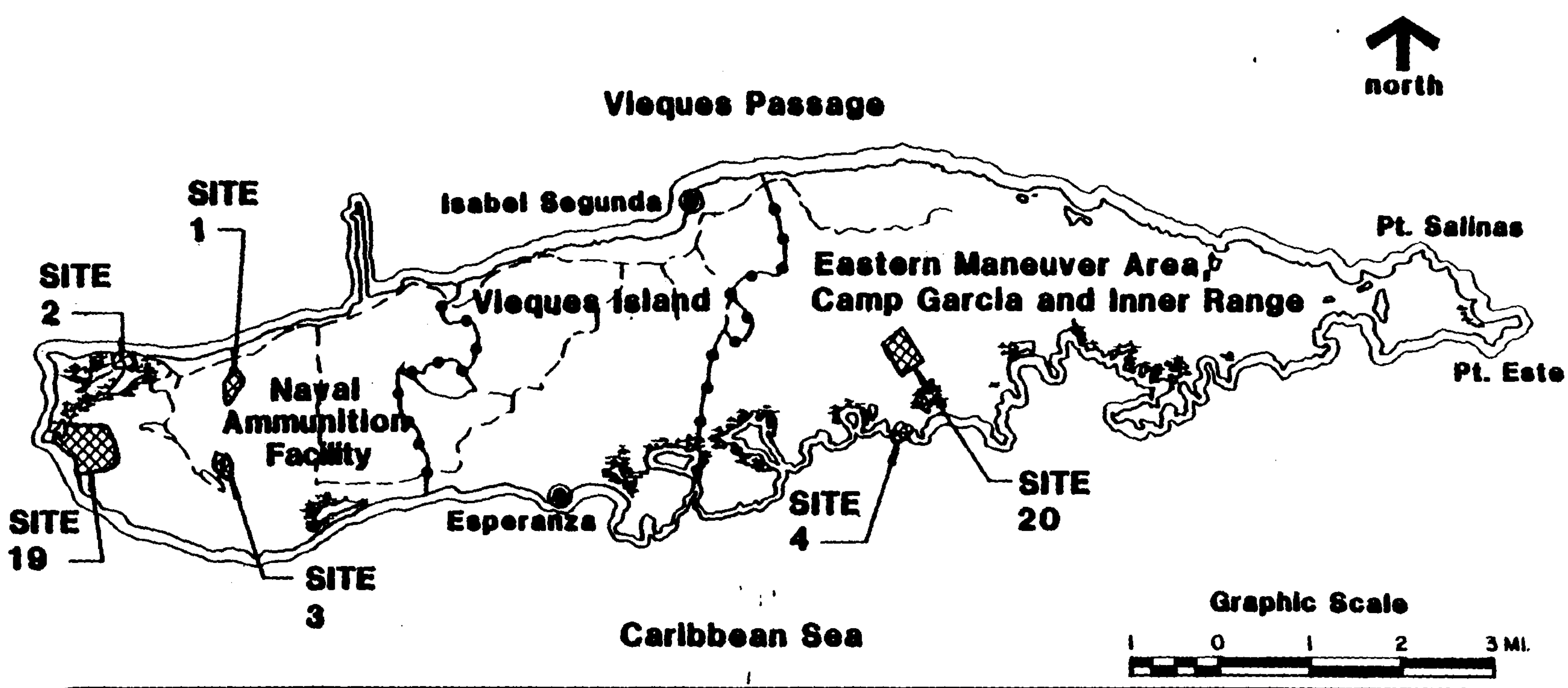
2.2 POTENTIAL FOR CONTAMINANT MIGRATION. Contaminant migration can occur in surface water through streams and ditches or in ground water. Ground water can discharge to surface water bodies such as streams, ditches, lakes, and bays.

The potential for contaminant migration in ground water is related to the physical properties of the aquifer, the chemical properties of the contaminant, and the hydraulic gradient. Migration potential is examined here in terms of a conservative chemical constituent traveling with the ground water. This does not take into account dispersion, dilution, attenuation, chemical reaction, or biological degradation of contaminants.

2.2.1 Vieques. Contaminants at the Naval Ammunition Facility (NAF) on Vieques can migrate by both surface water and ground water. The most likely pathways of surface water migration are from runoff in the quebradas, which are intermittent drainage areas. Runoff in the quebradas along the northern portion of Vieques enters the Vieques Passage. Runoff in the quebradas along the southern portion enters the Caribbean Sea. Other pathways include the areas of mangrove swamp that are subject to tidal inundation and ground water.

Ground water on Vieques flows generally to the northwest in the Valle de Resolución, one of the two main sources of ground water on the island and the only source located within the NAF boundaries. The Valle de Resolución is possibly subject to contamination. However, all potable water from the NAF and most of the rest of the island is supplied by pipeline from Puerto Rico; only a few houses outside the distribution system use ground water from the other source of ground water on the island, the Valle de Esperanza, located to the east outside the boundaries of the NAF.

Potential receptors in and around Vieques include such endangered species as the Caribbean manatee (Trichechus manatus) and the hawksbill, leatherback, green, and loggerhead sea turtles, all of which are found in the Vieques



Legend

Site # — Site Name

Confirmation Sites		Non-Confirmation Sites			
1	Quebrada Disposal Site	4	Fuels Off-Loading Site	•—•	Navy Property
2	Mangrove Disposal Site	19	EOD Range	— —	Roads
3	IRFNA/MAF 4 Disposal Site	20	Camp Garcia Disposal	◉	Towns
					Mangroves

INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

Figure 2-2 Areas of Significant Findings at Vieques Island

Passage. In addition, one spring on NAF property currently leased to a cattlemen's cooperative serves as a water source for wildlife and livestock.

2.2.2 NAVSTA Roosevelt Roads. Contamination at NAVSTA Roosevelt Roads can migrate both by surface water and by ground water. The most likely pathways of surface water migration are from runoff in the drainage ditches, which flow either into the Rio Daguao watershed, which occupies 2,000 acres on the southwestern portion of the base, or into Ensenada Honda, Puerca Bay, Medio Mundo Passage, Port Medio Mundo, or the mangrove swamps found along the shoreline of the station. Contamination from areas within the mangroves enters the surface waters when the swamps are inundated by tidal action. All surface waters from NAVSTA Roosevelt Roads eventually enter the Vieques Passage.

Ground water at NAVSTA Roosevelt Roads flows generally to the southeast. The alluvial aquifers are shallow (less than 30 meters deep) and yield water with high concentrations of iron and manganese from lenticular beds of clay, sand, gravel, and rock fragments. No use is made of ground water on the station; the nearest successful ground water development is approximately 10 kilometers to the north near Fajardo.

Receptors in the area of NAVSTA Roosevelt Roads include such endangered species as the Caribbean manatee; the hawsbill, leatherback, loggerhead, and green sea turtles; the yellow-shouldered blackbird; the Eastern brown pelican; the American peregrine falcon; the Puerto Rican plain pigeon; and the Puerto Rican boa. In addition, contamination may enter the human food chain through consumption of fish, shellfish, and crustaceans caught by base personnel or the local civilian population.

2.3 CONFIRMATION SITES.

2.3.1 Site 1, Quebrada Disposal Site, Vieques. This disposal area is located in the north-central portion of the NAF, Vieques, south of North Shore Road, within and adjacent to a quebrada which discharges to the Vieques Passage and ultimately to the Atlantic Ocean and the Caribbean Sea (see Figure 2-2). The site was in use from the early 1960s to the late 1970s by both civilian and U.S. Navy personnel. The site covers an area approximately 500 feet long by about 20 feet deep, and is about four feet wide. The IAS team estimates that there are about 1,500 cubic yards of trash at the site, including ordnance carriers; cans of oil and lubricants; solvents; paint; rubble; buried and exposed 55-gallon drums; cars; and all types of general base trash. The material apparently was tumbled down the side of the quebrada, and is partially buried. Some material lies on the bottom of the quebrada, where it has been transported further toward the Vieques Passage by the water that floods the quebrada.

No reliable information exists of the amount of material present that may be hazardous. The IAS team has calculated that possibly 15 cubic yards (between 3,000 and 13,000 pounds) of material could be considered hazardous when disposed, primarily solvents and paints (see page 8-1).

The disposal area is approximately 350 meters south of the Vieques Passage, and is about 10 meters above sea level. The slope of the quebrada is about 3%, with the exception of the 50 meters nearest the Vieques Passage, where the slope is about 10%. The soils in the quebrada are in the Coamo-Guarnani-Vives Association, and are moderately permeable (10^{-3} to 10^{-4} cubic meters per second).

Receptors in the Vieques Passage include such endangered species as the Caribbean manatee and the hawksbill, leatherback, green, and loggerhead sea turtles.

Contamination also could enter the human food chain through the consumption of fish caught in this area by base personnel or the local civilian population.

Site 1 is recommended for a Confirmation Study.

2.3.2 Site 2, Mangrove Disposal Site, Vieques. The mangrove disposal site (Site 2) is located in the northwestern portion of Vieques along North Shore Road (Route 70) (see Figure 2-2). The site stretches along North Shore Road for approximately 300 feet, and extends into a seaside mangrove swamp for about 100 feet. The site is located immediately east of the Laguna Kiani bridge, between Laguna Kiani and the Vieques Passage. During the 1960s and 1970s the site was used as a base disposal area. Materials found at the site include all types of trash, cans of oil and lubricants, solvents, paint, and rubble. The site contains an estimated 800 cubic yards of material. The material was piled, burned, and shoved into the mangrove swamp. No reliable information exists regarding the amount of material disposed of at the site that might be hazardous. The IAS team has calculated that possibly eight cubic yards (between 1,600 and 7,000 pounds) of material could be hazardous (see page 8-3).

Any contamination resulting from the waste disposed of at this site washes immediately into the ocean and would affect sea life, including manatee and sea turtle breeding and feeding grounds. The manatee and various species of sea turtles found in the Vieques Passage are listed as endangered or threatened species by the federal and Commonwealth governments. Contaminants also could enter the human food chain through the consumption of seafood caught in this area, especially the soft-shell crabs that are trapped in the vicinity of the Laguna Kiani Bridge.

Site 2 is recommended for a Confirmation Study.

Recommendations were made to remove the trash in the Draft Environmental Impact Statement (TAMS/E & E, 1979) and in the Mangrove Forests of Vieques report (Lewis et al., 1981) to ensure preservation of the mangroves as well as the sea life and and wildlife in the area. However, any cleanup activities should be delayed until completion of the Confirmation Study.

2.3.3 Site 3, IRFNA/MAF-4 Disposal Site, Vieques. In 1975, Weapons Department personnel emptied the fuel from 25 AQM-37A target drones into a quebrada near Building 422 at the NAF, Vieques (see Figure 2-2). A maximum total of 1,775 pounds of mixed amine fuel (MAF-4) and 5,275 pounds of inhibited red fuming nitric acid (IRFNA) were poured into the low area.

The quebrada lies within the surface drainage area for one of the few running springs on Vieques. The spring lies about 1.8 kilometers southeast of the disposal site. The source of the spring is not known; however, the general direction of flow in the Valle de Resolución ground water system is to the northwest, with water-bearing lenses found at a depth of about 30 meters, with no known springs. It is probable that the spring derives its flow primarily from surface recharge, including the drone fuel disposal area. The spring is on the property of the Cooperativa de los Ganaderos, a privately run livestock raising cooperative. The spring is used by both livestock and wildlife. Usually once a year, all other water sources (troughs, tubs, etc.) are removed to force the livestock to the spring, the only available source of water, where they can be captured, counted, or branded by cooperative members.

Site 3 is recommended for a Confirmation Study.

2.3.4 Site 5, Army Cremator Disposal Area. The Army Cremator disposal area (Site 5) is located south of the intersection of the access road to the Ammo Pier and Langley Drive, west and southwest of the Navy Exchange and Bowling Alley, in and near the Ensenada Honda mangrove swamp (U.S. Fish and Wildlife Service, 1978) (see Figure 2-1). Designated as the "Army Cremator" on early station maps, the area was used for waste disposal from the early 1940s through the early 1960s. Specific information concerning the materials disposed of at this site is limited. It is known, however, that most solid waste generated on the base during this time was disposed of at this site. An estimated 100,000 tons of waste material were disposed of here, including scrap metal, batteries, tires, appliances, cars, cables, dry cleaning solvent cans, paint cans, gas cylinders, construction debris, dead animals, and residential waste. During the aerial survey, the IAS team also viewed several large mounds of drums, some of which appeared to be intact in the trees. The material was disposed of by piling and burning, and then compacting. No reliable information exists regarding the amounts of material present in the disposal area that could be hazardous. The IAS team estimates that as much as 1,000 tons of hazardous material could be present in the area (see page 8-5).

Migration of contaminants to the Ensenada Honda mangrove area and ultimately to Ensenada Honda is probable. Some of the disposed material lies directly in the mangrove swamp, and is subject to periodic tidal inundation. The majority of the material lies on soils of the Swamp-Marshes Association, which are poorly drained, and subject to flooding by high tides or following intensive rainfall.

The mangroves are considered an ecologically important area because they provide food and shelter for the minute organisms at the start of the food chain. The disposal area itself is designated by NAVSTA Roosevelt Roads (LANTNAVFACENGCOM, 1981) as habitat for the short-eared owl (see Figure 4-1). The Ensenada Honda mangrove area provides habitat for the following species: the white-crowned pigeon, yellow-shouldered blackbird (a federally listed endangered species), reddish egret, common egret, snowy egret, great blue heron, whimbrel, osprey, and willet. Ensenada Honda provides habitat for the West Indian manatee and several species of sea turtles which are federally designated endangered species. Contamination from the Army Cremator disposal area could affect the food chain for these endangered species, as well as base personnel and civilians through bioaccumulation of contaminants contained in the small fishes and other marine life upon which they feed.

Site 5 is recommended for a Confirmation Study.

2.3.5 Site 6, Langley Drive Disposal Site. The Langley Drive disposal site (Site 6) served as a landfill from approximately 1939 to 1959 (see Figure 2-1).

The volume of waste disposed of at the site is estimated to be 1,700 cubic yards of material and fill. Materials found during site inspection included partially buried metal and concrete objects, old fuel lines, flexible metal hoses, small containers containing pellets, steel cables, hardened tar, rubble, and 10 to 15 full 55-gallon drums which are corroded. The drum contents, usually consisting of a whitish solid with a green outer crust, are exposed. The IAS team estimates that as much as 20,000 pounds of hazardous material could be present at the site (see page 8-7).

The disposed material lies within the perimeter of the Ensenada Honda mangrove area. Surface and subsurface drainage flows directly into the immediate mangrove area and subsequently into Ensenada Honda. Much of the disposed material is partially buried in the mangrove mud; the area visited by the IAS team lies completely within the mangrove swamp and is subject to periodic tidal inundation.

Primary receptors are the flora and fauna, including endangered species which inhabit the mangrove environment (see Section 2.3.4). Stressed vegetation is apparent at the site. Secondary receptors are those species which live at the mangrove-bay exchange zone, including sea turtles and manatees which are listed as threatened and endangered species by the federal government. The site could also present a hazard to the base population through the food chain since the Army Pier, a prime recreational fishing area, is located adjacent to the drainage.

Site 6 is recommended for a Confirmation Study.

2.3.6 Site 7, Station Landfill. This site has been used as the station landfill since the early 1960s, when the Army Cremator disposal area (Site 5) was abandoned (see Figure 2-1). The landfill reportedly has received at least 270,000 tons of waste including paint waste, solvents, polychlorinated biphenyls (PCBs), OTTO Fuel II, Agentine, pesticides, transformers, asbestos, waste oil, dead animals, and other wastes. Prior to 1978, disposal was not regulated. The site encompasses 85 acres, most of which were used for waste disposal prior to 1978.

A number of drums and other containers are piled in the brush around the site. No reliable information exists regarding the amount of material that might be hazardous that was disposed of at this location. At least 200 gallons of PCB dielectric fluids were disposed of here, as well as several 55-gallon drums filled with fluids drained from transformers that could be contaminated with PCB. The IAS team estimates that as much as 2,700 tons of hazardous material could be present at the older portions of the site (see page 8-9).

Contamination from this site could migrate by surface and subsurface flow. The soils of the site are hydraulic fill, which generally consists of sand and mud. The water table in this area is very near the surface, everywhere less than 10 feet, and in places at depths of two feet or less. Ground water flow has not been measured in the area, but can be assumed to be in all directions toward the surrounding bodies of water, e.g., the Ensenada Honda and Puerca Bay.

Ensenada Honda provides habitat for the West Indian manatee and several species of sea turtles designated as endangered species. In addition, the entire Naval

Station, with the exception of built-up areas, has been officially designated as critical habitat for the yellow-shouldered blackbird. Contamination from the old sections of the station landfill could affect the food chain through bioaccumulation of contaminants contained in the small fishes and other marine life upon which these endangered species feed; base personnel and the local population also fish in these areas.

Site 7 is recommended for a Confirmation Study.

2.3.7 Site 8, Drone Washdown. The drone washdown site (Site 8) is located adjacent to Building 860 (see Figure 2-1). During the 1960s and 1970s approximately 4,000 gallons of oil, grease, and JP-4 and JP-5 fuel were disposed of in a drainage ditch adjacent to Building 860. The drainage system flows through mangrove areas to Ensenada Honda. Movement of contaminants from this site would be primarily by surface flow.

Ensenada Honda is a feeding and breeding ground for the endangered West Indian manatee and four species of sea turtles. The mangrove areas contain such receptors as the endangered yellow-shouldered blackbird and is an important habitat for small fishes and other food organisms.

Contamination could also enter the human food chain through bioaccumulation in the fish feeding in this area of the harbor, which could be consumed by base personnel or the local civilian population.

Site 8 is recommended for a Confirmation Study.

2.3.8 Site 9, PCB Disposal, Dry Dock Area. In approximately 1968, 25 five-gallon cans (125 gallons) of Askarel (a PCB dielectric fluid) were disposed of by dropping them into Puerca Bay off the south side of the wharf at the dry dock (see Figure 2-1). Some of the cans, which had been stored in Public Works Building 31, were in a rusted condition at the time of the disposal.

The site is located in an area designated as critical habitat for the manatee (see Figure 4-1), and is also a known habitat for several Commonwealth and federally designated rare and endangered species, including several species of sea turtles. Potential receptors of PCB contamination from this site also include infaunal and sessile benthic organisms (polychaetes, corals, bivalves, clams, and annelides), predators of benthic organisms (fish), and ultimately the people who use the wharf for recreational fishing.

Site 9 is recommended for a Confirmation Study.

2.3.9 Site 10, Building 25 Storage Area. Building 25 was used for temporary storage of Public Works-Supply Department material scheduled to be turned over to the Defense Property Disposal Office (DPDO). Building 25 was used from the 1940s to about 1979, when it collapsed. The site contains material within the collapsed building, around the building, and randomly scattered along the various access roads in the immediate vicinity (see Figure 2-1). Material found included 20 to 25 apparently empty to partially filled 55-gallon drums, 10 to 15 corroded five-gallon pails (the contents of which have been exposed to the environment), asbestos sheeting, transformers (one of which has leaked dielectric fluid), mechanical devices, gas cylinders, and construction rubble. The overgrown areas between the access roads have been used for the disposal o. similar material, including containers and large canisters. In addition, adjacent to the northern boundary of the Building 31 transportation lot, approximately 50 drums are present, most of which are full or partially full. Some of the drums are leaking. Some of the containers appear to have been used for the disposal of materials other than their original contents, i.e., they have obviously been opened and reused. Other containers appear to be intact, and may contain the original material. Most original markings on the containers are no longer discernible. The IAS team has concluded, based on the sampling efforts conducted at Site 11, Building 145, that the contents of these containers would be classified as hazardous.

Due to the physical characteristics of the site and the lack of ground water use, ground water contamination is not of great concern, although stressed vegetation was evident in the immediate location of some drums. However, the location of these leaking drums allows direct contact with base personnel, thus representing an immediate health and safety concern. Because of the free access to the area, the primary receptors are base personnel and wildlife.

Site 10 is recommended for a Confirmation Study.

2.3.10 Site 11, Building 145. Building 145 (Site 11) contains an estimated 60 55-gallon drums, about 100 five-gallon pails, and a number of other small containers (see Figure 2-1). The building is a bunker about 60 yards long and about seven feet high and eight feet wide, with three openings to the surfac through the roof covered with dilapidated wood structures, and one entrance ground level. Based on the structure's shape and location, it is probable the building was designed to be used for activities in conjunction with the dry dock.

The drums and other containers have been in the building for some years, probably since 1957. Samples were taken by the IAS team from 21 55-gallon drums, eight five-gallon pails, and three areas of spills or other materials. This left over 75 containers unsampled. The containers sampled ranged from drums with fairly discernible markings and intact bung seals, to drums and pails that had obviously been opened and used for disposal of waste material. Material identified only by sight by the IAS team included spray paint, olive drab paint, black boot polish, and some adhesives. The remaining materials are awaiting analysis by contract laboratories under hire to Atlantic Division, Naval Facilities Engineering Command (LANTNAVFACENGCOM).

A number of containers that were not opened have rusted through, or are missing tops or bungs. Some containers are intact, and probably contain the original material shipped in them. Other containers have obviously been used for the disposal of materials other than their original contents. Most containers have illegible markings. Some containers have totally disintegrated, and their contents have spilled onto the floor. Based on the nature of the material sampled, and the ambient air characterization readings obtained with various instruments during the sampling effort, the IAS team has concluded that the majority of the material (an estimated 2,000 gallons) could be classified as hazardous.

A number of containers are on the verge of rupturing or leaking. The ambient air characterization conducted by the IAS team indicates that the contents of these containers are highly volatile; additional leaks could lead to an explosive or flammable atmosphere in the building.

The tunnel has water, probably rain water, in the lowest point. Several trees have sunk roots into the water through the roof opening. The concrete floor seems impervious. The building is accessible to base personnel.

Site 11 is recommended for a Confirmation Study.

Tow

2.3.11 Site 12, Two Way Road Fuels Farm. A number of fuel storage tanks are located north of Two Way Road on a hill overlooking Ensenada Honda (see Figure 2-1). Spills, leaks, and sludge disposal have occurred here since 1957.

In 1957 or 1958 a fuel line to Tank 82 burst, resulting in a major spill of Bunker C fuel. It is estimated that 420,000 gallons of Bunker C fuel leaked from the storage tank. The oil spill followed a path downhill toward the harbor in a southwesterly direction across Two Way Road and into Ensenada Honda, extending to the shoreline and the Ensenada Honda mangrove swamp across the harbor.

It is also estimated that 420,000 gallons of fuel spilled from Tanks 56A and 56B, located north of Building 54 on Two Way Road, onto the surrounding soil over a 15- to 20-year period. The tanks were removed in February 1984. A dark fuel-stained soil was present around the old tanks. Isolated pools of oil from the spills and leaks were evident on the ground water that seeped into the holes where the tanks had been removed.

Between 1971 and 1972, Tanks 83 and 1080 were cleaned and the Bunker C fuel-sludge was emptied into two pits dug within a 100-foot radius of the tanks. One pit was dug approximately 100 feet in circumference and 10 to 20 feet in depth near Tank 83; the second pit was 50 feet in circumference and 10 to 20 feet in depth near Tank 1080. It is estimated that 3,900 to 7,500 cubic yards of Bunker C fuel-sludge were cleaned from the tanks and disposed of at the site in these pits.

In 1978 a leak occurred at Tank 1080, resulting in the release of about 65,000 gallons of diesel fuel from the tank. It is estimated that about 10,000 gallons were recovered during cleanup operations. Effects from the spill are still present along the approximate 2,000-foot-long, 100- to 200-foot-wide spill corridor. These include stressed vegetation, stained soil devoid of vegetation, constant seepage of fuel into the leaching trench and the harbor, and contaminated shoreline and mangrove swamps.

Contaminants could migrate from the site by surface and subsurface flow. Oil-stained ground at the site clearly depicts the surface flow pattern from the bermed fuel farm through culverts across Two Way Road to an outlet into Ensenada Honda, where oil booms are left in place to catch the oil that still emerges after rainfall. A leaching pit dug to the northwest of the Fuel Pier is filled with oil that is migrating below the surface. Diesel fuel was observed on top of ground water in the holes where Tanks 56A and 56B were removed.

Receptors in this area include wildlife and sea life in the Ensenada Hor mangrove area and Ensenada Honda, including manatees and sea turtles. Contamination may also enter the human food chain through the consumption of fish caught in the harbor by base personnel or the local civilian population.

Site 12 is recommended for a Confirmation Study.

2.3.12 Site 13, Tanks 210 to 217. This site is located within a 300-foot diameter around each of the Tanks 212 to 217 along Manila Bay Road, north of Forestal Drive (see Figure 2-1). The tanks were constructed in 1948 for the storage of AVGAS, and were cleaned approximately every five years until 1978. (This excludes Tanks 210 and 211, which were abandoned in 1950, and probably cleaned only once.) Tank cleaning normally resulted in the removal of 20 to 30 drums (800 to 1,250 gallons) of leaded sludge per tank. This sludge was disposed of in a series of pits (eight feet by eight feet by eight feet), which were dug by a backhoe within 300 feet of the tank being cleaned. After the sludge settled in the pits, it was covered with three to four feet of soil. It is estimated that 30,000 to 50,000 gallons of leaded sludge were disposed of at these areas over a 40-year period.

The contaminants could migrate from the site by subsurface flow. The disposal pits are located on hillsides at elevations five to 15 meters above the adjacent Machos mangrove swamp. The slope from the tanks to the swamp varies from 10% to 40%. The soils are in the Descalabrado clay loam and Jacana clay series, which have shallow depth to bedrock.

Receptors include the Machos mangrove area, which is a habitat for the yellow shouldered blackbird. Contaminants would also enter the Vieques Passage, which serves as a breeding and feeding ground for the manatee and sea turtles previously discussed. The mangroves also serve as a habitat for many juvenile fish species.

Contamination may also enter the human food chain through consumption of fish caught in the harbor by base personnel or the local civilian population.

Site 13 is recommended for a Confirmation Study.

2.3.13 Site 14, Ensenada Honda Shoreline and Mangroves. This site is located in Ensenada Honda and along the shoreline adjacent to Berthing Pier No. 3, Community Beach, the mangrove swamp north of Community Beach, and the area south to about Punta Cascajo (see Figure 2-1). It is estimated that 210,000 gallons of diesel fuel spilled into the harbor from the tanker ship, the Arco Prestige, in 1981. Cleanup operations were conducted by the Navy and Crowely Environmental Company. An oil separator barge was used to collect oil from the harbor, and absorbent pads were used to remove oil along the shoreline. Oil-stained sand was also removed from Community Beach. An estimated 20,000 gallons were recovered. The remainder of the fuel was blown ashore or sank. In addition, material from the 1978 diesel spill from Tank 1080 and the 1958 Bunker C fuel spill from Tank 82 drifted into the Ensenada Honda mangroves.

Spilled oil can still be found in the Ensenada Honda mangrove swamp and along the shoreline in proximity to the berthing pier. Contamination may also be present on the bottom of the harbor. Receptors include the manatee and sea turtles previously discussed, the endangered yellow-shouldered blackbird, and the many juvenile and food organisms found in the mangrove swamps. Contaminants may also enter the human food chain through the consumption of fish caught in the harbor by base personnel or the local civilian population.

Site 14 is recommended for a Confirmation Study.

2.3.14 Site 15, Substation 2. This area has been utilized for the repair of electrical transformers since 1964 (see Figure 2-1). From 1964 to 1979 oil drained from transformers was poured onto the ground in the vicinity of Building 90 (Substation 2). It is estimated that a maximum of 3,000 gallons of transformer oil, probably containing PCB, were disposed of at this site.

The soils at this site are probably contaminated with PCB. This site poses a potential threat to the health of the workers who currently work at the site.

Site 15 is recommended for a Confirmation Study.

2.3.15 Site 16, Old Power Plant, Building 38. From 1956 to 1964 Building 38 (Site 16) was used for the repair and storage of electrical transformers (see Figure 2-1). During this period, used oil drained from transformers was poured onto the ground in the vicinity of Building 38. It is estimated that a maximum of 1,600 gallons of transformer fluid probably containing PCB were disposed of in the area.

Contamination from this site could migrate by subsurface flow. The site is at a high point on hydraulic fill with a gentle (3%) slope to the northeast toward Puerca Bay and southwest toward Ensenada Honda, both within 250 meters. The water table is at about a 10-foot depth. Immediately southwest, west, and north of the site is a large rock outcropping 10 meters high surrounding Building 38 on three sides and limiting ground water movement in three directions. Immediately southwest of the disposal site, and running across the width of the peninsula, is a subsurface inlet-outlet tunnel for cooling water for the old power plant, which withdrew water from Ensenada Honda and discharged it to Puerca Bay. Contaminants from the disposal site could migrate to the southeast to the cooling water tunnel, and migrate along the trench to the northeast and southwest.

Both Puerca Bay and Ensenada Honda provide habitat for the endangered West Indian manatee and several endangered sea turtles. Potential receptors include base personnel, who fish in the harbors, and the endangered manatee and sea turtles.

Site 16 is recommended for a Confirmation Study.

2.3.16 Site 18, Pest Control Shop and Surrounding Area. Building 258 served as the Pest Control Shop from the late 1950s through 1983 (see Figure 2-1). Accidental spillage of pesticides occurred in and around the building during this time. The immediate area is devoid of vegetation. Pesticide application equipment was routinely cleaned over a storm drain which discharged to a ditch in back of the building. Excess pesticides were also disposed of in this ditch, where vegetation kills have been reported. According to Annual Pest Management Plan for NAVSTA Roosevelt Roads, pesticides used in the past include

DDT, Paris Green, maldene, malathion, and chlordane. Pesticide odors are :ry strong in the vicinity of Building 258, even though pesticides have not been stored there since 1983.

No reliable information exists regarding the amount of pesticides used, spilled, or disposed of at the site. The IAS team estimates that at least 10 gallons of malathion from a ruptured 55-gallon drum entered the drainage ditch; other spills, leaks, and rinse water could amount to several hundred gallons of material spilled over the more than 20 years of operation.

The drainage ditch is located within two meters of the storm drain used for equipment washdown, and about 10 meters from the building itself. Areas of stressed vegetation are within one meter of the ditch, which flows into Ensenada Honda. Contaminants could have migrated from the site by surface flow through this system.

Receptors include the endangered species previously discussed, and might include base personnel who consume fish caught in Ensenada Honda.

Site 18 is recommended for a Confirmation Study.

2.4 NON-CONFIRMATION SITES AND OTHER SIGNIFICANT FINDINGS.

2.4.1 Site 4, Fuels Off-Loading Site, Vieques. This site is located off the south coast of Vieques in Ensenada Tanqueray east of Bahia de la Chiva (Blu Beach) (see Figure 2-2). Over a 25-year period, offshore refueling of fou fuel tanks (containing diesel fuel, MOGAS, and JP-5 fuel) that were located a hilltop overlooking the bay occurred a maximum of four times a year. Fuel was pushed through an eight-inch submarine pipeline to remove the saltwater. The seawater/fuels mixture spilled onto the shore as the line was cleared; once fuel pumping was complete, the line was detached from the fuels barge and dropped back into the water.

The effects of spills resulting from the refueling operation were minimal. An extensive environmental survey conducted in 1978 (TAMS/E & E, 1979), shortly after the tanks were dismantled and the refueling halted, failed to find any indications of stressed vegetation or fauna; no oiled beaches or other indications of pollution were found. Because no effects on the environment or to human health could be postulated, Site 4 is not recommended for a Confirmation Study.

2.4.2 Site 17, Crash Crew Fire Training Area. Two unlined fire fighting training pits were used from 1963 to 1983 at the Crash Crew training area (Site 17) located near Building 827 (see Figure 2-1).

The first pit, which was used for about 20 years (1963 to 1983), received approximately 120,000 gallons of waste solvents, fuels, oil-stained absorbent pads, fuel filter elements, trash, wood, oily rags, plastic, and oils from various departments at Roosevelt Roads, including Hangar 200, Aircraft Intermediate Maintenance Division (AIMD), Fleet Composite Squadron Eight (VC-8), Navy Marine Construction Battalion (NMCB), Surface Operations, and the Fuels

Division. A new concrete-lined fire fighting training pit of about the same dimension (40-foot diameter) was constructed in 1983 in the same location as the old pit. Visibly contaminated soils were excavated in the immediate vicinity of the old pit during construction; there are no records of ultimate disposal for this contaminated material. A soil sample was taken of this soil and no PCBs were detected.

Another unlined fire fighting training pit measuring about 200 feet in diameter was only used five or six times in 1983 during the construction of the new pit mentioned above. Approximately 3,000 gallons of waste oil, fuel, oily rags, trash, wood, plastic, and solvents were burned in this area. The majority of material was burned.

Because the contaminated soils associated with the original fire pit were removed during construction of the new pit and no PCBs were detected, and because the temporary pit was used so little, the IAS team has concluded that there is no threat to human health or the environment from this site. No further action under the NACIP Program is warranted.

2.4.3 Site 19, West Explosive Ordnance Disposal (EOD) Range, Vieques. The West EOD Range (Site 19) on Vieques was located on the western edge of the island, on NAF property, within an estimated one-half-mile radius of the old bridge at Punta Boca Quebrada (see Figure 2-2). Other ranges have been used and are being used on Vieques; however, these ranges are outside the scope of the IAS. The West EOD Range was in operation from at least 1969 to 1979, and according to some interviewees, had perhaps been in use since the late 1940s.

The West EOD Range was used for disposal of excess and retrograde ammunition and, on a twice yearly basis, unexploded munitions found around the targets on the Eastern Maneuver Area (EMA). Other sources of materials would be the material from the rework of munitions (loose powder, primers) and ordance items from the Torpedo Shop. Materials disposed of at the site include flares and cartridge-activated devices. The range had a maximum blow limit of 4,000 pounds of TNT equivalent.

The range was closed in 1976 to most uses and swept for a one-mile radius by EOD personnel at least three times. The range was fully closed in 1979.

Currently, only inert items are visible in the area. Due to the limited nature of materials disposed of there (for example, no smoke generating material or other chemicals were disposed of) and the extensive cleanup of the area, the IAS team has concluded that further study of the site under the NACIP Program is not warranted.

2.4.4 Site 20, Camp García Disposal Site, Vieques. The Camp García disposal site (Site 20) is located on high ground approximately 3,000 to 4,000 feet north-northwest of Bahía de la Chiva (Blue Beach) and 1.5 to 2 miles east of Camp García (see Figure 2-2). The site was in operation from approximately 1954 to 1978. It is estimated that 1,800 to 3,120 tons of waste, including paper, corrugated containers, rugs, wood, scrap metal, cans and food packaging materials, and yard waste, were brought to the site and burned (trench method of disposal). No hazardous materials were placed in this disposal area. The materials disposed of at the site present no threat to ground water or to the wildlife and sea life at or in proximity to the site.

Other disposal areas on Camp García include a construction rubble dispo area, a scrap metal disposal area, and an aboveground disposal area for gene trash. These areas do not constitute a potential pollution threat. The team has concluded that further investigation under the NACIP Program is warranted.

2.4.5 Crown Mountain, St. Thomas. The Crown Mountain site facility on S Thomas is part of the Atlantic Fleet Weapons Training Facility (AFWTF) targ tracking and control system, and serves also to track aircraft and surfa vessels in conjunction with AFWTF facilities at Pico del Este (see Figure 2-3

Waste generating activities at the current site (occupied since 1975), and t old site some 100 yards away, have been extremely limited. All solid wast are disposed of by island authorities. No hazardous materials are used at t contractor-operated site. Because of the insignificant waste generation, th Crown Mountain site does not warrant further study under the NACIP Program.

2.4.6 St. Georges Hill, St. Croix. St. Georges Hill, St. Croix, is part o the AFWTF Electronics Warfare Range (EWR) and is engaged in tracking and con trolling targets (drones); tracking missiles, aircraft, and surface vessels providing a realistic simulated hostile electronic environment for the trainin of ship and aircraft electronic warfare teams; and supporting exercises o other AFWTF ranges by generating an electronic order-of-battle (see Figur 2-4). The St. Georges Hill complex consists of several trailers and vec facilities such as Threat Platform Simulators (TPS).

Activities at the complex are such that little waste is generated. The amounts and types of waste, coupled with the facility's location atop 864-foot-high St. Georges Hill, lead the IAS team to conclude that this site is not a potential threat to human health or the environment, and thus does not warrant further study under the NACIP Program.

2.4.7 Underwater Tracking Range (UTR), St. Croix. The UTR is located on the western seashore of St. Croix at Sprat Hole. The UTR provides roughly 69 square miles of deep water fully instrumented for the three-dimensional tracking of ships, submarines, and underwater weapons. The complex consists of a number of trailers and a cable head-in (see Figure 2-4).

The types and amounts of waste generated by activities at the facility are so innocuous that the site does not represent a potential pollution problem. Further study under the NACIP Program is not warranted.

2.4.8 Observation Post (OP), Culebra. The OP on Flamenco Point on Culebra is the only remaining facility of what was once the major gunnery and aircraft bombing range for the Atlantic Fleet. The OP now serves as a communications relay station (see Figure 2-5).

The area adjoining and partially on the OP property is a unique boulder forest, one of two known in the world. The boulder forest is also home to the arboreal nocturnal carniverous giant Culebra anole, an extremely rare species.

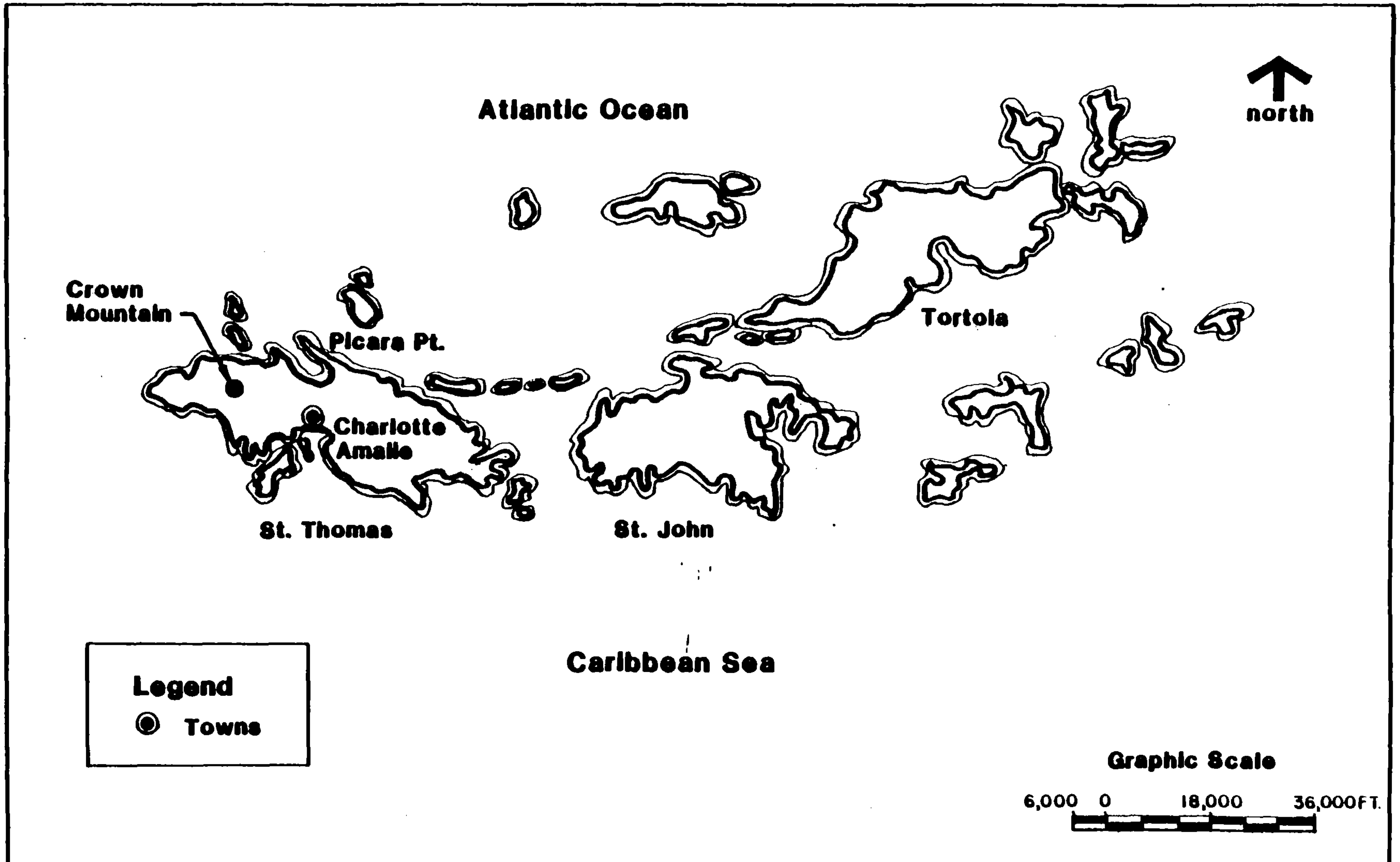


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Figure 2-3. Areas of Significant Findings at St. Thomas Island

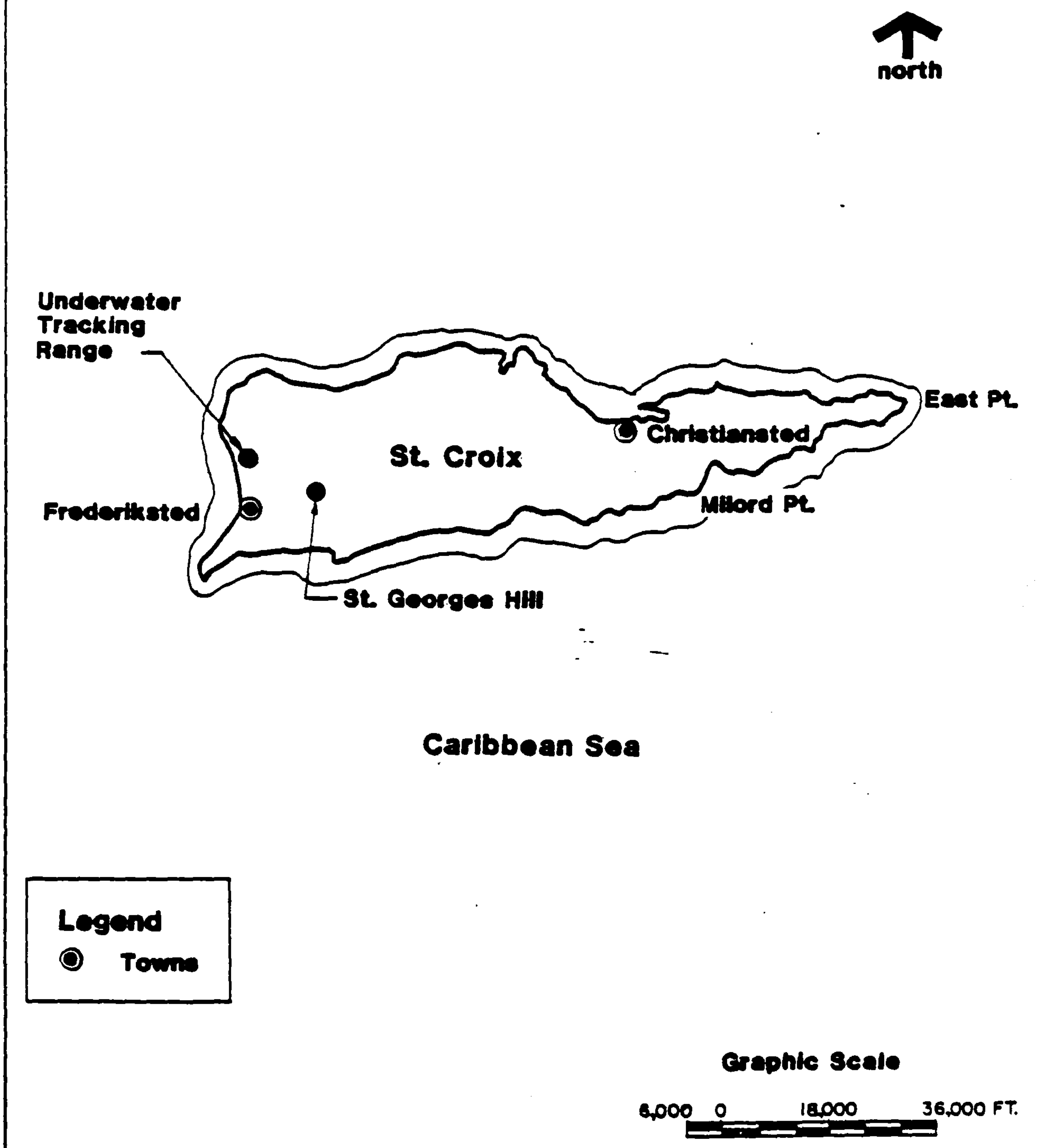

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Figure 2-4.
Areas of Significant Findings
at St. Croix

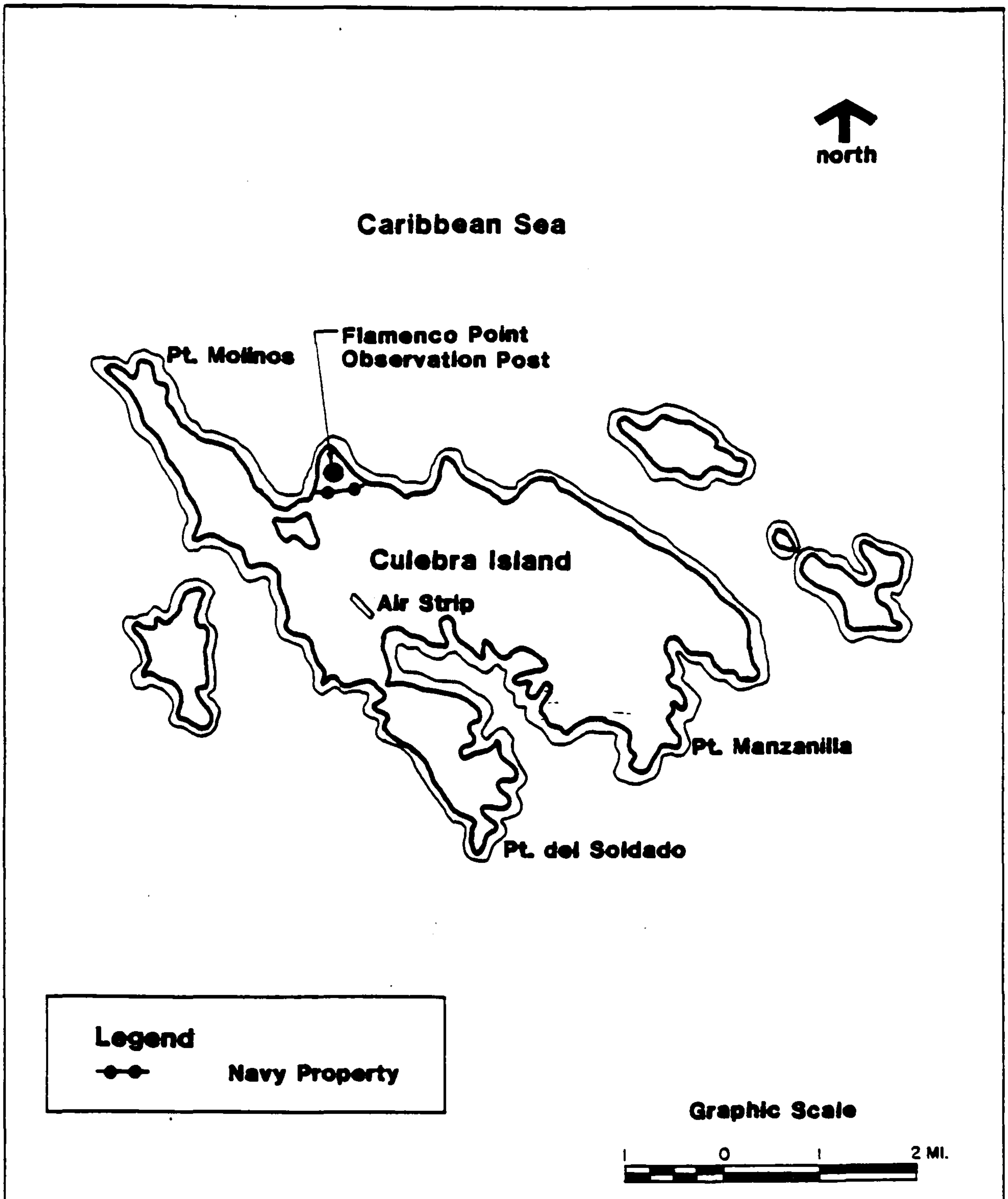

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Figure 2-5.
Areas of Significant Findings at Culebra Island

None of the activities conducted at the OP generated wastes that present threat to human health or the environment. The IAS team has concluded that the site does not warrant further study under the NACIP Program.

2.4.9 Pico del Este. The AFWTF site at Pico del Este is located in the Luquillo National Forest, and provides air and surface radar coverage for the AFWTF operating area. No hazardous wastes have ever been generated here. The IAS team has determined that further investigation under the NACIP Program is not warranted at this site.

2.4.10 NAVSTA Roosevelt Roads, West Annex, Aguadilla. This facility is located at the former Ramey Air Force Base at Punta Borinquen. Roosevelt Roads currently owns 11 buildings which were excessed by the Air Force in 1973. Two the buildings (Buildings 561 and 703) are leased to the Commonwealth of Puerto Rico, which in turn leases them for commercial use. All of the buildings have been declared excess and are awaiting disposal through the General Services Agency. There were no areas of contamination identified at this site. The IAS team has concluded that further investigation under the NACIP Program is not warranted.

CHAPTER 3. RECOMMENDATIONS

3.1 INTRODUCTION. Based on the significant findings and conclusions, three sites on Vieques and 13 sites at Roosevelt Roads are recommended for Confirmation Studies. No sites on St. Thomas, St. Croix, Culebra, or at the West Annex and Pico del Este were recommended for Confirmation Studies. Table 3-1 presents a summary of the recommended studies. A two-step Confirmation Study Ranking System (CSRS) was used to systematically evaluate the relative severity of potential problems at each site.

3.2 CONFIRMATION STUDY RECOMMENDATIONS.

3.2.1 <u>Site 1, Quebrada Disposal Site, Vieques</u>. See Figure 3-1.

Type of Samples:	Soil borings.
Number of Soil Samples:	Three samples consisting of three borings at each location composited into one sample.
Frequency of Soil Sampling:	Twice; once each during wet and dry periods.
Testing Parameters:	Total organic carbon (TOC); total organic halogens (TOX); pH; oil and grease; purgeable organics; copper, chromium, lead, and zinc (see Table 3-2).

Remarks: One series of three samples upgradient of the major deposits in the quebrada, one series of three samples at the northernmost edge of the deposits, and one series of three samples south of the North Shore Road (Route 70) just before the quebrada crosses underneath the road. Three samples will be taken from zero to six inches at each location and composited.

3.2.2 <u>Site 2, Mangrove Disposal Site, Vieques</u>. The sampling is designed to establish the nature of the material disposed of at the site. See Figure 3-1.

Type of Samples:	Soil borings to determine depth of material disposed; composite split spoon samples.
Number of Soil Samples:	Four in disposal area.
Frequency of Soil Sampling:	One time; positives will dictate the need for additional sampling.
Testing Parameters:	TOX; chromium, copper, lead, and zinc (see Table 3-2).

Table 3-1

SUMMARY OF RECOMMENDATIONS, NAVAL STATION ROOSEVELT ROADS, STUDY NUMBER 051

			Verification (One Time Study)			Characterization (First Year Effort)		
			Sampling			Sampling		
Site Number	Site Name	CSRS* Score	No. Soil Samples	No. Water Samples	Lab Testing Parameters	No. of Wells	No. of Samples	Lab Testing Parameters
051-1	Quebrada Disposal Site	9	6	--	TOC, TOX, pH, oil and grease, purgeable organics, Cu, Cr, Pb, Zn	--	--	--
051-2	Mangrove Disposal Area	10	8	--	TOX, Cr, Cu, Pb, Zn	Dependent on positives from verification effort		
051-3	IRFNA/MAF-4 Disposal Site	17	--	2	Unsymmetrical dimethylhydrazine (Udmh), diethylenetriamine	Dependent on positives from verification effort		
051-5	Army Cremator Disposal Area	9	5	5	For water and soil: TOC, TOX, purgeable organics (water only), pH, chlorides, Cr, Cu, Pb, Zn. For containers: Dependent on sampling team recommendation, on-site characterization, and ultimate disposal requirements. See Section 3.2.4.	5	12	Positives from verification analysis
051-6	Langley Drive Disposal Site	9	Not to exceed 15	--	For soil: TOC, TOX, purgeable organics, pH, chlorides. Same as for Site 051-5 (above), with cadmium, chromium, lead, mercury, nickel, copper, selenium, and zinc.	Soil sampling dependent on positives from container sampling		

Table 3-1 (Cont.)

			Verification (One Time Study)			Characterization (First Year Effort)		
			Sampling			Sampling		
Site Number	Site Name	CSRS* Score	No. Soil Samples	No. Water Samples	Lab Testing Parameters	No. of Wells	No. of Samples	Lab Testing Parameters
051-7	Station Landfill	23	--	8 to 14	For groundwater: Pesticides, PCBs, pH, and specific conductance; purgeable organics, Cr, Cu, Pb, Zn. For "drum ditch": Oil and grease, TOC, and TOX from a grab sample. For containers: See Sites 051-5 and 051-6 (above).	--	--	--
051-8	Drone Washdown	9	7 (5 composite)	--	TOC, oil and grease	--	--	--
051-9	PCB Disposal, Dry Dock Area	28	10 sediment cores with Recommendation 2	--	Recommendation 1: Visual and magnetometer survey of area; sediment grab samples where indicated; PCB analysis. Recommendation 2: 3 samples from each core at 0 to 12 inches, 24 to 36 inches, 48 to 60 inches; PCB analysis.	--	--	--
051-10	Building 25 Storage Area	17	1 (up to an additional 19)	--	For soil: PCBs and positives from containers. For containers: See Sites 051-5 and 051-6 (above). For transformer sample: PCBs.	--	--	--

Table 3-1 (Cont.)

Site Number	Site Name	CSRS* Score	Verification (One Time Study) Sampling: No. Soil Samples	No. Water Samples	Lab Testing Parameters	Characterization (First Year Effort) Sampling: No. of Wells	No. of Samples	Lab Testing Parameters
051-11	Building 145	19	--	1	For containers: See Sites 051-5 and 051-6 (above). For standing water: positives from previous sampling by IAS team.	--	--	--
051-12	Two Way Road Fuels Farm	23	27	--	Soil and leaching pit grab sample: Oil and grease, lead.	--	--	--
051-13	Tanks 210-217	16	50	As encountered	Following infrared photography and terrain conductivity studies, borings to be made in the indicated areas. Soil and any groundwater encountered will be analyzed for purgeable organics, total lead, and TOC.	--	--	--
051-14	Ensenada Honda Shoreline and Mangroves	15	Not more than 10 grab samples	--	Oil and grease following visual inspection.	--	--	--
051-15	Substation 2	20	6	--	PCBs	--	--	--

Table 3-1 (Cont.)

			Verification (One Time Study) Sampling			Characterization (First Year Effort) Sampling		
Site Number	Site Name	CSRS* Score	No. Soil Samples	No. Water Samples	Lab Testing Parameters	No. of Wells	No. of Samples	Lab Testing Parameters
051-16	Old Power Plant, Building 38	11	6	--	PCBs, oil and grease	--	--	--
051-18	Peat Control Shop	23	22	--	Pesticides	--	--	--

* Confirmation Study Ranking System

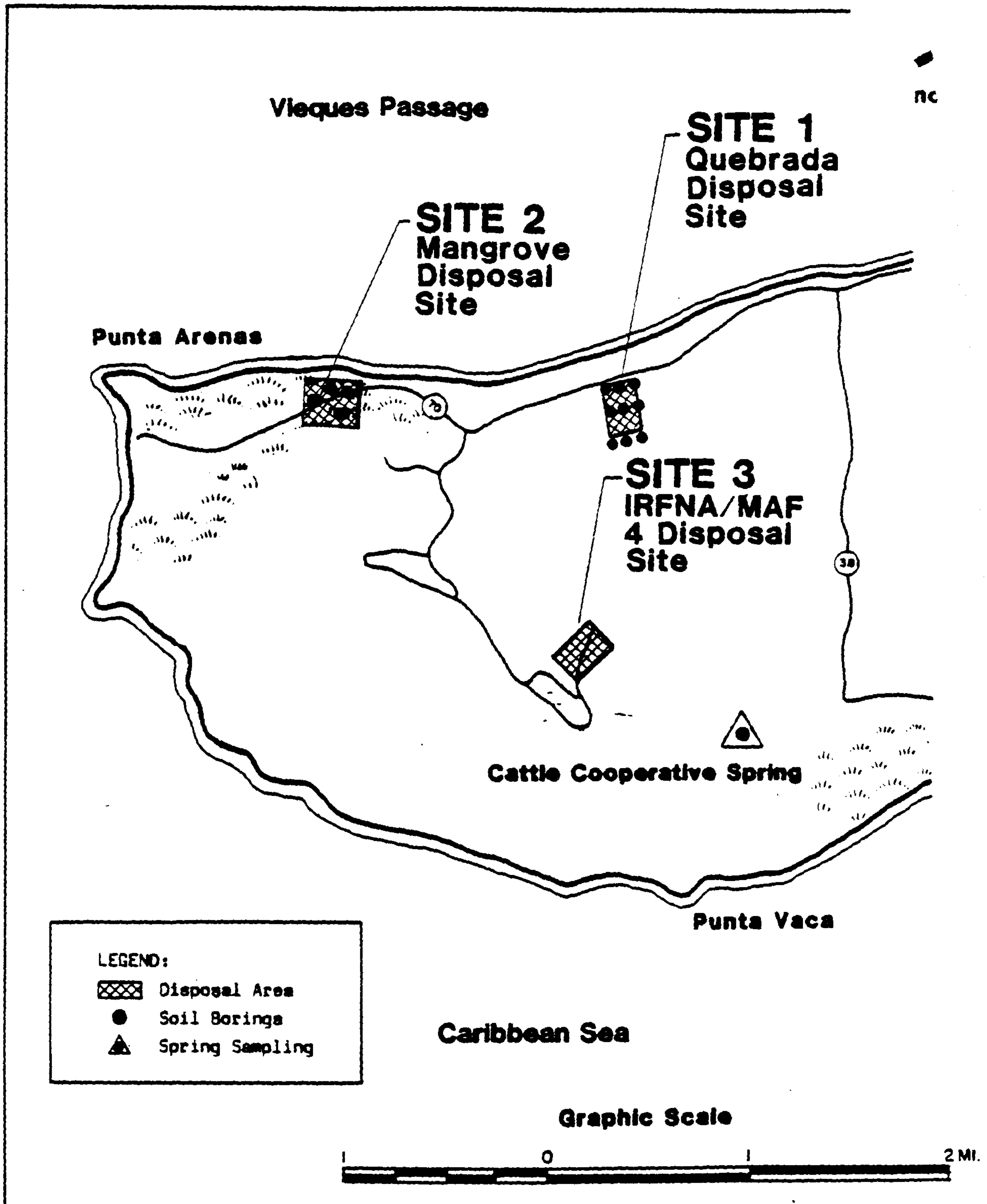

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FIGURE 3-1
SAMPLING MAP
SITES 1, 2, & 3

Table 3-2

ANALYTICAL METHODS
(By Method Number)

Parameter	Sample Type: Soil	Fresh-Water	Saline Water	Drum Liquid	Drum Solid
TOC	9060°	415.1†	415.1†	9060°	9060°
TOX	NA	9020°	9020°	9020°	NA
Chlorides	325.3†	325.3†	325.3†	325.3†	325.3†
Pesticides	8080°	608*	608*	8080°	8080°
PCB	8080°	608*	608*	8080°	8080°
Purgeable Halocarbons	NA	601*	601*	NA	NA
Oil and Grease	413.2†	413.2†	413.2†	NA	413.2†
Cadmium	7131°	213.2†	213.2†	7131°	7131°
Chromium	7191°	218.2†	218.2†	7191°	7191°
Mercury	7471°	245.1†	245.1†	7470°	7471°
Total Lead	7421°	239.2†	NA	7421°	7421°
Nickel	7521°	249.2†	249.2†	7521°	7521°
Copper	7210°	220.1†	220.1†	7210°	7210°
Selenium	7741°	270.3†	270.3†	7741°	7741°
Zinc	7950°	289.1†	289.1†	7950°	7950°

<u>Methods</u>

°"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 2nd Edition, USEPA, 1982.

†"Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, USEPA, March 1983.

*"Methods for Organic Chemical Analysis of Municipal and Industrial Waste Water," EPA-600/4-82-057, USEPA, July 1982.

Remarks: The soil borings will be spaced in the site on both side North Shore Road (Route 70) where surface evidence of dispo: (burned debris, etc.) can be seen. The borings will be used to determine distance to the water table and the depth to which disposed material can be found. The samples will be taken from zero to six inches, and from the deepest six inches of disposed material, and composited. The samples will be visually inspected for debris when taken.

3.2.3 Site 3, IRFNA/MAF-4 Disposal Site, Vieques. The purpose of this sampling effort is to establish if contaminants from fuel disposal have persisted and are present in the livestock water source. See Figure 3-1.

Type of Samples:	Surface water grab sample; soil borings if positives are found during the first sampling.
Frequency of Sampling:	Twice.
Testing Parameters:	Unsymmetrical dimethylhydrazine (Udmh), diethylenetriamine.

Remarks: The samples should be taken at high flow and low flow conditions.

3.2.4 Site 5, Army Cremator Disposal Area. See Figure 3-2

Type of Samples:	Ground water, soil, and container samples.
Ground Water Monitoring Wells:	Five; three on-site and two off-site.
Frequency:	Quarterly, for one year.
Testing Parameters:	TOC, TOX, purgeable organics (water only), pH, chlorides; copper, chromium, lead, and zinc (see Table 3-2).

Remarks: Ground Water and Soil: If screening of the composite soil samples taken while boring or of the ground water identifies any contamination, additional samples and analyses will be required.

Containers: Each intact container (55-gallon drums, pails, etc.) should be opened and sampled, using extreme caution. Sample analysis parameters will be decided based on the best professional judgment of the sampling team (only skilled, experienced personnel should undertake this operation) combined with an in-field ambient characterization by flame- and photoionizing detectors. Table 3-3 contains a generalized procedure for container opening, sampling, and analysis. Parameters analyzed for should include, but not be limited to, the following:

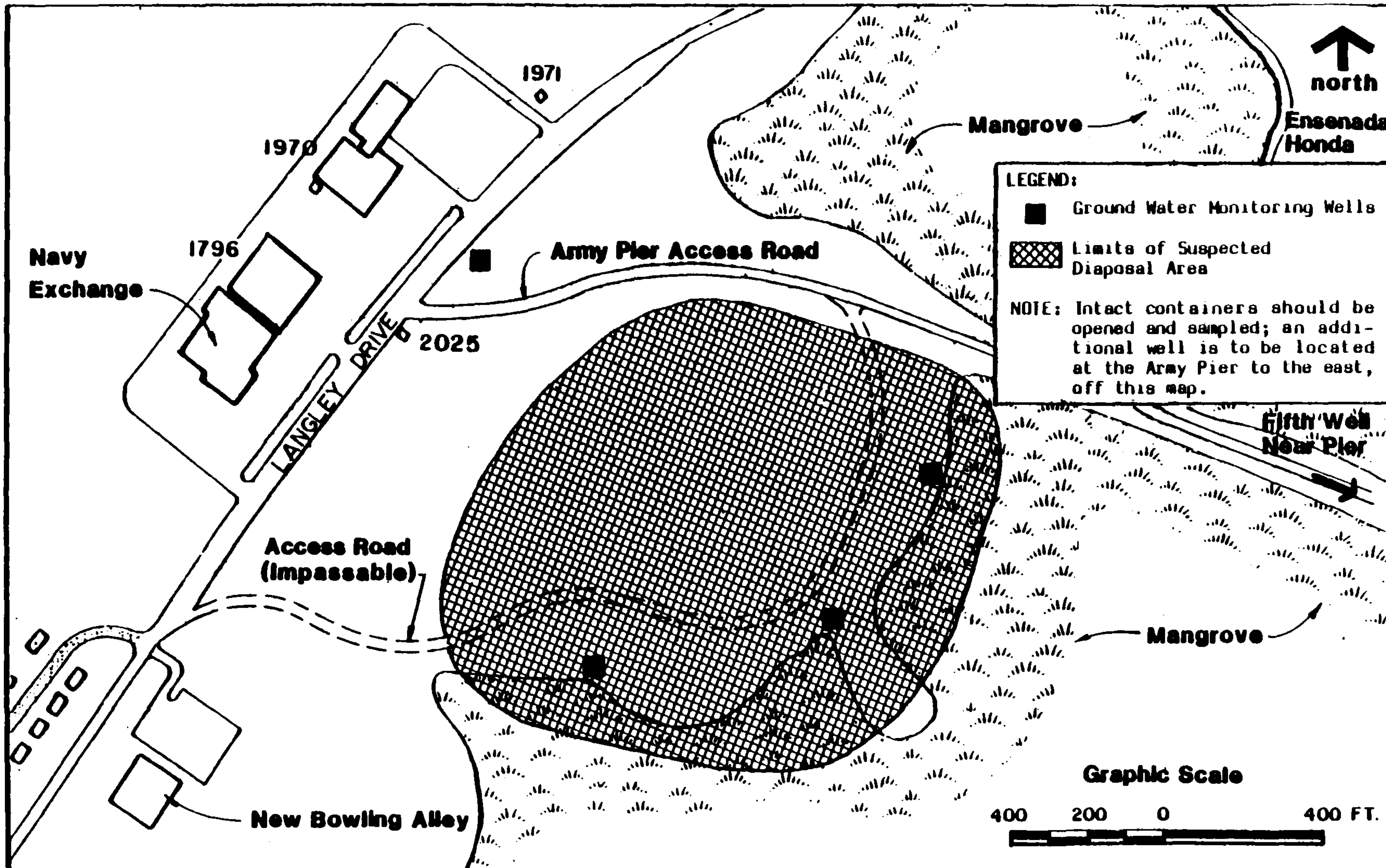

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FIGURE 3-2
SITE 5, ARMY CREMATOR DISPOSAL AREA

Table 3-3

CONTAINER OPENING AND SAMPLING PROCEDURES

The opening and sampling of containers used for the disposal of hazardous material is rated as one of the most potentially dangerous operations undertaken by hazardous waste investigators. The possibility of major releases of material by container rupture, fire, or explosion is a real one, and threatens not only the field workers but also the surrounding populace and environment. The procedures discussed below have been used successfully many times in the field by experienced trained personnel; under no circumstances should they be considered for use by inexperienced personnel.

Operation	Discussion
1. Establish Operational Boundaries	A. Define exclusion area, segregation area, disposal staging area, contamination reduction area, personnel and equipment decontamination area, command post, safety observer post, laboratory and analysis area, dress-out area, and parking/visitors area. Establish downwind vapor hazard area, and secure perimeter. Establish first-aid station.
2. Establish Operational Procedures	Designate operations manager (OM); site safety officer (SSO); ambient monitoring team, documentation team, sampling team, decon team, chain-of-custody team, work party, equipment coordinator, and communications/logbook coordinator. Determine communications means (at least two of each network), procedures, and emergency evacuation notification. Determine and publish evacuation procedures (on-site, immediate surrounding area, and general evacuation). Establish air-monitoring stations and action levels. Coordinate with fire department, hospital, ambulance and emergency rescue teams, and police. Determine need for creation of restricted air zone. Establish media coordination. Establish vehicle maintenance and fueling area.
3. Undertake Operations	A. OM/SSO determine level of protection, work regime, decontamination procedures, and other safety measures.
	B. Remove and segregate containers for sampling. Unstack or unpile containers, using drum grappler, drum slings, grabbers, all-terrain forklifts, etc. Overpack all containers that leak or rupture. Neutralize spills; evaluate need for evacuation at the time of each spill. Stage empty containers for disposal. Segregate containers by size or type, being particularly cautious of drums containing acids/caustics. Immediately notify the OM/SSO of any containers that are corrugated, made of stainless steel or other exotic metals, are distended or burned, or have reinforcing bands. DO NOT MOVE THESE DRUMS. Notify the OM/SSO of any reactions.
	C. Documentation. Label each container with a unique number. Photograph each container. Record all markings and labels.

Table 3-3 (Cont.)

Operation	Discussion
3. Undertake Operations (Cont.)	D. Open and sample. Opening will be done by remote means, such as a three-foot copper-beryllium spike on a backhoe bucket, with the operator protected by a 1/4-inch Plexiglass splash shield and a 3/4-inch Lexan blast shield. Inform OM/SSO of any reactions. Overpack any leaking drums or containers; evaluate need for evacuation. Using glass thief, scoopula or other appropriate method, take two eight-ounce samples in wide-mouth EPA-prepared glass jars with Teflon-lined lids, labeled with the drum number. Note appearance of contents on sample record. Note any reactions (strong acids or oxidizers). Give one sample to laboratory for analysis; hold second sample in secure storage area.
	E. Analyze. Each drum will be monitored with a radiation indicator, explosive vapor indicator, and flame or photoionization device. Record all readings. Evacuate work party immediately if radiation readings are above 10 millREMS per hour, or an explosive atmosphere exists. Determine need for additional evacuation. Analyze samples for parameters necessary for acceptance at permitted disposal site; these may include, but will not necessarily be restricted to, the following categories: pH, sulfides (pH 7 or higher), cyanide (pH 4 or higher), hydrogen cyanide, flammability, reactivity (air, which is usually evident, and water), reduction and oxidation potential (redox), chlorinated hydrocarbons, PCBs (less than 50 ppm, 50 to 500 ppm, greater than 500 ppm), organics with flashpoints greater or less than 60°C, and neutral aqueous. Mark analysis on sample record and on each container.
	F. Segregate for disposal. Reseal containers (overpack, new bungs, or absorbent pads with bentonite sealer). Segregate for disposal, taking care to have adequate spacing between incompatible materials. Insure the containers meet Department of Transportation standards for transport to disposal area. If containers are to be held for any length of time, secure the area, store off the ground, and protect from elements.
	G. Decontaminate and dispose. Arrange for disposal with permitted facility. Note: The individual signing the transportation manifests should have sufficient authority to match the liability he is incurring. Decontaminate (on a daily basis) all personal equipment; keep as many tools and equipment as possible down range to minimize daily decon. Decontaminate using hydroblasters, steam jennys, detergents, decon solutions, scrubbing, soaking, or scraping. Contain all decontamination solutions and wash waters; dispose of properly. Throw away, rather than decontaminate as much as economically feasible; dispose of properly. Test soils and determine need for disposal of contaminated material. Dispose of oil, oil filters, hydraulic fluid, and air filters on vehicles and machinery used downrange. OM/SSO will certify all tools, equipment, and vehicles as clean and ready for use by unprotected personnel.
4. Site Safety Considerations	All on-site workers will probably require Level B protection (appropriate dermal protection and self-contained breathing apparatus). The appropriate sections of 29 CFR 1910.34 must be adhered to as well as other applicable OSHA regulations.

Source: Ecology and Environment, Inc. 1984.

pH; radiation; sulfides; cyanide; flammability; reactivity (a and water); redox potential; chlorinated hydrocarbons; PCBs, organics; and neutral aqueous solutions.

3.2.5 Site 6, Langley Drive Disposal Site. See Figure 3-3.

Type of Samples:	Ten to 15 samples of container contents; soil, as necessary (not to exceed 15 samples).
Number of Samples:	Sample each drum and other containers, particularly the glass containers of pellets (see Table 3-3 for procedures). If drum contents are determined to be hazardous, soil samples should be taken in and around their locations and analyzed.
Frequency of Sampling:	One time.
Testing Parameters:	TOC, TOX, purgeable organics (water only), pH, and chloride; copper, chromium, lead, and zinc (see Table 3-2).

Remarks: The area should be thoroughly traversed to determine location of all drums and other disposal areas. Samples taken from the 10 to 15 rusted-out drums should include portions of the greenish crust and white, plaster-like inner material. Any containers that are closed should be opened only by experienced personnel. If the drum contents are not hazardous, consideration should be given to mitigative actions such as removing the drums and other debris.

3.2.6 Site 7, Station Landfill. See Figure 3-4.

Type of Sample:	Ground water, "drum ditch" grab samples, and container contents, as appropriate.
Ground Water Monitoring Wells:	Eight new wells and up to six existing wells, if they can be developed.
Frequency:	Quarterly, for one year.
Testing Parameters:	Ground water: Pesticides, PCBs, pH, and specific conductance; purgeable organics and copper, chromium, lead, and zinc (see Table 3-2). Containers: See Section 3.2.4.

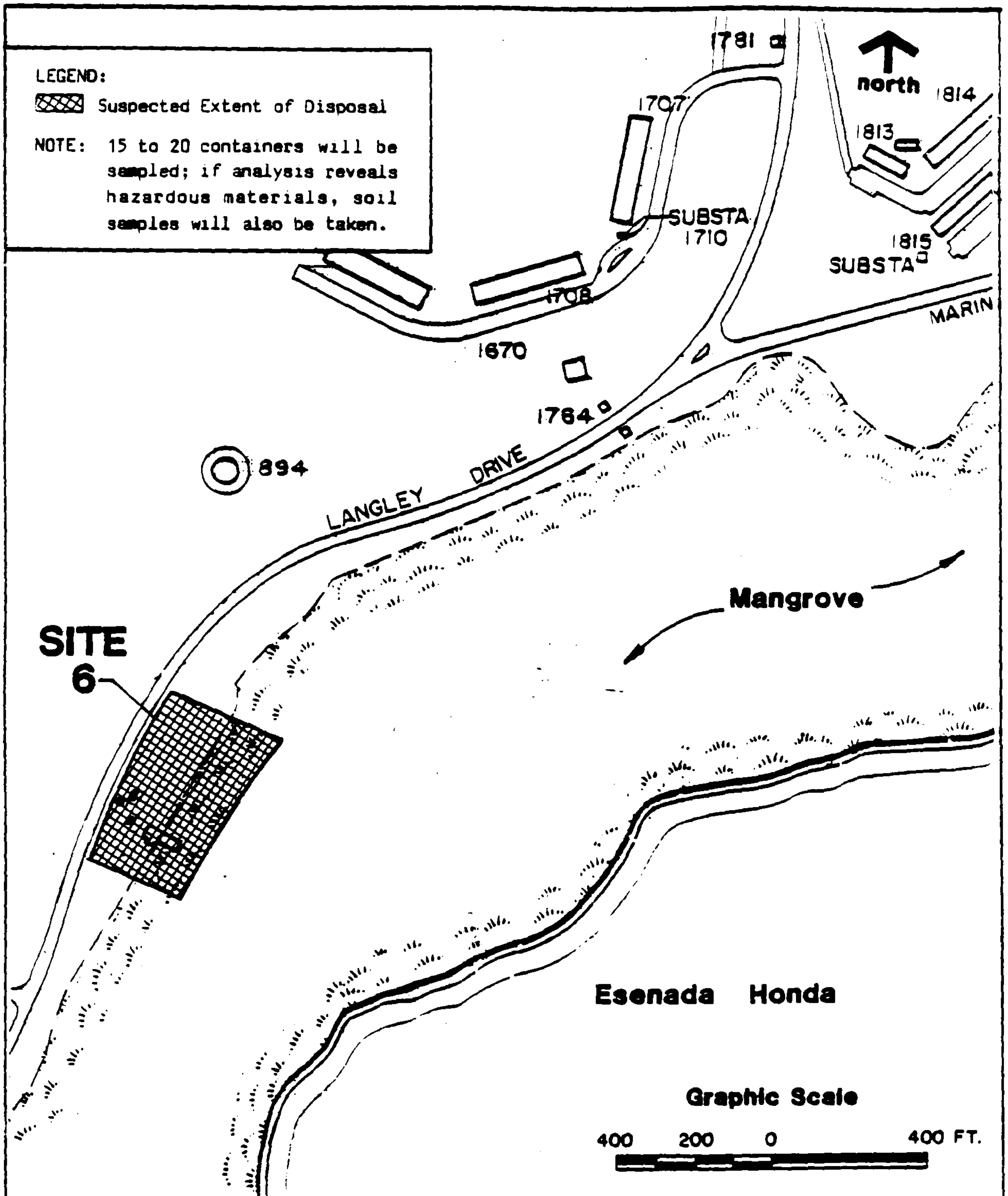

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FIGURE 3-3
SITE 6, LANGLEY DRIVE SITE

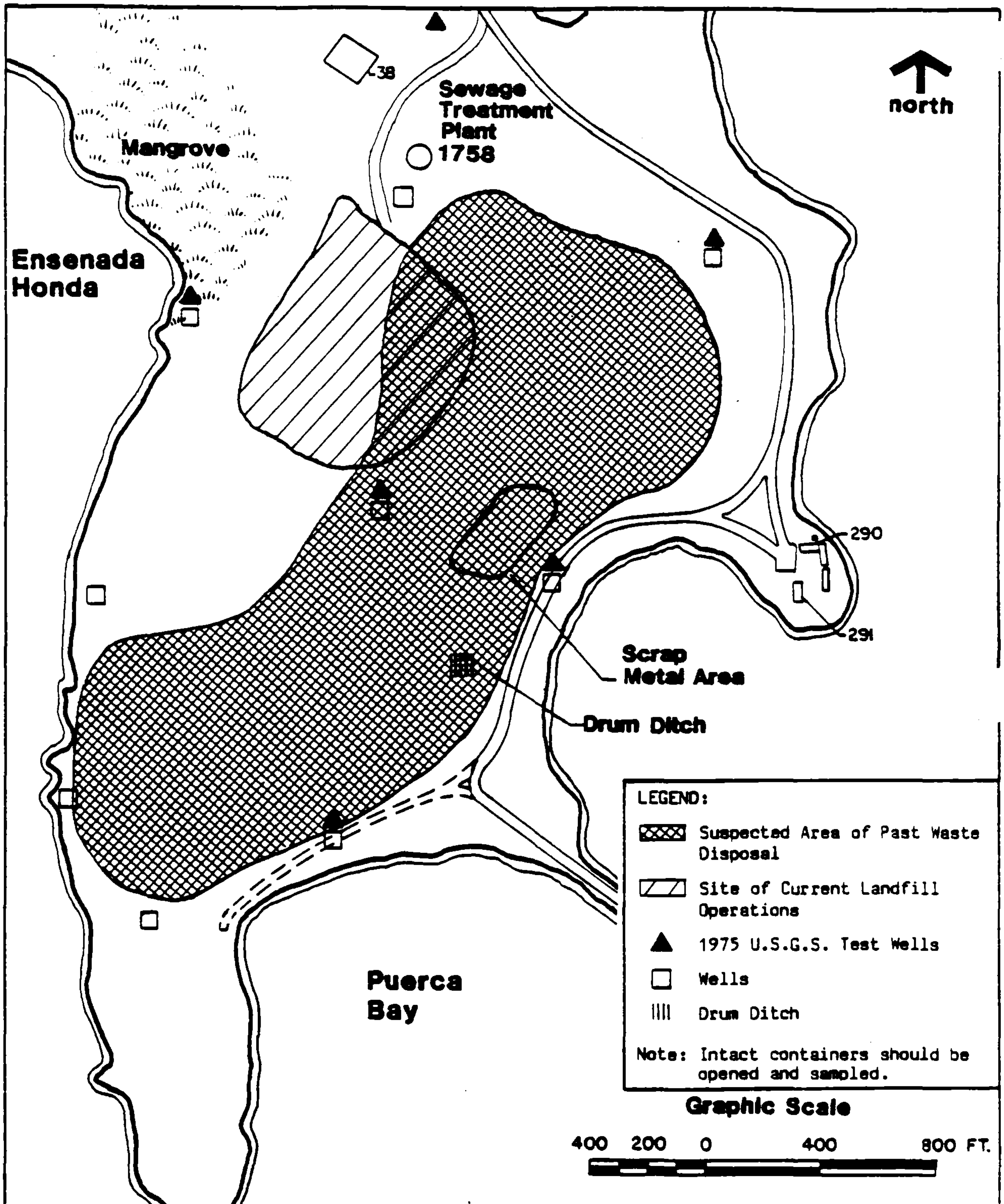

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FIGURE 3-4
SITE 7, STATION LANDFILL

Drum Ditch: Oil and grease, TOC, TOX (see Table 3-2).

Remarks: If ground water screening identifies any contamination, additional samples and analyses will be required. The monitoring wells that were previously installed by the U.S. Geological Survey at the landfill and the sampling conducted were intended solely for drinking water analysis and may not have adequately defined the nature and extent of contamination by hazardous material. The sampling was only conducted on a one-time basis. It is probable that all of the U.S. Geological Survey monitoring wells have since been destroyed by landfill operations. Those still intact should be developed, if possible, and sampled. The ground water monitoring wells suggested above will detect contaminant migration from the drum ditch.

The piles of material inaccessible to the IAS team from the ground should be examined for intact containers, which should be opened and sampled only by skilled, experienced personnel. Samples analysis parameters will be decided based on the recommendations of the team leader. See Table 3-3.

3.2.7 Site 8, Drone Washdown. See Figure 3-5.

Type of Samples: Soil borings.

Number of Soil Samples: Five composite samples from the drainage ditch; one near Building 229 for background; and one from the spill area at Building 860.

Frequency of Soil Sampling: One time, for verification.

Testing Parameters: TOC, oil and grease (See Table 3-2).

Remarks: Samples to be taken upstream and downstream of the probable entry point of the drone washdown fluids into the drainage ditches north, south, and southeast of the site. Three samples to be taken from each point in ditch bottom, at zero-to six-inch depth, and composited. If contamination is found, the ditches should be sampled to their eventual termination point in the mangroves. Sampling of the ground around Building 860 also will be necessary to determine the extent of contamination. Sampling at Building 229 will establish background levels existing from normal airfield operations.

3.2.8 Site 9, PCB Disposal, Dry Dock Area. See Figure 3-6

Recommendation 1: It is recommended that an underwater visual inspection and magnetometer or metal detector survey be conducted by the Explosive Ordnance Team first. If intact cans

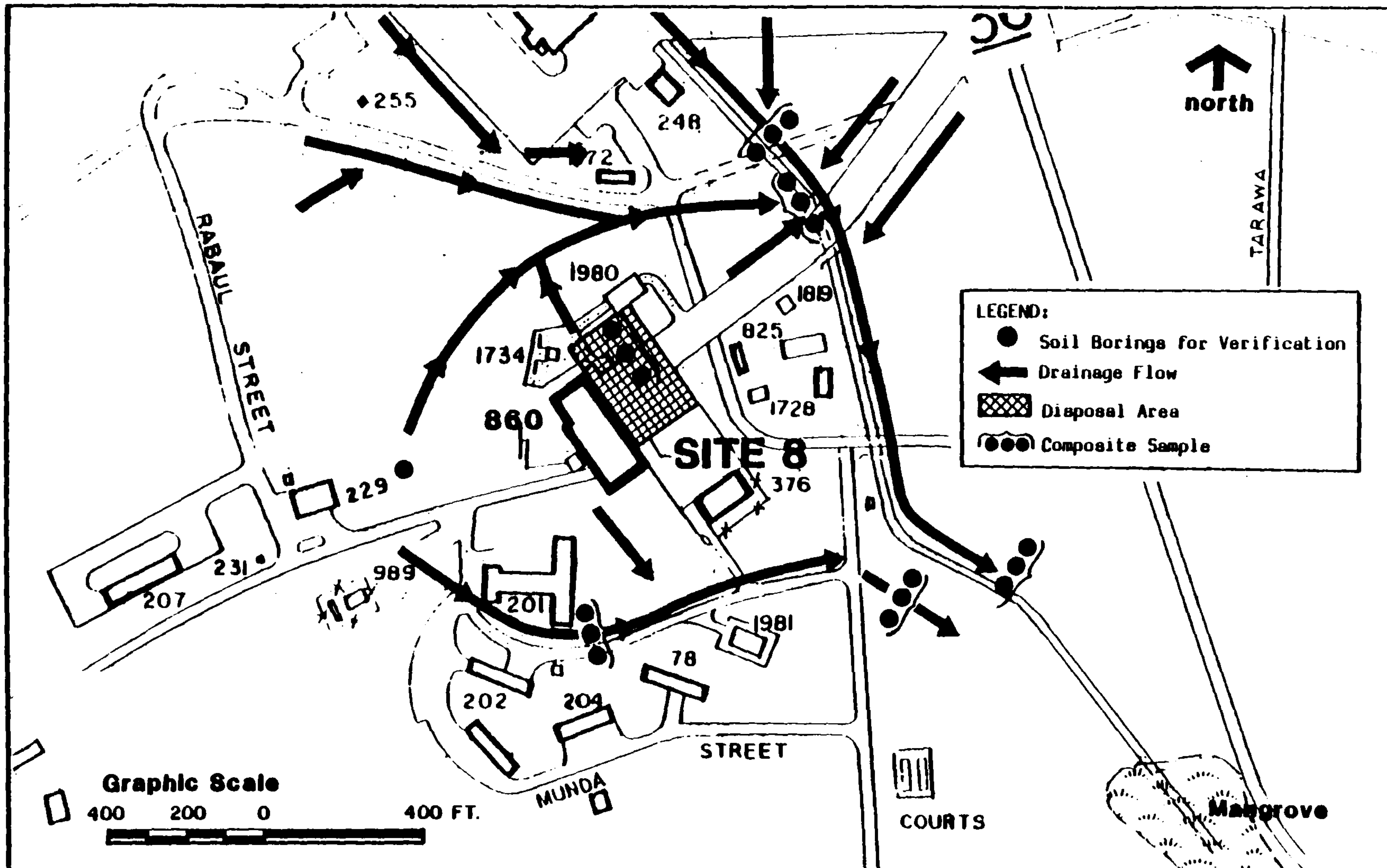

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FIGURE 3-5
SITE 8, DRONE WASHDOWN

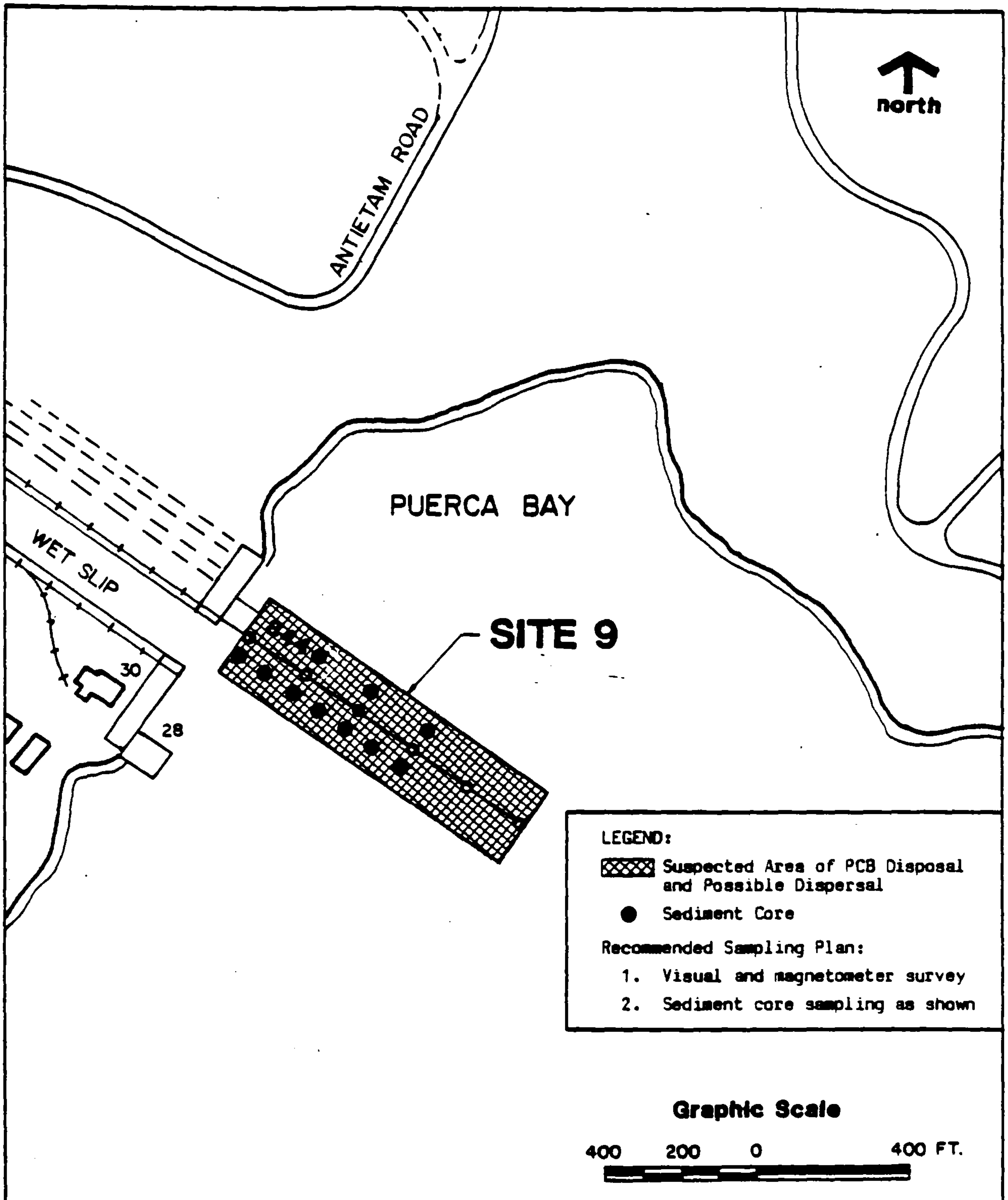

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FIGURE 3-6
SITE 9, PCB DISPOSAL
DRY DOCK AREA

(or magnetometer readings) indicating concentrations o ferrous metal are found, a biased grab sampling shou be conducted in the immediate vicinity of the item.. See Figure 3-6.

Type of Samples: Sediment (grab).

Number of Samples: One sample per each area of magnetic anomally or cans.

Testing Parameter: PCBs.

Recommendation 2: If the visual and magnetometer survey does not reveal heavy concentrations of metal or the presence of five-gallon cans, the following sediment sampling program is recommended.

Type of Samples: Ten sediment cores taken with a piston coring device.

Number of Samples: Thirty; three from each core taken from the depth intervals 0 to 12 inches, 24 to 36 inches, and 48 to 60 inches.

Testing Parameters: PCBs.

Remarks: Ten sediment cores, each 60 inches long, to be taken with piston coring device at the locations indicated on Figure 3-6.

3.2.9 <u>Site 10, Building 25 Storage Area</u>. See Figure 3-7.

Type of Samples: Container contents and soil.

Number of Samples: Containers: One sample from each drum or other container in the area around Building 25 and the transportation lot of Building 31. One sample from the leaking transformer.

Soil: One sample from the stained area where the transformer has leaked. Up to 19 additional soil samples (zero to six inches) taken throughout the disposal area, particularly in areas of spills, stains, or stressed vegetation.

Testing Parameters: Containers: See Section 3.2.4.

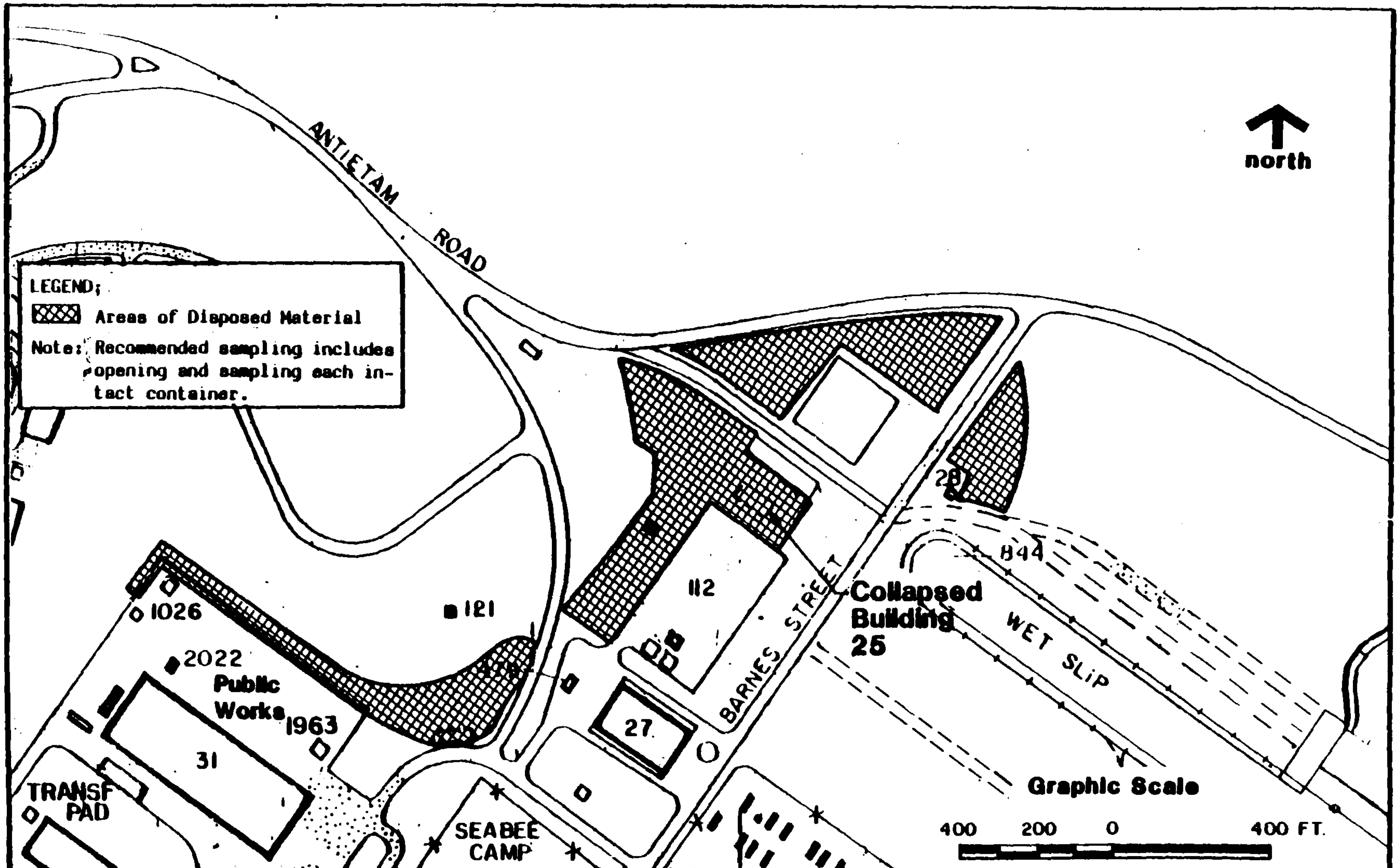

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FIGURE 3-7
SITE 10, BUILDING 25 STORAGE AREA

Transformer: PCBs.

Soils: Stained soil near transformer should be tested for PCBs. Analysis of other soil samples to be conducted after analysis of container contents; analyze soils for positives shown by container analysis.

Remarks: It is recommended that the disposal area be restricted to preclude possible exposure of base personnel. Based on the site inspection, some drums show severe corrosion about the seals. Extreme caution must be taken so as not to release drum contents. Only trained, experienced personnel should open, sample, and move the drums and other containers (see Table 3-3).

3.2.10 Site 11, Building 145. See Figure 3-8.

Type of Samples: Sample from each container; grab sample of standing water in the building.

Frequency of Sampling: Once.

Remarks: Those containers previously sampled by the IAS team should be disposed of in an appropriate manner based on the results of the analysis conducted by LANTNAVFACENGCOM. Results of these analyses indicate the majority of the material is extremely flammable. The remaining containers (about 100 five-gallon pails and 25 55-gallon drums) should be sampled in accordance with the procedures outlined in Table 3-3, and properly disposed of. Prior to this sampling, the standing water in the building should be sampled; testing parameters should be based on the positives obtained by LANTNAVFACENGCOM mentioned above.

3.2.11 Site 12, Two Way Road Fuels Farm. See Figure 3-9.

Type of Samples: Soil and leaching pit liquid.

Number of Samples: Nine soil; one liquid grab sample from leaching pit.

Frequency of Sampling: One time.

Testing Parameters: Oil and grease, lead (see Table 3-2).

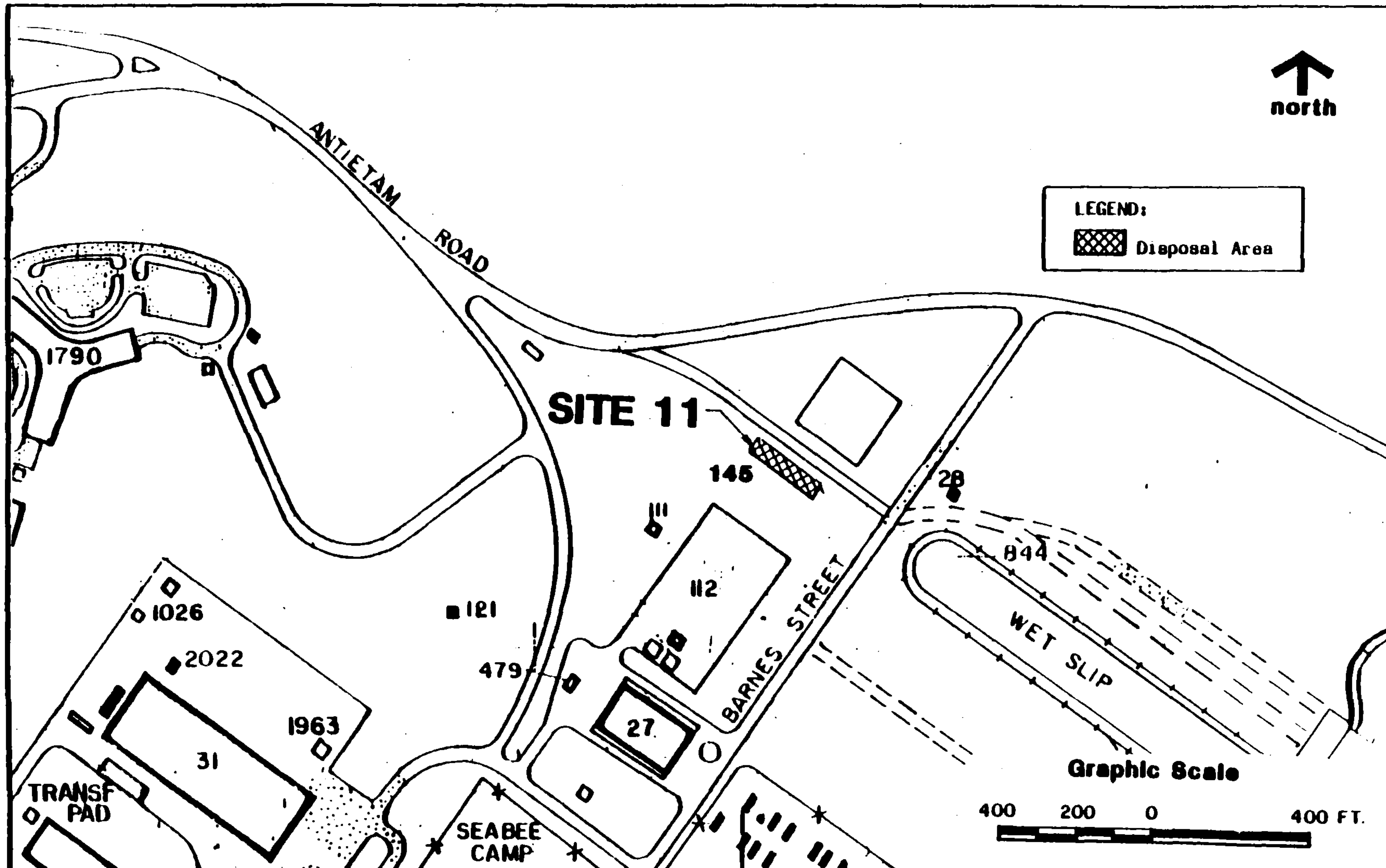

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FIGURE 3-8

SITE 11, BUILDING 145

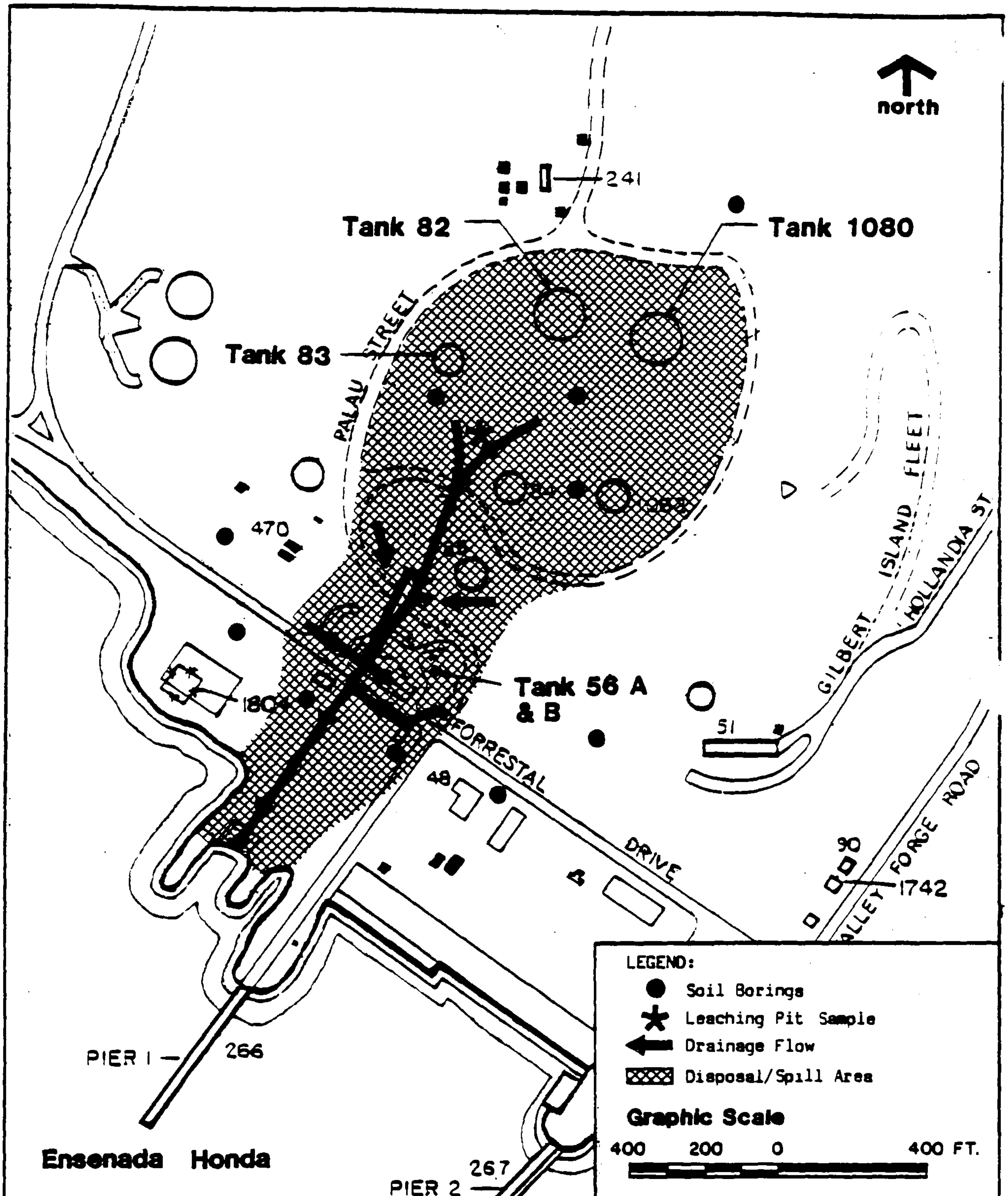

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FIGURE 3-9
SAMPLING MAP
SITE 12, TWO WAY ROAD
FUELS FARM

Remarks: Nine soil samples, as shown on Figure 3-9, and a grab sample from the leaching trench downgradient of the tanks should be taken. Samples will be taken at zero to six inches, 24 to 30 inches, and the last six inches before ground water. Soils will be visually examined at the time the samples are taken. Augering south of Tank 83 should be deep enough (perhaps as much as 10 feet) to sample the sludge buried there.

3.2.12 Site 13, Tanks 210 to 217. See Figure 3-10.

Type of Samples: Soil; sludge if found; ground water (see remarks).

Number of Samples: 50 each.

Frequency of Sampling: One time.

Testing Parameters: Total lead, purgeable organics, TOC (see Table 3-2).

Remarks: Prior to any soil boring being conducted, an attempt should be made to obtain infrared photography of the tank sites, preferably historical, to determine the actual disposal areas. The IAS team did not find any infrared photos during its records search; it is probable that classified photos or information from other remote sensing devices can be made available. A terrain conductivity survey of the sites can also be made. This would necessitate removal of some portion of the vegetation (this is also necessary to conduct boring activities). The soil borings will be as much as eight to 12 feet deep in areas indicated by the infrared photos or terrain conductivity survey. Samples will be taken on a grid basis to define the extent of contamination. Soil borings will be examined, and those samples showing stains or containing sludge will be analyzed. Only ground water encountered will be sampled. If bedrock is encountered without any sludge or discolored soil being found, a sample of the six inches of soil in contact with the bedrock will be analyzed.

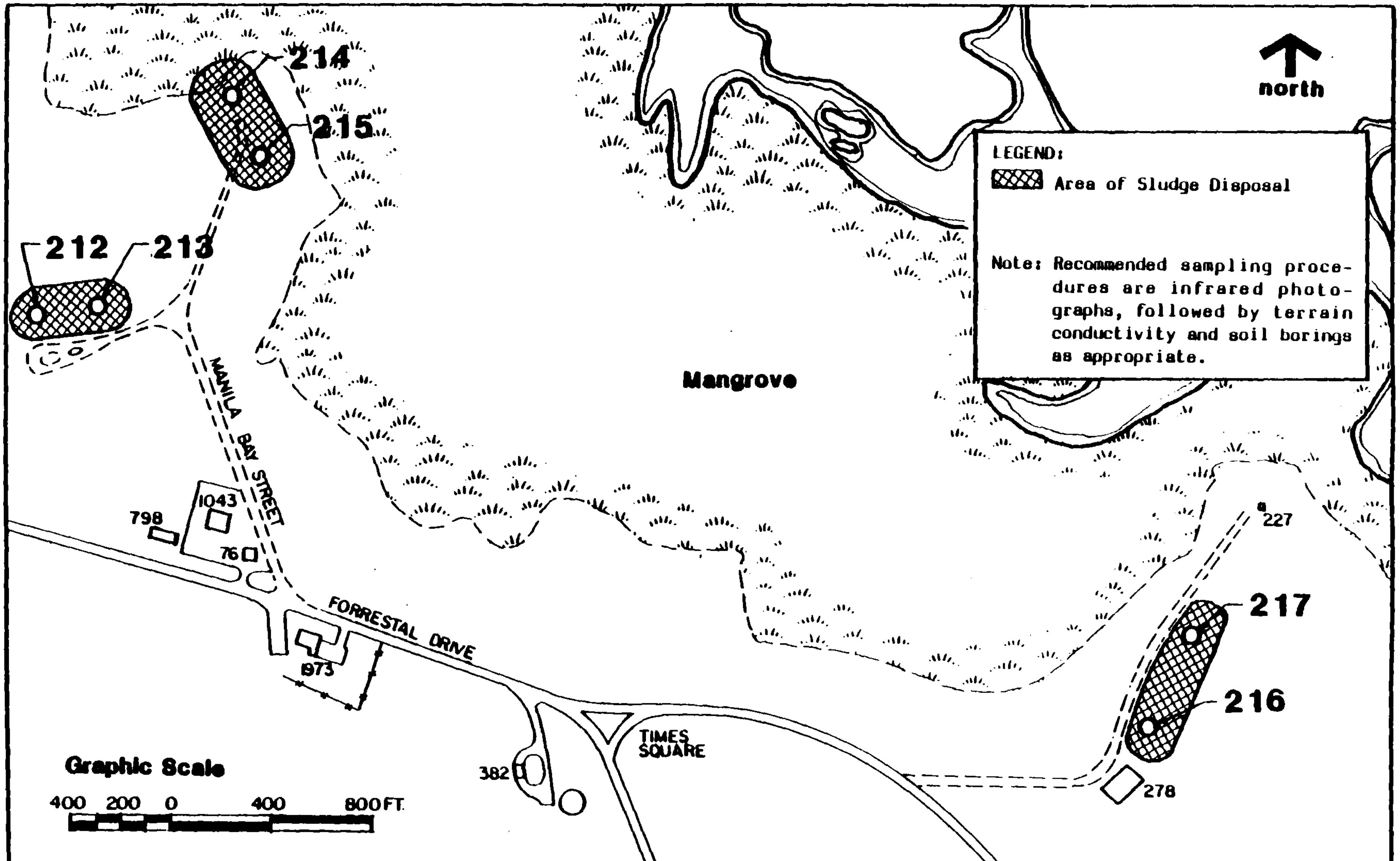
3.2.13 Site 14, Ensenada Honda Shoreline and Mangroves. See Figure 3-11.

Type of Samples: Visual inspection; grab samples not to exceed 10.

Testing Parameters: Oil and grease; see Table 3-2

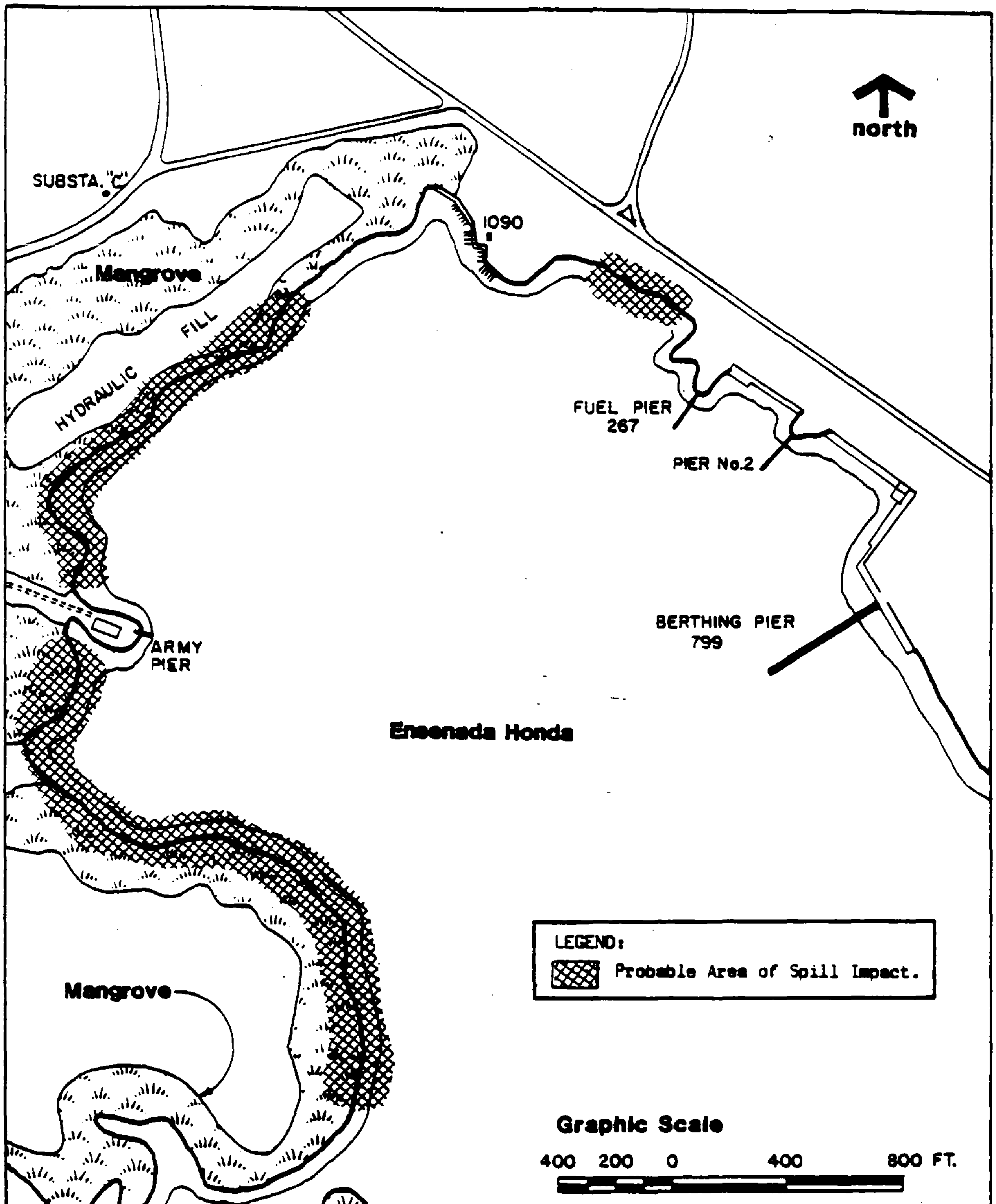
Remarks: A light inflatable raft (e.g., Avon, Zodiac) should be used to conduct a waterside survey of the mangroves, as shown on Figure 3-11. The mangroves will be inspected for tar balls, oil stains on vegetation, and discolored soil. Grab samples will be taken as appropriate. The impact of the material and need for mitigative action will be determined following analysis.

3.2.14 Site 15, Substation 2. See Figure 3-12.



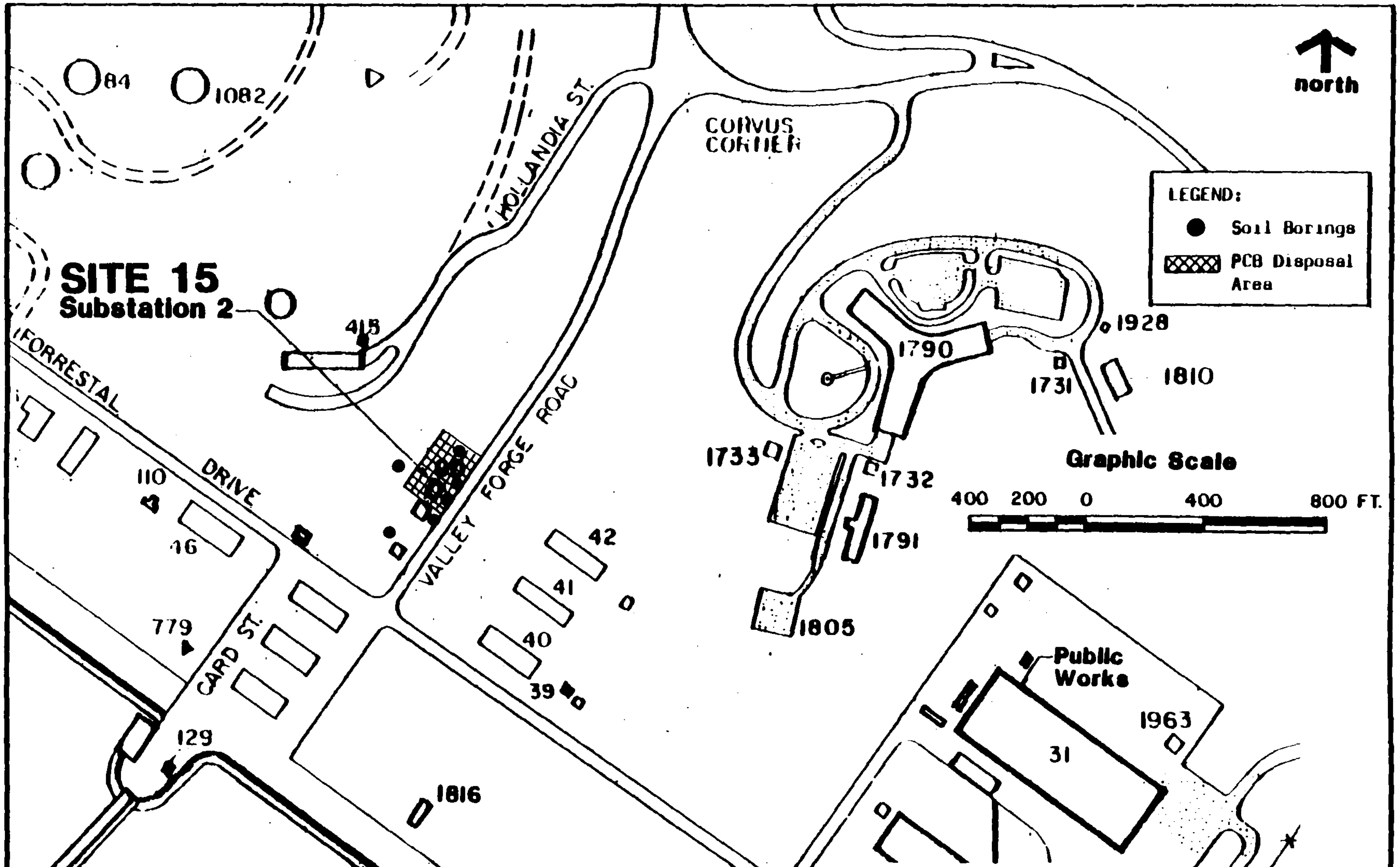
INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 3-10
SITE 13, TANKS 212-217



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 3-11
SITE 14, ENSENADA HONDA
SHORELINE AND MANGROVES



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 3-12
SITE 15, SUBSTATION 2

Type of Samples: Soil (hand augered).

Number of Samples: Six; one per each boring taken over the zero to 12-inch depth interval. One sample each taken to the north, west, and south of the building; three samples taken equally spaced east of the building.

Frequency: Initial sampling effort at this time.

Testing Parameter: PCBs (see Table 3-2).

Remarks: Care should be taken to clean auger between samples to prevent cross contamination.

3.2.15 Site 16, Old Power Plant, Building 38. See Figure 3-13.

Type of Samples: Soil (hand augered).

Number of Soil Samples: Six, each over the zero to 12-inch depth interval.

Frequency of Soil Samples: Initial sampling effort at this time.

Testing Parameters: PCBs, oil and grease (see Table 3-2).

Remarks: Two samples to be taken from the oil-stained ground northwest of the building; four samples to be taken on a grid basis in the area to the north and northeast of the building. Care should be taken to clean auger between samples to prevent cross contamination.

3.2.16 Site 18, Pest Control Shop. See Figure 3-14.

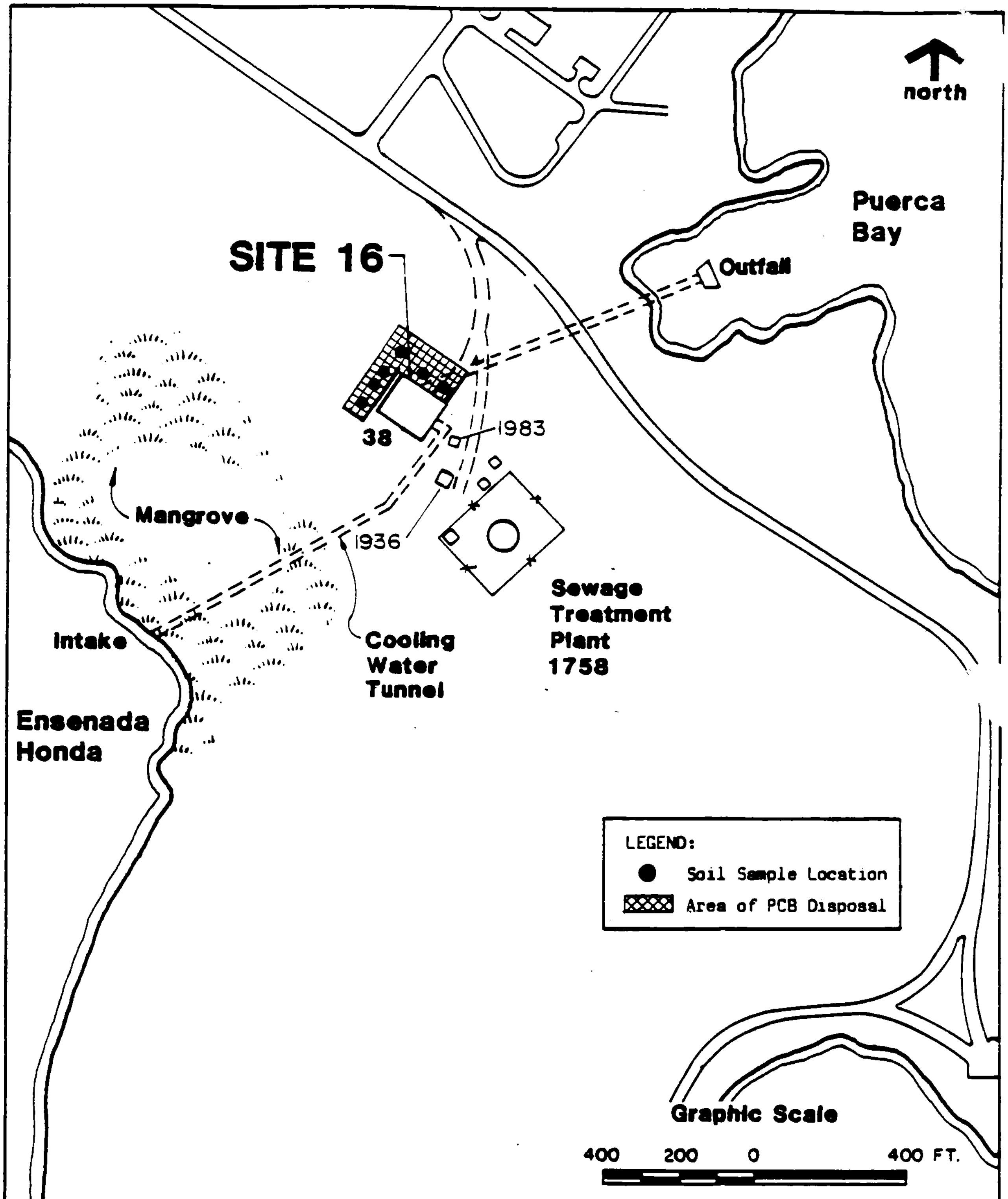
Hand-Auger Soil Borings: Twenty-two.

Number of Samples: Twenty-two; one composite taken upgradient in the drainage ditch; one composite downgradient; one sample near the road for background; and 19 samples in a grid pattern.

Testing Parameter: Pesticides (see Table 3-2).

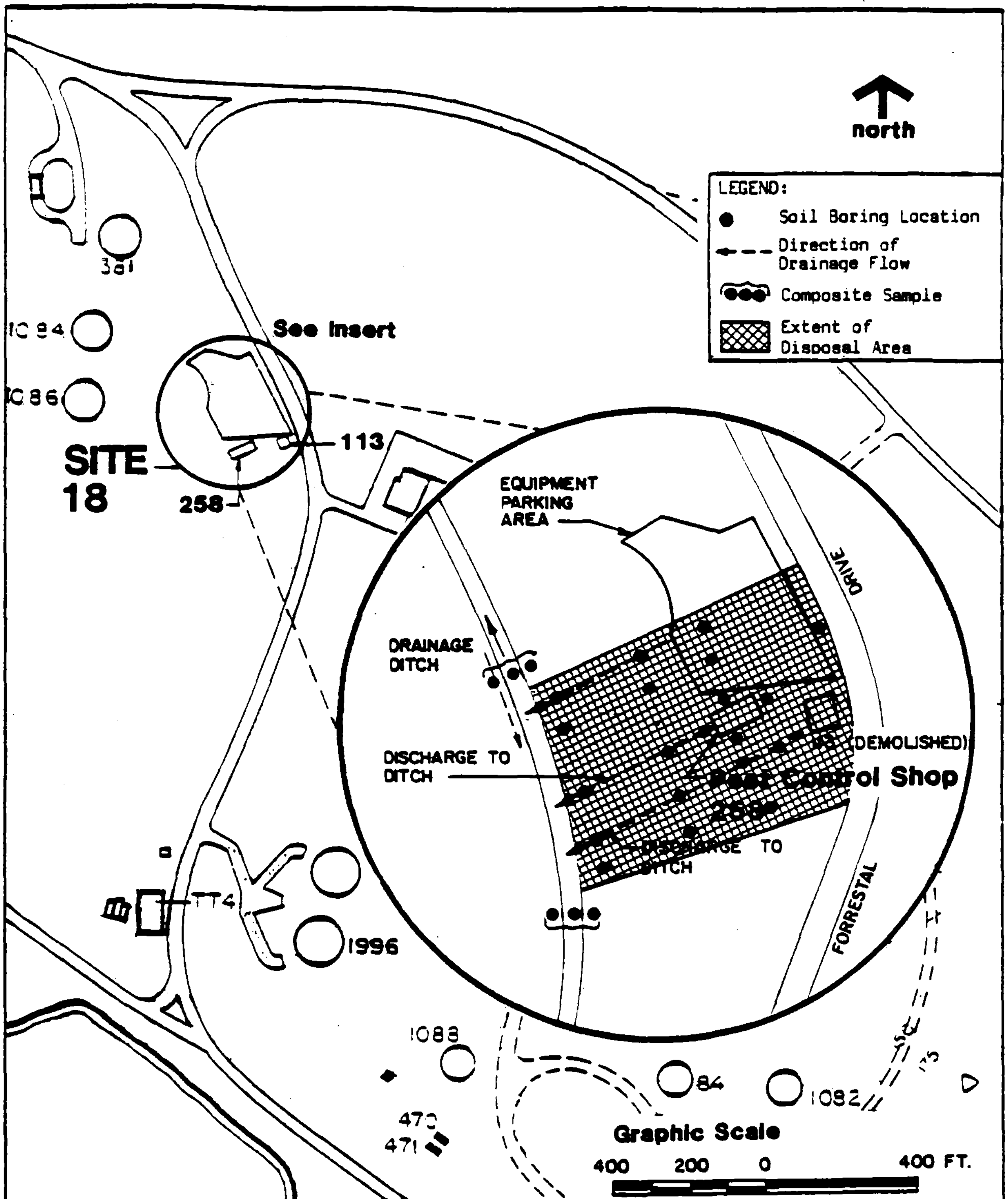
Remarks: Care should be taken to clean the auger between samples to prevent cross contamination. If contamination is detected in the drainage ditch, additional sampling will be necessary to determine the extent and degree of contamination further upgradient.

3.3 GENERAL RECOMMENDATIONS. All sites recommended for Confirmation Studies or for mitigative action should be designated on the base maps. The sites



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 3-13
SITE 16, OLD POWER PLANT, BUILDING 38



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 3-14
SITE 18, PEST CONTROL SHOP

should be entered into the facility Master Plan with a description of tl proposed Confirmation Studies or mitigative actions. Any planned activities in these areas should be reexamined in light of the potential hazards that might be present on the site.

A separate series of recommendations for immediate mitigative actions to be undertaken at specific sites and to limit certain planned activities has been forwarded by NAVENENVSA to LANTNAVFACENGCOM.

CHAPTER 4. BACKGROUND

4.1 NAVSTA ROOSEVELT ROADS.

4.1.1 General. NAVSTA Roosevelt Roads is located on the east coast of Puerto Rico in the municipality of Ceiba, approximately 33 miles southeast of the capital City of San Juan (see Figure 2-1). The nearest major town is Fajardo, which is 10 miles north of the station. Immediately to the west of the station and adjacent to its western boundary is the town of Ceiba.

NAVSTA Roosevelt Roads encompasses over 33,500 acres of land, consisting of seven land holdings (see Table 4-1). A portion of the Navy's real estate assets in Puerto Rico are currently in the process of being excessed, with the potential recipient being the Commonwealth of Puerto Rico. Major facilities and land areas having this status are:

- NAVSTA San Juan and other facilities in Metropolitan San Juan;
- Naval Communication Station (NAVCOMSTA) Fort Allen; and
- Roosevelt Roads West Annex.

The primary mission of the Roosevelt Roads Naval Complex is to provide full support for Atlantic Fleet weapons training and development activities.

4.1.1.1 Adjacent Land Use. NAVSTA Roosevelt Roads is bordered on all sides but the west by the Caribbean Sea. Located to the southwest is agricultural land use and Bosque Estatal de Ceiba, which is a mangrove forest adjacent to the station's western border from south to north are several settlements, including Esperanza, Daguao, Quebrada Seca, Aguas Claras, and the town of Ceiba. The town of Ceiba has the largest population in the vicinity of the station, with 15,000 people in an area of approximately 27.5 square miles. Land use in these adjacent settlements is primarily residential, with some commercial uses interspersed. There are no industrial uses adjacent to the station.

There have been no instances in the past of contamination of station properties by adjacent land uses.

4.1.2 History. The present site of NAVSTA Roosevelt Roads, Puerto Rico, was first considered as a possible location for a Naval base as early as 1919. A report by LT Robert L. Pettigrew (CEC) USN in that year discussed the possibility, availability, and comparative advantages of several locations in the Vieques area, where no Naval activities existed at the time. Nothing further developed until U.S. involvement in World War II appeared inevitable. In letters to the Chief of Naval Operations (CNO) dated 13 and 15 May 1940, Captain R.A. Spruance, USN, Commandant of the Tenth Naval District, stated the need for a Fleet Base in the Puerto Rico area, and referred to LT Pettigrew's 1919 report.

The advantage of the Roosevelt Roads site, in addition to its location midway between Guantánamo Bay and Trinidad and its remoteness from the San Juan metropolitan area, included a strategic position; the availability of various supporting bases on San Juan and St. Thomas; the excellent land for positioning

Table 4-1

NAVAL STATION ROOSEVELT ROADS
LAND HOLDINGS

Land Holding	Acres
• Naval Station Roosevelt Roads	8,055
• Vieques East (Atlantic Fleet Weapons Training Facility Ranges, Camp García, and East Maneuver Area)	14,516
• Vieques West (Ordnance Storage Area)	8,081
• Culebra (Flamingo Point)	87
• St. Thomas (Crown Mountain)	7
• St. Croix (Underwater Tracking Range and St. Georges Hill)	7
	76
Total	30,829

Source: LANTNAVFACENGCOM, 1981.

coast artillery guns surrounding the area; the large size and available protection of the anchorage; the availability of sites for aircraft landing fields; the availability of three entrances; the short distance to water too deep for enemy mining; and the availability of a well sheltered bay on the mainland of Puerto Rico for piers to be used in connection with a shore establishment built on the adjoining land.

Roosevelt Roads was envisioned as a major operating base, the keystone of the Caribbean Defense System, with a thoroughly protected anchorage, a major air station, and an industrial establishment capable of supporting a large portion of the fleet under war conditions. It was intended that this base should furnish logistic support to the outlying secondary air bases at Antigua, St. Thomas, and Culebra, and that it would have facilities to provide the necessary support services for 60% of the Atlantic Fleet. The project was expected to cost $108,000,000. It is frequently stated in various references that "in the event Great Britain was overwhelmed by the Axis Powers, Roosevelt Roads was to become the new operating port for the British Fleet." This is a popular belief today, and while nothing in official military documents concerning the Caribbean area can be found to substantiate this, it is quite possible that such an agreement did exist at high planning levels.

When the United States Naval Operating Base, Roosevelt Roads, was commissioned in 1943, it was far from being the finished product of the 1940 plan. The essential operations and industrial portion of the projected base were completed in three years. By now, however, it was clear to the Allied leaders that due to the location of most Allied operations, a base of the intended size would not be necessary in the Caribbean.

On 1 September 1944 it was redesignated United States Naval Station Roosevelt Roads by the CNO, and in November of the same year it was placed in caretaker status under the supervision of a Public Works Officer, assisted by a small detachment of Seabees and a large labor force of local civilians. Placed in a maintenance status in the spring of 1945 it was again established as Naval Operating Base, Roosevelt Roads, Puerto Rico, on 1 April 1947. During these changes of status, the base was utilized primarily as a training site for portions of the Atlantic Fleet, and acted as an important refueling station.

In 1957 Roosevelt Roads was once more designated a Naval Station and given an entirely new mission. Because of its location, and the facilities already in existence on the base, Roosevelt Roads was chosen for development as the primary center for Fleet Guided-Missile Training Operations in the Atlantic.

When the base's original buildup was curtailed in 1943, many of the important facilities had been completed, including a dry dock 1,088 feet by 145 feet which is still among the world's largest, capable of receiving any ship; a machine shop to repair and service such ships as might arrive; a water supply system; a power plant; and fuel storage facilities. Dredging of the harbor, completion of the airfield, and completion of ammunition storage facilities were accomplished soon thereafter. With these completed there was no further expansion until 1957.

One of the first steps in the 1957 expansion of Roosevelt Roads was the acquisition of the U.S. Army's old Fort Bundy, an area which now comprises the southern portion of the station. Fort Bundy was established in 1940 as the headquarters for all coast artillery emplacements in the area; its mission was to provide defenses against enemy attack while the Naval base was under construction. Training and maintenance became the garrison's primary tasks. In 1947 the post was placed on standby status, and reopened within a year as headquarters for the 504th Field Artillery Battalion. When the 504th departed for the Canal Zone in 1950, Fort Bundy became inactive and was acquired by the Navy.

At dedication ceremonies for Roosevelt Roads on 21 May 1959, the airfield was named Ofstie Field in honor of the late Vice Admiral Ralph A. Ofstie, a distinguished leader in Naval aviation. The primary runway was extended to 11,000 feet and is capable of handling any existing jet aircraft. Numerous buildings and facilities were also erected to support the guided-missile mission.

Roosevelt Roads has provided support for various special and joint exercises that are held annually in the Caribbean waters (Operation Springboard, CARIBEX, etc.) for the Atlantic Fleet as well as for foreign navies.

Roosevelt Roads also provides support to tenant activities. The history of the Atlantic Fleet Weapons Training Facility (AFWTF) began with the Guided-Missile Operations Control Unit (GMOCU). In July 1963 AFWTF was commissioned as a separate activity. In July 1967 AFWTF activated its computerized Central Command and Control System (CCCS). The new CCCS is oriented around the Naval Tactical Data System (NTDS), allowing a rapid exchange of data between ships and aircraft exercising many miles apart at sea. The inauguration of the CCCS marked another milestone in the evolution of the Roosevelt Roads Complex as one of the largest, most technologically advanced training complexes in the world. A Remote Data and Drone Control System (RDDCS) was added to the CCCS in September 1968. This system provides for the control of drones from the Range Operations Center (ROC) instead of the three separate drone control sites located at the Naval Station and on St. Thomas and St. Croix.

During the early 1970s the closure of Naval Station San Juan brought four major commands to Roosevelt Roads: Commander, Tenth Naval District; Commander, Caribbean Sea Frontier Command; Antilles Defense Command; and Commander, Southern Atlantic.

4.1.2.1 Historical Sites. To date no systematic archaeological survey has been conducted at NAVSTA Roosevelt Roads. However, various sitings of aboriginal rock carvings (petroglyphs) on clusters of rocks located at the waters edge of Ensenada Honda were documented as early as 1893. The petroglyphs are in good condition and can be viewed by boat from Ensenada Honda. Past surveys have also identified various primitive campsites and village sites within the area of the station.

4.1.3 <u>Legal Actions</u>. The only environmental litigation which has been brought against NAVSTA Roosevelt Roads is the Romero vs. Brown case concerning Vieques. This litigation is discussed in Section 4.2.3.

4.1.4 <u>Biological Features</u>.

4.1.4.1 Ecosystems. Within NAVSTA Roosevelt Roads property there are four distinct ecosystems, the upland forest, mangrove, marine, and freshwater ecosystems, which are discussed in the following subsections.

4.1.4.1.1 Upland Forest Ecosystem. Upland forest areas include coastal dry-wood forests, beach strand association, and grassland areas. The upland forest is typified by trees with compound or simple leaves that are succulent or leathery, with broad expansive crowns. These trees rarely exceed 45 feet in height. Coppicing is common at the Naval Station, and results in the production of dense stands of relatively small trees. The most common tree species of the upland forest are listed in Table 4-2. Beach strand vegetational indicators are also listed in Table 4-2.

The upland forest ecosystem functions as an inhibitor of erosion, while it concurrently aides in ground water recharge. This type of habitat is principally utilized by avian species.

4.1.4.1.2 Mangrove Ecosystems. Mangrove ecosystems are self-maintaining coastal landscape units which couple upland terrestrial and coastal estuarine ecosystems; as such, they are perhaps the most important habitat type encompassed by Naval Station Roosevelt Roads. The three main species of mangroves are the red mangrove (Rhizophora mangle), black mangrove (Avicennia nitida), and white mangrove (Laguncularia racemosa). The red mangrove is capable of withstanding high salinities, and is generally found growing in pure stands on the seaward edge of a mangrove forest, becoming mixed with other species farther inland. The black mangrove is also tolerant of high salinities. It is not morphologically adapted to withstand prolonged submersion, although it is reportedly much more tolerant of shallow stagnant water than either the red or white mangrove. Thus it is generally found just landward of the red mangrove. White mangroves are the third species of importance at Roosevelt Roads; they are generally found on upland areas which are rarely subject to inundation by the sea.

Variations in structure and composition of mangrove forests are dependent upon such limiting factors as elevation, drainage patterns, tidal fluctuations, salinity, size, and geomorphology of their respective watersheds.

Three recognized mangrove associations occur at Roosevelt Roads: riverine, fringe, and basin forests. The basin forest is typified by a predominance of black and white mangroves, with a few red mangroves interspersed. This association is generally found in shallow depressions landward of the beach ridge or a fringing mangrove.

Fringe forests, dominated by red mangroves, are found in direct contact with the sea along the shoreline as well as inland along the banks of tidal channels.

Riverine mangrove forests are situated along the banks of freshwater drainages. They are characterized by a dominant fringe of red mangroves along the shoreline, which gives way to a mixture of red and black mangroves to landward. Table 4-3 gives the acreages of the major mangrove areas and their associated lagoon systems on the station.

Table 4-2

SPECIES INDICATORS OF COASTAL DRYWOOD FOREST
AND BEACH STRAND ASSOCIATION

Scientific Name	Common Name (Spanish, English)
Coastal Drywood Forest	
Bursera simaruba (L.) Sarg.	Almacigo, turpentine tree
Prosopis juliflora (Sw.) DC	Mesquite
Pictetia aculeata (Vahl) Urban	Tachuelo
Bucida buceras L.	Ucar
Guaiacum officinale L.	Guayacan
Guaiacum sanctum L.	Guayacan blanco
Leucaena glauca (L.) Benth.	Zarcilla, leadtree
Tamarindus indica L.	Tamarindo
Acacia macracantha Humb. & Bonpl.	Tamarindo silvestre
Acacia farnesiana (L.) Willd.	Sweet acacia
Melicoccus bijugatus Jacq.	Quenepa
Beach Strand Association	
Suriana maritima	Bay cedar
Cocolobo uvitera	Seagrape
Cocos nucifera	Coconut
Conocarpus erectus	Buttonbush
Hippomare mancinella	Manzanillo

Sources: Ewel and Whitmore, 1973; and
Little and Wadsworth, 1964.

Table 4-3

MANGROVES AT NAVAL STATION ROOSEVELT ROADS

Site	Area in Acres*				Shoreline (miles)
	Mangrove	Lagoon	Deforested	%	
Machos	855	140	170	16	13.0
Ensenada Honda	470	35	230	33	6.5
Río Daguao	460	11	15	3	3.4
Punta Figueras	160	6	0	0	2.0
Isla Piñeros	65	13	0	0	1.2
Punta Puerca	35	2	10	28	0.5
Total	2,045	207	425	17	26.6

*Lagoon areas do not include Cascajo Bay or Punta Blanca Bay. The term deforested refers to total acres of mangrove lost due to construction, dredge filling, or other modification. The estimates are based on March 1936 aerial photographs, as well as coastline topographic contours from U.S. Geological Survey quadrangles.

Source: U.S. Department of Agriculture, National Forest Service, 1976.

Recent scientific investigations have shown that mangrove forests are very im portant to fish and wildlife. They function as shoreline stabilizers by inhibiting erosive forces, such as wind and waves. They also act as "settling filters" for upland runoff, which results in relatively clean water return to the ocean after heavy rains. More importantly, mangroves provide food for primary consumer organisms through detrital leaf and twig fall. These organisms are fed upon in turn by successively larger species. Thus mangroves fix sunlight energy, which is then passed on through detrital fall to become a primary energy source upon which a large portion of the marine "food web" is dependent.

Mangrove forests (especially riverine and fringe association), then, provide food, cover, and nursery areas for the wide variety of marine sport and commercial fish species found at Roosevelt Roads (see Table 4-4).

The root systems of red mangroves also provide a large amount of submerged surface area which serves as substrate for a diversity of sessile (non-motile) marine organisms such as tunicates, sponges, and mangrove oysters.

The canopy of a mangrove forest provides nesting and roosting area for a variety of birds. Large egrets and pelicans will commonly roost in the top and outer areas of canopy, while smaller passerine (perching) birds utilize the lower and interior sections.

Certain avians are indigenous to mangroves, i.e., they are restricted to mangrove habitat alone--other habitat types cannot provide for their needs in terms of suitable food or cover.

4.1.4.1.3 Marine Ecosystems. The station also contains various marine ecosystems which can be generally characterized as coral reef associations and seagrass associations. While these areas remain unquantified (in terms of acreage) and are generally unmapped, they are nonetheless important habitat areas.

Coral reefs at Naval Station Roosevelt Roads are made up of stony and soft corals. They are utilized as habitat by a large variety of marine fish. Many of the coral reefs are pristine in more remote areas of the station. Coral reefs develop slowly and are highly sensitive to such factors as substrate and water quality. Once killed, they may be lost forever.

Seagrass beds consisting of turtlegrass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*) are common in the clear shallow embayments of the station. The U.S. Army Corps of Engineers has estimated their areal extent in Ensenada Honda alone at approximately 600 acres.

While seagrasses grow rapidly, they are extremely slow in reproducing; thus once a bed has been damaged, it may be several years before it revegetates in the area affected. These communities tend to dissipate wave energy, which allows sediments to settle out of the water column. Further, they provide the majority of dissolved oxygen present in their associated waters. Finally, the plants serve as food and cover for myriads of marine vertebrates and invertebrates.

Table 4-4

FISHES IN THE MANGROVES OF
NAVAL STATION ROOSEVELT ROADS

Scientific Name	Common Name
Dasyatidae	Stingrays
Dasyatis americana	Southern stingray
Aetobatis narinari	Spotted eagle ray
Elopidae	Tarpons
Megalops atlanticus	Tarpon
Clupeidae	Herrings
Opisthonema ogliun	Thread herring
Herengula humeralis	Red ear sardine
Synodontidae	Lizardfishes
Synodus intermedius	Sand diver
Belonidae	Needlefishes
Stongylura timucu	Timucu
Mugilidae	Mullets
Mugil curema	White mullet
Sphyraenidae	Great barracuda
Sphyraena barracuda	Great barracuda
Polynemidae	Threadfins
Polydactilus virginicus	Barbu
Surranidae	Groupers
Epinephelus striatus	Nassau grouper
Grammidae	Fairy basslets
Gramma loreto	Fairy basslet
Centropomidae	Snook
Centorpomus undecimalis	Snook

Table 4-4 (Cont.)

Scientific Name	Common Name
Hemiramphidae	Halfbeaks
Hemirampus balao	Balao
Carangidae	Jacks
Carans fusus	Blue runner
Carans latus	Horse-eye jack
Oligoplites saurus	Leatherjacket
Lutjanidae	Snappers
Lutjanus apodus	Schoolmaster
Lutjanus jocu	Dog snapper
Lutjanus manogoni	Mahogany snapper
Ocyurus chysurus	Yellowtail snapper
Pomadasydae	Grunts
Haemulon sciurus	Bluestriped grunt
Haemulon flavolineatun	French grunt
Haemulon macrostomum	Spanish grunt
Anisotremus virginicus	Porkfish
Sparidae	Porgies
Archosargus rhomboidalis	Sea bream
Gerreidae	Mojarras
Gerres cinereus	Yellowfin mojarra
Eucinostomus lefroyi	Mottled mojarra
Ephippidae	Spadefish
Chaetodlipterus faber	Spadefish
Scorpaenidae	Scorpionfishes
Scorpaena plumeri	Spotted scorpionfish
Dactylopteridae	Flying gunards
Dactylopterus volitans	Flying gunard
Chaetodontidae	Butterflyfishes
Chaetoclon capistratus	Foureye butterflyfish

Table 4-4 (Cont.)

Scientific Name	Common Name
Pomacentridae	Damselfishes
Eupomacentrus fuscus	Dusky damselfish
Eupomacentrus leucostictus	Beau gregory
Abuclefcluf saxatillis	Sergeant major
Labridae	Wrasses
Lachnolaimus maximus	Hogfish
Halichoeres burittatus	Slippery dick
Halichoeres poeyi	Black-ear wrasse
Thallasoma bifasciatum	Bluehead
Scaridae	Parrotfishes
Sparisoma rubrippine	Yellowtail parrotfish
Sparisoma aurofrenatum	Redband parrotfish
Scarus guacamaia	Rainbow parrotfish

Source: Puerto Rico Department of Natural Resources.

Each of these ecosystems (mangrove, upland forest, coral reef, and grassbe , are highly complementary and interdependent. For example, the mangrove and upland forest function of filtering or inhibiting upland runoff is vital to the well-being of nearby coral reefs, which are extremely sensitive to turbid water. Coral reefs and grassflats are a "first defense" against wave energy, and thus complement the erosion-inhibiting function of the shore zone mangroves. Coral reefs and grassflats are mutually beneficial as cover and feeding areas for fishes, which may be fed upon by birds such as the pelican, which uses mangroves for roosting and nesting habitat.

4.1.4.1.4 Freshwater Ecosystems. Although freshwater bodies (with the exception of rivers) are not common in Puerto Rico, Naval Station Roosevelt Roads encompasses two small ponds located near the airport and the Officer's Club. These ponds are intermittent, i.e., they dry up at times due to weather conditions. The pond areas support birds including the white-crowned pigeon, osprey, white-cheeked pintail, and the blue and green-wing teal. The areas are utilized as feeding, roosting, and nesting habitat by these species.

4.1.4.2 Endangered, Threatened, and Rare Species. The abundance of relatively undisturbed shoreline, mangrove, and upland forest areas supports a unique and diverse number of bird species at Roosevelt Roads, including waterfowl, shorebirds, seabirds, birds of prey, and passerine birds. In fact, more than one-half of all the bird species found on the entire island can be found at the Naval Station either as residents, migrants, or vagrants. This abundance of avifauna may be partially attributable to the fact that the station has been declared a sanctuary where no hunting is permitted. Destruction of wetland ar shore zone habitats on the east coast of Puerto Rico is increasing, which also a factor contributing to the high diversity of bird populations found on the station.

Table 4-5 presents a species list of bird life at Roosevelt Roads. Included in this table are codes for each species' use of habitat at the station (e.g., breeding) where known, as well as a code relating to the species' status (e.g., endangered) developed by the Puerto Rico Department of Natural Resources.

The station supports a variety of federally protected biota (see Table 4-6 and Figure 4-1) which have been listed pursuant to the Rare and Endangered Species Act of 1973. The entire station "exclusive of those existing man-made structures or settlements which are not necessary to the normal needs or survival of the species" (U.S. Fish and Wildlife Service, 1983) has been designated as "critical habitat" for the yellow-shouldered blackbird (Agelaius xanthomus). Critical habitat consists of those areas that are vital to the continued existence and well-being of a given species. Yellow-shouldered blackbirds are endangered due to several factors, including contagious disease, lack of mangrove nesting areas free from rodent predation, and nest parasitation by glossy cowbirds.

The Eastern brown pelican (Pelecanus occidentalis carolinensis), while rare in the continental United States, is common throughout Puerto Rico and the Virgin Islands, although breeding rookeries are small as well as few in number.

The major concentration of West Indian manatees (Trichechus manatus manatus) i Puerto Rico is found within the protected waters of the station. This aggreg

Table 4-5

BIRDS OF NAVAL STATION ROOSEVELT ROADS

Common Name	Scientific Name	Code
Pied-billed grebe	Podilymbus podiceps	
Red-billed tropic bird	Phaethon aethereus	(2)
Brown pelican	Pelecanus occidentalis	(4)
Brown booby	Sula leucogaster	
Magnificent frigatebird	Fregata magnificens	
Great blue heron	Ardea herodias	(3)
Louisiana heron	Hydranassa tricolor	B
Snowy egret	Egretta thula	B (3)
Great egret	Egretta alba	B (3)
Green heron	Butorides virescens	B
Little blue heron	Florida caerulea	B
Cattle egret	Bubulcus ibis	
Least bittern	Ixobrychus exilis	B
Yellow-crowned night heron	Nyctanassa violacea	B
Black-crowned night heron	Nycticorax nycticorax	(2)
Bahama pintail	Anas Bahamensis	B (1)
Blue-winged teal	Anas discors	
American widgeon	Anas americana	
Red-tailed hawk	Buteo jamaicensis	B
Osprey	Pandion haliaetus	B (3)
Merlin	Falco columbarius	
Clapper rail	Rallus longirostris	B
American coot	Fulica americana	
Caribbean coot	Fulica caribaea	B (3)
Common gallinule	Gallinula chloropus	B
Piping plover	Charadrius melodus	
Semipalmated plover	Charadrius semipalmatus	
Black-bellied plover	Squatarola squatarola	
Wilson's plover	Charadrius wilsonia	B
Killdeer	Charadrius vociferus	B
Ruddy turnstone	Arenaria interpres	
Black-necked stilt	Himantopus himantopus	B
Whimbrel	Numenius phaeopus	(2)
Spotted sandpiper	Actitis macularia	
Semipalmated sandpiper	Calidris pusilla	
Short-billed dowitcher	Limnodromus griseus	(3)
Greater yellowlegs	Tringa melanoleuca	
Lesser yellowlegs	Tringa flavipes	
Willet	Catoptrophorus semipalmatus	(3)
Stilt sandpiper	Micropalama himantopus	
Pectoral sandpiper	Calidris melanotos	
Laughing gull	Larus atricilla	
Royal tern	Thalasseus maximus	(2)

Table 4-5 (Cont.)

Common Name	Scientific Name	Code
Least tern	Sterna albifrons	B (2)
Sandwich tern	Thalasseus sandvicensis	(2)
Bridled tern	Sterna anaethetus	
Brown noddy	Anous stolidus	(5)
White-winged dove	Zenaida asiatica	B
Zenaida dove	Zenaida aurita	B
White-crowned pigeon	Columba leucocephala	B (4)
Mourning dove	Zenaida macroura	B
Red-necked pigeon	Columba squamosa	
Common ground dove	Columbina passerina	B
Bridled quail dove	Geotrygon mystacea	
Ruddy quail dove	Geotrygon montana	
Caribbean parakeet	Aratinga pertinax	
Smooth-billed ani	Crotophaga ani	B
Yellow-billed cuckoo	Coccyzus americanus	B
Mangrove cuckoo	Coccyzus minor	B
Short-eared owl	Asio flammeus	B (2)
Chuck-will's widow	Caprimulgus carolinensis	
Common nighthawk	Chordeiles minor	(5)
Antillean crested hummingbird	Orthorhyncus cristatus	B
Green-throated carib	Sericotes holosericeus	B
Antillean mango	Anthracothorax dominicus	B
Belted kingfisher	Ceryle alcyon	
Grey kingbird	Tyrannus dominicensis	B
Loggerhead kingbird	Tyrannus caudifasciatus	
Stolid flycatcher	Myiarchus stolidus	
Caribbean elaenia	Elaenia martinica	
Purple martin	Progne subis	
Cave swallow	Petrochelidon fulva	B
Barn swallow	Hirundo rustica	
Northern mockingbird	Mimus polyglottos	B
Pearly-eyed thrasher	Margarops fuscatus	B
Red-legged thrush	Mimocichla plumbea	B
Black-whiskered vireo	Vireo altiloquus	B
Prairie warbler	Dendroica discolor	
American redstart	Setophaga ruticille	
Yellow warbler	Dendroica petechia	B
Parula warbler	Parula americana	
Magnolia warbler	Dendroica magnolia	
Black and white warbler	Mniotilta varia	
Cape May warbler	Dendroica tigrina	
Black-throated blue warbler	Dendroica caerulescens	
Adelaide's warbler	Dendroica adelaidae	
Palm warbler	Dendroica palmarum	
Ovenbird	Seiurus aurocapillus	

Table 4-5 (Cont.)

Common Name	Scientific Name	Code
Northern water thrush	Seirus noveboracensis	
Bananaquit	Coereba flaveola	B
Stripe-headed tanager	Spindalis zena	B
Shiny cowbird	Molothrus bonariensis	B
Black-cowled oriole	Jeterus dominicensis	B (4)
Greater antillean grackle	Quiscalus niger	B
Yellow-shouldered blackbird	Agelaius xanthomue	B (4)
Hooded mannikin	Lonchura cucullata	B
Yellow-faced grassquit	Tiaris olivacea	B
Black-faced grassquit	Tiaris bicolor	
Ruddy duck	Oxyura jamaicensis	(3)
Peregrine falcon	Falco peregrinus	(2)
Marbled godwit	Limosa fedoa	(2)
Puerto Rican lizard cuckoo	Saurothera vieilloti	
Prothonotary Warbler	Protonotaria citrea	(1)
Green-winged teal	Anas carolinensis	

Code*:

B = breeding;
(1) very endangered,
(2) endangered,
(3) on the verge of being endangered,
(4) status undetermined, and
(5) peripheral

*According to Rare and Endangered Animal Species of Puerto Rico list.

Source: Data compiled by James W. Wiley, U.S. Department of Agriculture Forest Service, Institute of Tropical Forestry, Rio Piedras, Puerto Rico, 1976.

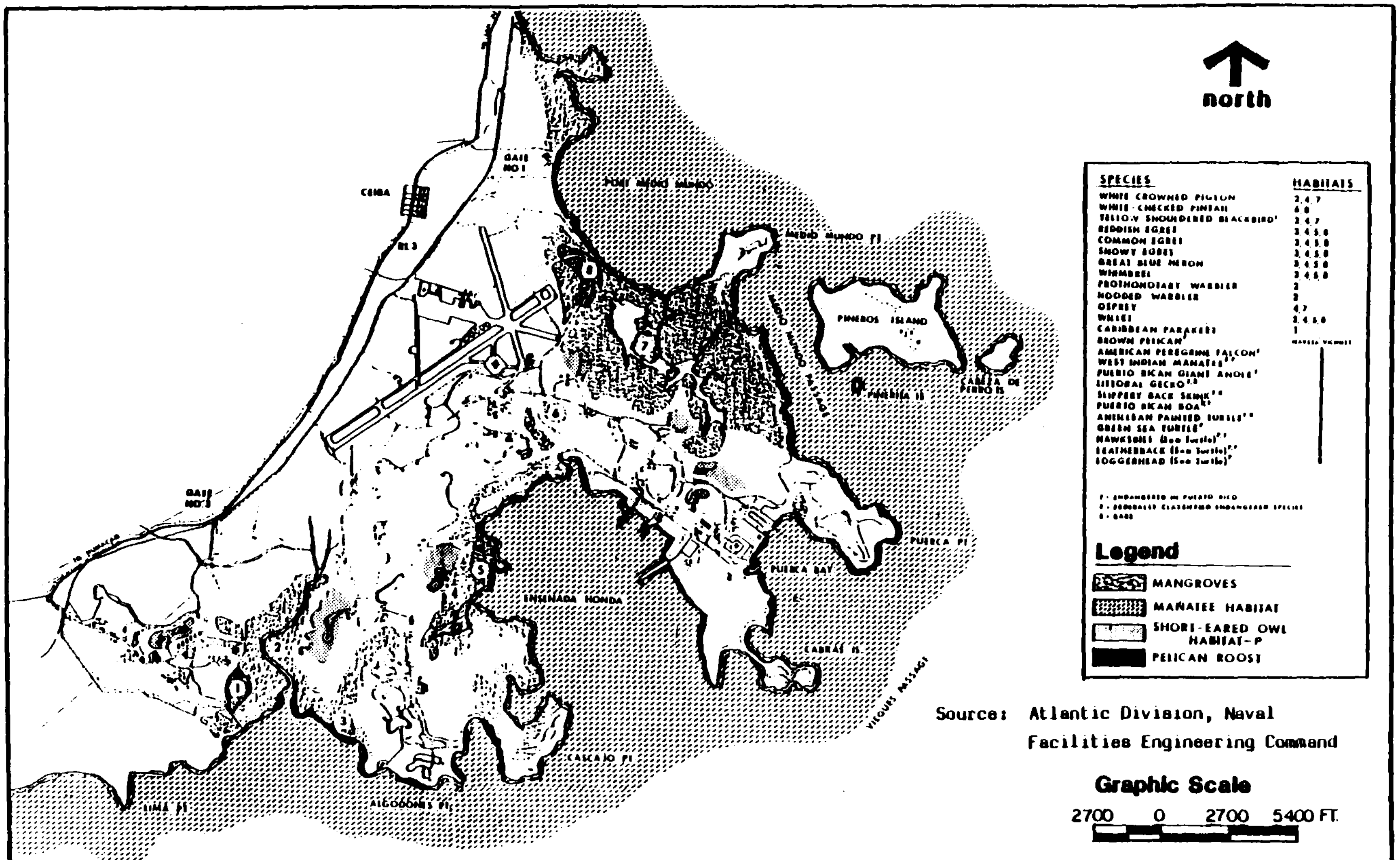
Table 4-6

FEDERALLY LISTED RARE AND ENDANGERED FAUNA
AT NAVAL STATION ROOSEVELT ROADS

Scientific Name	Common Name
Eretmochelys imbricata	Hawksbill turtle
Dermochelys coriacea	Leatherback turtle
Epicrates inornatus	Puerto Rican boa
Pelecanus occidentalis	Eastern brown pelican
Falco peregrinus anatum	American peregrine falcon
Columba inornata wetmori	Puerto Rican plain pigeon
Agelaius xanthomus*	Yellow-shouldered blackbird
Trichechus manatus	West Indian manatee

*Entire station, except for built-up areas, has been designated as critical habitat for this species.

Source: U.S. Fish and Wildlife Service.



Source: Atlantic Division, Naval Facilities Engineering Command

INITIAL ASSESSMENT STUDY
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FIGURE 4-1

AREAS OF VARIOUS SPECIES, NAVSTA ROOSEVELT ROADS tion undoubtedly exists here due to the extensive seagrass beds which are utilized as a feeding area and the ready availability of freshwater from statin wastewater outfalls. The manatee population utilizes the Vieques Passa between the station and Vieques for feeding and breeding.

Sea turtles have been sighted near coral reefs and grassbeds in protected, remote bays. There is a possibility that they nest on some of the more tranquil beaches. All sea turtles except the green sea turtle have been listed, and their survival depends on preservation of their feeding and nesting habitat.

The Puerto Rican boa (Epicrates inornatus) is also under federal protection and is considered endangered throughout its range. Currently, it appears that the species is recovering from severe habitat destruction and mongoose predation. Due to the undisturbed nature of large areas of the station, it may be a major refuge for this species. No collection of the species has been made on the station; however, collections have been made in ecologically similar areas adjacent to the station.

The Commonwealth government has compiled a list of rare and endangered species of Puerto Rico which is more extensive than that of the federal government (see Table 4-5).

At present, there are no freshwater sport fisheries on the station. Station personnel do, however, enjoy saltwater fishing for such species as snook (Centropomus undecimalis), great barracuda (Sphyraen barracuda), bonefish (Albula vulpes), snapper (Lutjanidae), and grouper (Serranidae).

4.1.5 Physical Features.

4.1.5.1 Climatology. The climate of the Roosevelt Roads area is characterized as warm and humid, with frequent showers occurring throughout the year. A major factor affecting the weather is the trade winds associated with the Bermuda High, the center of which is in the vicinity of 30° north, 30° west. The prevailing wind direction reflects the easterly trade winds. The area receives a surface flow from the northeast to the southeast about 75% of the time annually, and as much as 95% of the time in July when the easterly winds are strongest. The differential heating of the land and sea during the day tends to give a more northerly component to the flow on the northern side of the island and a more southerly component on the southern side. During the night, a land breeze causes a prevailing southeasterly flow in the north and a prevailing northeasterly flow over the southern coast. The mean annual wind velocity is 5.5 knots, with a minimum in November and a maximum in August. Gales associated with westward moving disturbances in the trade winds or hurricanes passing either north or south of the area have the highest probability of occurrence from June through October.

Uniform temperatures prevail, with small diurnal ranges as a result of insular exposure and the relatively small land areas. The warmest months are August and September, while the coolest are January and February. Mean annual maximum temperatures range from 82.0° in January to 88.2°F in August. The mean annual minimum temperatures vary from 64.0° in January to 73.2°F in June. The highest maximum temperature recorded was 95°F, while the lowest minimum was 59°F. Rain usually occurs at least nine days in every month, with an average of 60 inches per year. A dry winter season occurs from December through April. About 22 thunderstorm days occur per year, with maximum frequencies of three days per month from May through October.

In late summer the mean sky cover begins a steady decrease from a monthly maximum average of 6.5 tenths coverage in September to a minimum monthly average of 4.4 tenths coverage in February. From March through August the monthly average cloud cover increases steadily from 4.5 to 6.0 tenths coverage during the period. Over the open sea, a maximum of clouds (usually broken stratocumulus) occurs during early morning, with the skies clearing or becoming scattered with cumulus by afternoon. Completely clear or overcast skies are rare during daylight hours, while clear skies frequently occur at night.

The hurricane season is from mid-June through mid-September; maximum winds exceed 95 knots during severe hurricanes. An average of two tropical storms per year occur in the study area, one of which usually reaches hurricane intensity.

4.1.5.2 Topography. The regional area of the Naval Station consists of an interrupted narrow coastal plain with small valleys extending from the Sierra de Luquillo range, which has been deeply eroded by streams into valleys several hundreds of feet deep. Slopes of 30° to 45° are not uncommon.

In the immediate area of the station elevations range from sea level to approximately 295 feet. Immediately to the north of the station boundary, the hills rise abruptly to heights of 800 to 1,050 feet above sea level, with the tallest peak located within two kilometers of the station boundary. There is a series of three hilly areas on the station, two of which separate the southern airfield area from the Port/Industrial, Housing, and Personnel Support areas. The third set of hills is in the Bundy area. These ridge lines not only separate sections of the station, but dictate the degree of allowable development. The ridge line south of the airfield provides an excellent barrier which effectively decreases the aircraft-generated noise which reaches the Unaccompanied Enlisted Personnel Housing areas to an acceptable level. Relief is low along the shoreline. Lagoons and mangrove swamps are common.

4.1.5.3 Geology. The underlying geology of the station area is predominantly volcanic composed of lava and tuff, as well as sedimentary rocks derived from discontinuous beds of limestone. These rocks range in age from early Cretaceous to middle Eocene. The volcanic rocks and interbedded limestones have been complexly faulted, folded, metamorphosed, and intruded by dioritic rocks. This complex geological restructuring occurred sometime after the deposition of the limestone during the middle Tertiary age, when Puerto Rico was separated from the other major Antillean Islands by block faulting and was arched, uplifted, and tilted to the northeast. Culebra, Vieques, and the Virgin Islands are part of the Puerto Rican block; they are separated from the main island simply because of the drowning that resulted from the tilting.

In addition to the predominate volcanic and sedimentary rock, the northwestern and western sectors of the base are underlain by unconsolidated alluvial and old alluvial deposits from the Quaternary period. See Figure 4-2.

The primary geologic formations on and near NAVSTA Roosevelt Roads are various beach deposits, alluvium, quartz diorite and granodiorite, quartz keratophyre,

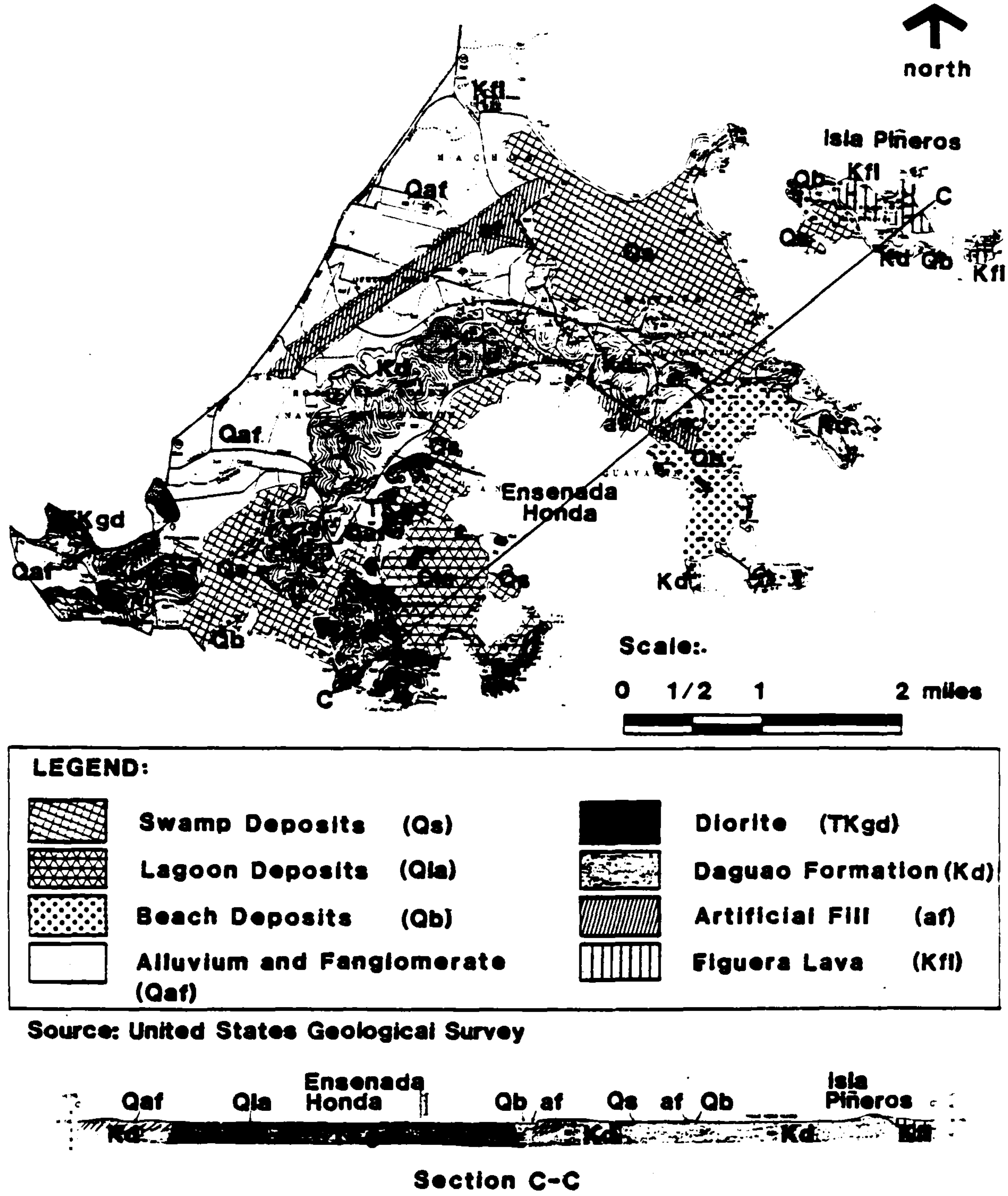

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Figure 4-2
Geological Formation
of Roosevelt Roads
Property

the Daguao formation, and Figuera lava (see Table 4-7). The station is traversed by the Peña Pobre fault zone.

4.1.5.4 Soils. The soil associations found at the Naval Station are predominately of two types typical of humid areas, namely the Swamps-Marshes Association and the Mabi-Rio-Arriba-Cayagua Association, as well as the Descalabrado-Guayama Association, which is typical of dry areas. In addition, isolated areas of the Caguabo-Mucara-Naranjito Association, the Coloso-Toa-Bajura Association, and the Jacana-Amelia-Fraternidad Association are found at the station (see Figure 4-2).

The Swamps-Marshes and Mabi-Rio-Arriba-Cayagua associations cover over one half of the station's surface area and are equally distributed. The remaining area is covered primarily by the Descalabrado-Guayama and Caguabo-Mucara-Naranjito associations.

The Swamps-Marshes Association consists of deep, very poorly drained soils. This association is found in level or nearly level areas that are slightly above sea level but are wet, and when the tide is high, are covered or affected by saltwater or brackish water. The soils are sandy or clayey, and contain organic material from decaying mangrove trees. They are underlain by coral, shells, and marl at varying depths. The high concentration of salt inhibits the growth of all vegetation except mangrove trees, and in small scattered patches, other salt-tolerant plants (U.S. Department of Agriculture, 1977).

The Mabi-Rio-Arriba-Cayagua Association consists generally of deep, somewhat poorly drained and moderately well-drained, nearly level to moderately steep soils found on foot and side slopes, terraces, and alluvial fans. Soils of this association at the Naval Station are basically clayey, and are located predominantly in the areas surrounding Ofstie Field (U.S. Department of Agriculture, 1977).

The Descalabrado-Guayama Association generally consists of shallow, well-drained, strongly sloping to very steep soils on volcanic uplands. Soils of this association are found primarily in the hilly areas located directly inland and adjacent to the soils of the Swamps-Marshes Association (U.S. Department of Agriculture, 1977).

The Caguabo-Mucara-Naranjito Association consists generally of shallow and moderately deep, well-drained, sloping to very steep soils on volcanic uplands. This association consists of soils which formed in residual material that weathered from volcanic rocks. This association is represented at the Naval Station by soils of the Sabana series, which are found on the side slopes and the hilly terrain west of Langley Drive in the Fort Bundy area. These soils are suited for pasture and woodland. Steep slopes, susceptibility to erosion, and depth to bedrock are the main limitations for farming and for recreation and urban uses (U.S. Department of Agriculture, 1977).

The Coloso-Toa-Bajura Association consists of deep, moderately well drained to poorly drained, nearly level soils found on floodplains. This soil association extends along the western boundary of the station and around the airfield. The

Table 4-7

GEOLOGIC FORMATIONS AT NAVAL STATION ROOSEVELT ROADS

Designation	Description
Qbp	**BEACH DEPOSITS OF PEBBLES AND COBBLES (HOLOCENE)** - Moderately sorted, generally well-rounded local pebble and cobble deposits. Composed mainly of volcanic rock fragments from lavas and dikes, coral fragments, and calcareous sand. Gradational into sandy beach deposits. Thickness ranges from two to four meters or more.
Qla	**LAGOON DEPOSITS (HOLOCENE)** - Mud and calcareous sand deposits periodically inundated by very shallow marine waters. Gradational into swamp deposits. Found on western side of Ensenada Honda. Thickness uncertain.
Qs	**SWAMP DEPOSITS (HOLOCENE)** - Black to dark brown organics-rich soil and muck in poorly drained part of alluvial plains. In large part covered with mangroves. Thickness probably as much as five meters locally.
Qb	**BEACH DEPOSITS (HOLOCENE AND PLEISTOCENE?)** - Unconsolidated fine- to coarse-grained sand and pebble deposits. South of Ensenada Honda composed of quartz and feldspar grains and plutonic and volcanic rock fragments, with considerable amounts of sand (shell, algal, and coral fragments) locally. From Ensenada Honda northward, quartz grains are rare and plutonic rock fragments uncommon; deposits are principally of calcium carbonate grains with local admixtures of volcanic rock fragments and pebble clasts. Gradational into, and partly overlain by, alluvial and swamp deposits. Thickness probably more than 10 meters locally.
Qaf	**ALLUVIUM AND FANGLOMERATE (HOLOCENE AND PLEISTOCENE)** - Unconsolidated to weakly consolidated, poorly to well-sorted, clay to boulder-sized material in fans and in stratified alluvial valley fill deposits. Locally terraced; includes slope wash, small landslides, and channel fill deposits. Gradational into units mapped as predominantly alluvium, alluvial plain, and terraced deposits. Thickness locally more then 25 meters.
TKgd	**QUARTZ DIORITE AND GRANO-DIORITE (TERTIARY?) AND UPPER CRETACEOUS?** - Light gray to light olive gray stocks of medium- to fine-grained unfoliated rock with hypodiomorphic-granular texture. Composition ranges from quartz diorite to granodiorite. Hornblende is the predominant mafic mineral; only minor amounts of biotite are present. Rounded metavolcanic xenoliths are locally present. A sample from the stock at the head of the Rio Daguao exhibits a peculiar fine-grained allotrimorphic-granular quartz and feldspar groundmass for the otherwise normally developed medium-grained minerals in the quartz diorite.
TKgdf	**FINE-GRAINED GRANO DIORITE FACIES.**
TKk	**QUARTZ KERATOPHYRE (TERTIARY? AND UPPER CRETACEOUS?)** - Stocks of medium-dark-gray to medium-bluish-gray porphyritic rock with an aphanitic matrix in north-central part of mapped area. Contains oligoclase and bipyramidal quartz phenocrysts. Weathers to grayish yellow, dusky yellow, and light brown. The quartz phenocrysts and the light colors are distinctive. Interior parts of the intrusive are massive in aspect, although the rock is commonly much jointed and locally shattered. Borders of the intrusive are often irregular, with numerous apophyses and dikes extending into the county rock. Groundmass is an intricate intergrowth of quartz albite and oligoclase. X-ray diffraction indicates that somewhat more than 10% of the rock is potassium feldspar, but this could not be confirmed optically. Phenocrysts of plagioiclase are albite and aligoclase in crystals about one to four millimeters in length. The three-millimeter-long quartz phenocrysts appear to be resorbed and rounded, although a bipyramidal shape is plainly evident in many of them. Epidote is common as patches and stringers throughout the rock.

Table 4-7 (Cont.)

Designation	Description
Kfl	**FIGUERA LAVA (LOWER CRETACEOUS)** - Andesitic lava sequence with intercalations of volcaniclastic breccia and tuff. Exposures generally confined to artificial cuts; most slopes show only float of lava fragments in soil. Medium-dark-gray to dark-gray, reddish-brown weathering lavas are generally fine-grained, medium-bedded to massive, and locally autobrecciated. The lava contains small, scattered andesine phenocrysts and sparse pyroxene phenocrysts. Quartz is fairly common in inlets, stringers, and blebs ranging from three to nine centimeters in length. The original composition of the groundmass appears to have been largely andesine and clinopyroxene with minor magnetite, but in most places the groundmass is altered to epidote, chlorite, tremolite-actinolite, quartz, and clay. Local amygdaloidal lavas have quartz, epidote, and calcite as vesicle fillings. Some lenticular zones of pillow lava are scattered through the section; the pillows range from one to two meters in diameter, and generally a light-colored, aphanitic, silicified(?) material occupies the interstices between the pillows. One thin light gray tuff bed (Kfla) crossed by Highway 975 along the ridge crest west of Ceiba appears in thin section to contain devitrified pumice fragments and glass shards in a brown cryptocrystalline groundmass containing scattered broken plagioclase and pyroxene crystals. A planar texture (flowage?) is readily discernible in the rock, and it is interpreted as a nonwelded andesitic ash flow tuff, relatively rich in crystal fragments. Volcaniclastic rocks occur in units a few meters thick as interbeds within the main lava sequence. These rocks include some graded tuffs in layers two to eight centimeters thick, but are mainly medium- to thick-bedded coarse tuff to lapilli tuff and tuff breccia. Clasts include some cherty-looking material (silicified tuff?) as well as minor pumaceous fragments, but are generally fine-grained lava and amygdaloidal lava, like that of the main part of the Figuera. An especially thick massive breccia (Kflb) underlying pillow lavas can be found along Route 972 on the ridge in the northwest part of the Naguabo quadrangle. The breccia is made up of angular to rounded pebble-sized clasts of pumice, amygdaloidal fine-grained lavas, and locally, silicified tuff in calcareous clinopyroxene-bearing tuff matrix. As much as 2,000 meters of Figuera Lava may be exposed in the area.
Kfld	**MIXED ZONE (LOWER CRETACEOUS)** - Interstratified Figuera Lava and Daguao Formation.
Kd	**DAGUAO FORMATION (LOWER CRETACEOUS)** - Interbedded volcanic breccia, lava, and subordinate volcanic sandstone and crystal tuff. The volcanic breccia is medium gray, massive, and is composed of clasts of dark-gray irregularly shaped subangular to subrounded granule- to cobble-size porphyritic andesite lava in a medium gray coarse-grained plagioclase and clinopyroxene crystal tuff matrix. The breccia units are commonly cut by fine-grained and prophyritic lava dikes. Breccia beds are generally exposed only in artificial excavations, and float on natural slopes consists largely of lava clasts. Lavas are principally medium-dark gray andesites with a pilotaxitic texture and andesine and clinopyroxene phenocrysts; they are locally amygdaloidal. Some of these lavas are flow breccias, with porphyritic andesite clasts commonly more than five centimeters in diameter, either welded together or in a matrix of sheared andesite. Some dark-greenish-gray, very fine-grained flows are also autobrecciated. Typical massive tuff breccia can be seen in housing excavations just northwest of Daguao; good breccia and lava exposures can be found along the coast southeast of Hucares. Coarse autoclastic lavas may be found throughout the section in the ridge directly west of Ensenada Honda and Langley Drive, on the Roosevelt Roads Naval Reservation. Dark- to medium-gray volcanic sandstones and tuffs are usually laminated to thin-bedded and graded, and are locally crossbedded. A few crystals tuffs are hornblende-rich; most sand stones and tuffs are composed of plagioclase and clinopyroxene grains like

Table 4-7 (Cont.)

Designation	Description
Kd (Cont.)	the matrix of the massive volcanic breccias, and calcareous are fairly common. The sandstones and tuffs generally form units only a few meters thick in the western part of the mapped area. Notably thicker sequences in the east are shown by diagonal lines. Thick sequences of thin-bedded to laminated tuff are well exposed along the coast from Punta Algodones to Punta Cascajo, on the Roosevelt Roads Naval Reservation. Rocks of the Daguao Formation are commonly epidotized and chloritized in varying degrees. Volcaniclastic hornfels (Kdh) occurs in a few places near the diorite and granodiorite stocks, and small exposures of phyllitic to schistose rocks (s) occur in one area north of Daguao, south of the keratophyre stocks (TKk). The formation interfingers with the overlying Figuera Lava in a few places (see text); its base is not exposed. The thickness of the Daguao is estimated to be on the order of 1,000 to 1,500 meters.
Kdi	**DAGUAO INTRUSIVE BRECCIA (LOWER CRETACEOUS)** - Hypabyssal intrusive rock medium-dark-gray brecciated andesite. Contains subangular clasts of dark-gray andesite with large plagioclase and clinopyroxene phenocrysts in a brecciated matrix of the same composition. The clasts seem to be lithologically identical to andesite clasts in the tuff breccias and autoclastic lavas of the Daguao Formation. The clasts of the two intrusive bodies in the Naguabo quadrangle east of Daguao range from three to 15 centimeters in length; on Isla Pineros in the Punta Puerca quadrangle blocks as large as 90 centimeters in length are found in an intrusive(?) body making up a small hill on the northwest corner of the island. The intrusive rocks are locally much epidotized and silicified; the epidote and quartz occur in veins and in irregular patches. In a quarry in the intrusive body that is south of the Roosevelt Roads airfield some podshaped zones several meters long have been largely replaced by epidote and quartz, yet the original texture of the porphyritic andesite breccia is discernible. An exposure of massive andesite lava about 100 meters wide and 200 meters long on the crest of the ridge to the northwest of Naguabo may also be an intrusive body. The lava is lithologically similar to the other intrusive breccias; although it is only partly brecciated, it does show some near vertical banding (flow lines).

Source: U.S. Geological Survey, 1977.

soils of this association formed in fine textured and moderately fine textured sediment of mixed origin on floodplains. The Coloso soils are deep and somewhat poorly drained; the Toa soils are deep and moderately well drained; and the Bajura soils and Maunabo soils are deep and poorly drained. The Reilly soils, also part of this association, are shallow to sand and gravel and are excessively drained; they lie adjacent to streams. The minor soils are Talante, Vivi, Fortuna, Vega Alta, and Vega Baja soils. The Talante, Vivi, Fortuna, and Vega Baja soils are found on floodplains, while the Vega Alta soils occupy slightly higher positions on terraces.

The Jacana-Amelia-Fraternidad Association consists generally of moderately deep and deep, well-drained and moderately well-drained, nearly level to strongly sloping soils on terraces, alluvial fans, and foot slopes. This association is represented at the Naval Station by soils of the Jacana series, which consist of moderately deep, well-drained soils found on the foot slopes and low rolling hills along Langley Drive and just east of the airfield. These soils formed in fine textured sediment and residium derived from basic volcanic rocks (U.S. Department of Agriculture, 1977).

4.1.5.5 Hydrology. Surface Water: The surface waters that flow across the northeastern plain of Puerto Rico, where the Naval Station is located, originate on the eastern slopes of the Sierra de Luquillo mountains. Surface runoff is channeled into various rivers and streams which eventually flow into the Caribbean Sea. The Daguao River and Quebrada Seca Stream (a tributary to Rio Daguao) collect surface waters from the hills immediately north of the station, and in periods of heavy rain, on-station flooding occurs. The Daguao-Quebrada Seca watershed comprises an area of approximately 7.6 square miles (4,864 acres), and the river falls some 700 feet from its source to sea level. Increased development in the Town of Ceiba, especially in areas adjacent to the station's northern boundary, has significantly increased the surface runoff reaching the station, causing ponding and erosion in the Boxer Drive area. Boxer Drive for a major portion of its length is subject to surface water flooding as are Hangar 200 and AIMD Hangar 379 and adjacent apron areas. See Figure 4-3.

In the low-lying shore areas, seawater flooding results from storms, wind, and abnormally high tides. The tidal ranges in the Roosevelt Roads area are rather small, with a maximum spring range of less than three feet.

Ground Water: Little information exists concerning the geohydrology of NAVSTA Roosevelt Roads. The only known possible sources of ground water are lenticular beds of clay, sand gravel, and rock fragments which occur at a depth of less than 30 meters. No wells have been developed on base from these formations. Some wells were developed upgradient of the station in Ceiba, some three kilometers from base headquarters, but were abandoned due to high levels of salinity.

4.1.5.5.1 Water Quality. The quality of surface waters is variable, reflecting the drainage area through which the water flows. Generally, surface waters have high turbidities and organics (naturally-occurring organics) due to the periodic heavy rains which can easily erode soils from steep slopes, exposed areas, and disturbed stream beds.

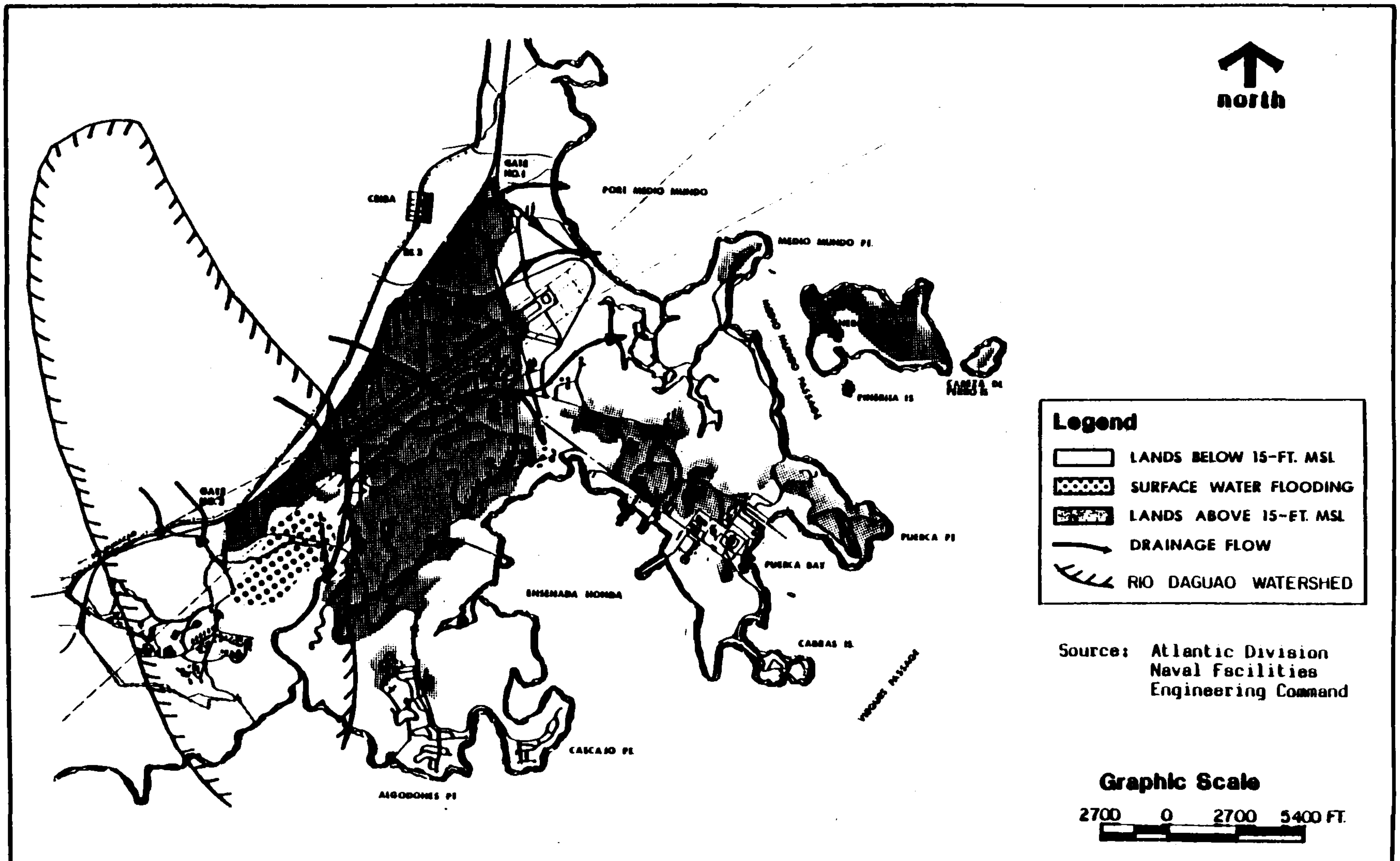

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FIGURE 4-3
SURFACE HYDROLOGY AND DRAINAGE PATTERNS,
NAVSTA ROOSEVELT ROADS

Water from alluvial aquifers along the coast of the Naval Station is of a calcium bicarbonate type, and has high concentrations of iron and manganese. The source of these minerals is unknown, but they may be derived from buried swamp or lagoon deposits.

A seawater-freshwater interface is present in the aquifers throughout the coastal areas of Puerto Rico, usually within a short distance inland of the coastline.

4.1.5.5.2 Water Supply. The Naval Station water treatment plant receives its raw water from the Rio Blanco through a 27-inch reinforced concrete pipe that replaced the old, open channel. The intake is located at the foot of the El Yunque rain forest. This buried raw water line traverses a distance of 14 miles from the intake to the station boundary. A raw water reservoir is located at the water treatment plant and has a 45-million gallon capacity. Additionally, there are two fire protection storage reservoirs with a total storage capacity of 520,000 gallons.

4.1.5.5.3 Potable Water. The base has been served for over 30 years by the present treatment facility. The plant (Building 88) has a capacity of 4.0 million gallons per day (mgd). Water flows by gravity into a 45 million gallon raw water storage basin from which the plant draws its supply at a rate of 1.3 mgd on the average. Treatment consists of pre-chlorination, coagulation sedimentation, filtration, and post-chlorination.

4.1.5.5.4 Industrial Water. The single potable water supply system also provides water to all industrial operations at the facility. The water supply is low in hardness, and therefore is an excellent source for industrial uses, particularly in boiler operation and maintenance.

4.1.5.5.5 Agricultural Water. Three hundred acres are used for pasture near Gate 1, and are irrigated as needed. Extensive sprinkling of lawns and green areas is evident throughout the base.

4.1.6 Migration Potential. Contaminants at NAVSTA Roosevelt Roads can migrate by surface runoff through the drainage ditches, by ground water movement, and by tidal action in the mangrove swamps.

Surface runoff would occur throughout the series of drainage ditches, which empty either into the Rio Daguao watershed and from there into Vieques Passage, or into the mangroves that fringe Ensenada Honda and Puerca Bay.

Ground water at Roosevelt Roads flows generally southeast, except in the areas of high ground on the peninsulas which constitute the Industrial Area, where sites 7, 10, 11, 12, 13, 15, 16, and 17 are located. In these areas, due to the steep slopes (as much as 40%), relatively shallow well-drained soils, and proximity of bedrock to the surface, subsurface contaminant migration will be in the direction dictated by local topography. This will generally be to the north and northeast into the mangrove swamps and Puerca Bay, or to the south and southeast into Ensenada Honda.

The various mangrove swamps are subject to tidal influence daily. In additi high tides or increased flow from the streams and drainage ditches t. terminate in the swamps would increase the migration of the contaminants.

4.2 VIEQUES.

4.2.1 General. Vieques is a long narrow island approximately 52 square miles in area. It is located in the Caribbean Sea approximately seven miles east of the southeast coast of Puerto Rico, between 65°35'W to 65°16'W longitude and 18°05'N to 18°10'N latitude.

The U.S. Navy began using Vieques, in conjunction with Naval Station Roosevelt Roads, in the early years of World War II as a base for Allied fleets. Land was acquired in the eastern and western sectors of the island between 1941 and 1943. Construction of Mosquito Pier and the building of facilities and magazines for an ammunition storage depot were generally completed by 1943. The Naval Ammunition Facility (NAF) on Vieques operated until 1948, when ammunition was removed and the facility closed. The facility was reactivated in 1962 in response to the Cuban missile crisis.

Although the acquisition of more land and the building of other facilities had been considered in the early 1940s, these plans were abandoned when an Allied victory seemed more promising. In 1947, however, the need to conduct amphibious training exercises and maneuvers resulted in the acquisition of additional land in the eastern portion of Vieques. Throughout the 1950s, Vieques was utilized primarily for Fleet Marine Force, Atlantic (FMFLANT), maneuvers and training. In 1960, the U.S. Navy established naval gunfire support (NGFS) and air-tc ground (ATG) targets on Vieques and began holding training exercises on th. island.

The land area of Vieques is approximately 33,000 acres, about three-quarters of which is owned by the Navy. The Navy leases about 10,200 acres for use as a cattle range. The rest of the land is held by individuals or by the government of Puerto Rico, and the bulk of it is devoted to grazing or other undeveloped uses. The Cooperativa de los Ganaderos de Vieques holds leases to the 10,200 acres used for cattle grazing, of which 3,900 acres are part of the NAF and 6,300 acres are in the maneuver area on the eastern end of the island. The Cooperativa uses the land within the leaseholds for grazing cattle and horses.

As in the past, the U.S. Navy, Atlantic Fleet, continues to use the Island of Vieques for naval training exercises and ammunition storage. Naval training activities on Vieques are conducted within an area known as the Inner Range, extending to three miles from the eastern shores. Naval Station Roosevelt Roads, Puerto Rico, is the main support base for Naval activities within the Inner Range.

Within the Inner Range, the Atlantic Fleet's surface ships, aircraft and marine forces carry out training in all aspects of naval gunfire support (NGFS); air-to-ground (ATG) ordnance delivery; air-to-surface mine delivery; amphibious landings; small arms, artillery, and tank fire; and combat engineering. The Inner Range comprises two facilities: the Atlantic Fleet Weapons Training Facility (AFWTF) on Vieques, and the Eastern Maneuver Area (EMA).

The AFWTF on Vieques occupies roughly 3,500 acres on the eastern tip of the island and is tasked with providing facilities for scheduling and conducting NGFS and ATG ordnance delivery training for 96 Atlantic Fleet ships, 30 North Atlantic Treaty Organization ships, eight air wings (an air wing consists of approximately 50 to 70 aircraft), and smaller air units from Great Britain and the Puerto Rico National Guard. In addition, AFWTF tests and evaluates weapons systems to enhance fleet readiness.

FMFLANT also uses the Inner Range to train shore fire control parties (spotters). Training entails live firing by the ships described above, with fall of shot observed and adjusted (in accordance with the standard bracketing and halving procedures) by Marine spotters.

Facilities utilized in NGFS training are the observation post at Cerro Matías, six point targets, and two area targets. The NGFS range officer directs the exercises from Cerro Matías, and he is in voice contact with the ship or ships. During the exercise, AFWTF personnel record the accuracy and the elapsed time of naval gunfire, so that AFWTF can score the performance of each ship.

The EMA occupies approximately 11,000 acres adjacent and to the west of AFWTF's Vieques lands. FMFLANT, the Puerto Rico National Guard, and foreign marine forces use the EMA for training for amphibious landings, maneuvers, small arms and artillery practice, and battalion landing teams combat engineering. Red, Blue, Yellow, and Purple beaches are used for amphibious landings. Red and Blue beaches are most frequently used. These beaches are located within a restricted area which prevents conflicts with non-participating craft during training.

The NAF on Vieques occupies approximately 8,000 acres on the western tip of the island. Operated by the Weapons Department of Naval Station Roosevelt Roads, its mission is to receive, store, and issue all ordnance authorized by Roosevelt Roads for support of Atlantic Fleet units. At present, training exercises are not carried out at the NAF, though in the past, marine landing operations have been conducted along the south and west beach areas. On the northwest coast of Vieques, the facility operates a 625-foot ammunition handling pier (Mosquito Pier). NAF also maintains magazines. In a 12-month period in 1978 it received over 4,100 tons of explosives and ammunition. During this same period, more than 3,500 tons of ammunition and explosives were issued. Transshipments amounted to about 1,200 tons.

The activities at AFWTF, EMA, and NAF function under the consolidated command of Commander Fleet Air Caribbean, Naval Forces Caribbean, and Antilles Defense Command, whose headquarters are at Naval Station Roosevelt Roads. The commanding officer of AFWTF has jurisdiction over the scheduling of all Naval exercises in the Inner Range.

Both the NAF and Camp García purchase their major power requirements from local sources but supplement these sources with emergency generators. AFWTF uses two 150-KW diesel generators and one 100-KV diesel generator as standby power sources and a 90-KW unit supplies Monte Pirata during operations. Training units at Camp García use tactical mobile electrical power equipment.

4.2.1.1 Adjacent Land Use. The land adjacent to the NAF is privately owned or is owned by the Commonwealth of Puerto Rico. This land is primarily used pasture or private homes, or has reverted to secondary forest growth. The land adjacent to the EMA is privately owned, or owned by the municipality of Vieques or the Commonwealth. The land along the northwest boundary of the EMA is used for cattle grazing and private residences. The remainder along the southwestern boundary of the EMA consists of pasture land, secondary forest growth, mangrove swamp, and a public beach (Sun Bay Beach).

4.2.2 History. The Caribbean Islands were settled by South American aborigines over 6,000 years ago. Vieques' prehistoric development occurred over a 3,000- to 4,000-year period. During this time the culture evolved from a preceramic and chipped stone tool technology, to permanent agricultural villages with a ceramic technology.

The first historical reference to Vieques occurs in 1493, when Columbus noted the island on his second trip to the New World. The next record of the island is in 1514, when Don Cristóbal de Mendoza led an expedition against a Carib tribe on Vieques in retaliation for an attack on a Spanish settlement.

Throughout the 17th century, Vieques was virtually uninhabited. The English occupied the island at the end of the 17th century; a 1718 map shows an English colony, and possibly a fort, on the south side of the island. During the same period France was establishing a foothold in the Caribbean and may have led an invasion on the island. Throughout this time both England and Spain claimed ownership to Vieques.

In the early 19th century, the first Spanish settlement was established Vieques. This led to a series of confrontations and near confrontations between the English and Spanish, and eventually also involved the Danes, who were then established in the Caribbean. By the mid-19th century, Vieques was firmly established as a Spanish colony. Its first governor, Don Teófilo Jaime José Marie Lequillou who served from 1832 to 1843, established a hacienda near Santa María, where his tomb is located. In 1845 a small Spanish fort was constructed on a hill overlooking Isabel Segunda. The fort was established after the cessation of hostilities between England and Spain, and was never used in military combat. This fort is being restored by the Institute of Culture, and is currently listed on the National Register of Historic Places (NRHP).

By the latter part of the 19th century the sugarcane industry had become the major economic base of Vieques. Four principal sugarcane factories and haciendas operated in the early 20th century. These were:

- La Patience or La Central Santa María, located in the Village of Santa María;
- Esperanza or La Central Puerto Real, located on the southwest coast on Puerto Real;
- Arcadia on the northwest coast near the present barracks on NAF property; and

- La Playa Grande, the largest, located on the southwest coast on NAF property; this was in operation until 1952.

The remains of La Playa Grande are scattered over a 25-hectare area, and portions of its former railroad beds extend to Punta Arenas, which was the major shipping point for La Central.

In addition to these larger haciendas and factories, a series of smaller haciendas were scattered throughout the island. Among these was Campana, located on the northeast coast. It was an early sugar hacienda, but later served as a cotton warehouse which fell to ruin when the land was turned to pasture animals. There was a hacienda at Puerto Ferro, where Camp García is currently located. Resolución was a small hacienda on NAF property which later consolidated with Playa Grande. Another hacienda, Santa Elena, was located near Resolución, also on NAF property. In addition, four smaller haciendas were also located on Vieques: Resignación, Perseverencia, Pistole, and Marquesado.

4.2.2.1 Historic Sites. Archaeological surveys have been conducted on the Vieques Naval Reservation from 1978 to the present. During these surveys, 227 prehistoric and historic sites were located on the EMA and NAF. Of these sites, 34 were submitted for eligibility for inclusion to the NRHP, and it is estimated that an additional 10 will be nominated after completion of the final phase now in progress.

4.2.3 Legal Actions. In March 1978 the governor of Puerto Rico instituted a court suit (Romero-Barceló vs. Brown) against the U.S. Navy concerning alleged violation of environmental laws, contending that Naval activities had been illegally transferred to Vieques (from Culebra and its cays). The objective of the suit was to enjoin the Navy from using any portion of its land on Vieques or surrounding waters for Naval training operations. The Court decision stated that the continued use of Vieques by the Navy was essential to National defense and injunction of training activities was not appropriate relief for violations the Navy might be found responsible for.

The Court found the Navy in violation of the Federal Water Pollution Control Act, Executive Order 11593, and the National Environmental Policy Act. All other claims were dismissed. To correct these violations, the Navy is attempting to acquire a National Pollutant Discharge Elimination System (NPDES) permit for the release or firing of ordnance into the waters of Vieques, has conducted cultural resources surveys to locate sites eligible for the NRHP, and has filed an Environmental Impact Statement (EIS) in connection with its activities in and around Vieques.

4.2.4 <u>Biological Features</u>.

4.2.4.1 Ecosystems.

4.2.4.1.1 Vegetation. The vegetation on Vieques is mostly characteristic of subtropical dry zones. The island is divided into subtropical moist and subtropical dry forest regions, with the western part being the most humid. Prior to Navy acquisition of the island, all but the steepest parts of the western one-half of the island were used for agriculture, primarily sugarcane, while the eastern end was used for pasture. Many of the beach areas \ developed as coconut plantations. Forests and scrub forests were restricted t. higher hills, steep slopes, limestone areas, tidal swamps and associated wet lowlands, and a few quebradas (drainages). The present distribution of forest is not considerably different, though forest is now even more restricted in some areas. In contrast, the extent of scrub increased significantly with abandonment of agricultural practices and grazing, and today much of the island is covered by scrub types in various stages of succession. Currently, little or no land is in crop production.

Although major parts of Vieques are covered by a mix of scrub types, discrete types of habitat also occur, for example, beach scrub, evergreen scrub on limestone, mangroves, upland forest, and lowland forest.

On the western part of the island, at the NAF, the major activity of the Navy consists of ammunition storage in grass-covered storage areas. Most of this region was originally used for sugarcane production, but the former agriculture fields are now covered by mixed thorn scrub. The characteristic species are Zizyphus mauritiana, Randiaculeata, and Acacia spp. Rauvolfia viridis is common, but it is not a thorn scrub. The thorn scrub areas are wild pastures that are used for grazing livestock. In restricted areas, particularly near the NAF base camp and in the southeastern part near the civilian zone, the brush has been cleared for grazing and the grass mat is relatively complete. Large trees such as Albizzia lebbeck, Pithecellobium saman, and Ficus laevigata occur scattered in parts of the NAF rangeland area, usually on lowland.

The NAF area includes two special features: Monte Pirata, which is the highe. point on the island, and a vast expanse of mangrove forest and associated lagoons. A microwave station is located on top of Monte Pirata, but much of the higher elevations of the mountain are covered with forest. This forest resembles a humid climax forest and is characterized by tall palms (Coccothrinax alta) and trees such as Bursera simaruba, Trichilia hirta, Zanthoxylum monophyllum, Citharexylum fruticosum, and other species.

Mangrove forests and lagoons are found on the northwestern part of Vieques. This complex is the largest of its kind on the island and is fringed on the coastal side by the largest continuous area of cocopalms on Vieques. The mangrove complex includes a large area of dead mangroves near the Laguna Boca quebrada.

The NAF is bordered by narrow beach on the north and northwest coasts. Beach scrub sites are mostly covered by cocopalms. The southwest and south coasts consist of cliffs, and lack substantial sandy beach as far east as Laguna Playa Grande, which is surrounded by mangroves.

The EMA is an area of low hills covered for the most part with microphyllous thorn scrub. Microphyllous thorn scrub consists of legume trees such as Prosopis juliflora and Acacia ssp., and has been named after the compound leaves with numerous small leaflets characteristic of these species. The shrubby trees are shade trees transmitting enough light for the development of a good grass cover, and the area is used for grazing. A part of the area in the south of the maneuver area was at one time used for sugarcane production, but the fields now support dense stands of microphyllous thorn scrub.

The more special vegetation of the maneuver area tends to occur along the southern coast. This area is relatively diverse and includes several limestone peninsulas covered by evergreen scrub and bays lined with mangroves. One of these bays, Puerto Mosquito, is noted for its bioluminescence.

The mangroves generally do not extend far inland, but in a number of lowland areas they are bordered by a broadleaf forest of ucar trees (Bucida bucerus). This forest has a limited distribution on the island and gives way to the microphyllous thorn scrub.

Upland forest is restricted to a number of hilltops and generally consists of a forest scrub. Bursera simaruba is the common tree, and the large pipe organ cactus (Cephalocerus royenni) is a frequent associate. Other important elements are Capparis ssp., Picteti , Pithecellobium, and Randia.

Stands of Lonochocarpus domingensis have been reported in some quebradas, but gallery forest is not well developed along the drainages of the eastern half of the island. Generally, the microphyllous thorn scrub occurs in a more solid stand where moisture conditions are favorable, and thins out on the hills.

The beaches are small in size and alternate with cliffs, particularly along the northeast. A number of these beaches, identified as Blue, Red, and Purple, are used for amphibious landing operations. Much of the area is used as a maneuver zone, and in the northeastern part, there are a number of small arms practice ranges run by AFWTF.

The vegetation in the AFWTF weapons training area displays some similarity with the previous description. However, this region appears to be drier and is more rocky. Microphyllous thorn scrub is a common vegetation type at lower elevations. On the higher hillsides, the common type has been classed as mixed low scrub, which consists of Lantana involucrata, Turnera diffus , Croton spp., Randia aculeata, Mimosa ssp., and others. Although the area is grazed by cattle, it is not an officially leased rangeland area. It is rocky, and the groundcover is generally sparse and open.

Upland forest is less extensive than in the regions previously described, since it appears to have been displaced mostly by mixed low scrub. While generally limited to a few small isolated sites, forest scrub is relatively extensive on the slopes of Cerro Matías and on the peninsula extending into Ensenada Honda. The composition of the forest scrub is similar to that described above for the EMA.

On hillsides, which are used by the Navy for artillery and practice bombing involving inert ordnance, the low mixed scrub or microphyllous scrub are widely dispersed and interspersed by a mixture of species characteristic of recently disturbed land, such as the giant milkweed (Calotropis procerus) and the low creeper (Stachytarpheta jamaicensis).

The most intensively used areas are the established target sites in the ATG impact zone. These sites require periodic rehabilitation (see Section 7.2.2), which consists of grading, and they are largely barren of vegetation or at best covered with a scattering of Calotropis, Stachytarpheta, and Prosopis.

Lowland forest in the surface impact area and ATG impact area has a limited extent. Lowland sites are mostly covered with dense stands of n. .rophyllous thorn scrub. Mangrove forest is restricted to the margins of a few lagoons.

The ATG impact area extends east to the eastern "friendly front line." East of this line, the area known as Punta Este consists of a flat limestone plateau that is covered with evergreen scrub. This evergreen scrub includes a palmetto (Thrinax morrisii) and the area is habitat for a rare orchid (Epidendrum bifidum).

4.2.4.1.2 Wildlife. On Vieques, birds are the dominant and most conspicuous wildlife, followed by herptiles (reptiles and amphibians), and mammals. Three distinct assemblages of birds, totaling 114 species, are known to occur on Vieques. The number of bird species fluctuates during the year because of spring and fall migrations, which affect primarily land birds and lagoon birds. Seabirds maintain a fairly constant population throughout the year.

Land birds are represented by the greatest diversity of species and the largest number of individuals. There are 36 species of lagoon birds, including herons, waterfowl, marshbirds and shorebirds, principally associated with the mangrove-lagoon complexes bordering the Vieques coast. An exception is the cattle egret, which is associated with cattle in all habitats. Seabirds are represented by only 12 species including pelicans, frigatebirds, boobies, tropic birds, gulls, and terns. These birds utilize the rocky shores, cliffs, small islands, sandy beaches, and to some degree, lagoons near the coast. The brown pelican, federally designated endangered species, nests in a rookery on a small isla Cayo Conejo, in Bahía Salina del Sur, just off the southeast coast of Vieque..

Herptiles are represented by 20 species and constitute the second most diverse group of wildlife on Vieques (see Table 4-8). There are 17 species of reptiles and three amphibian species which, with the exception of the Southern woodslave, are all endemic to Puerto Rico. There are four species of oceanic turtles, all of which are federally designated as endangered species.

Mammals are poorly represented on Vieques. The geographical isolation of Puerto Rico at an early geologic period prevented mammals from becoming established as a dominant wildlife form (Briggs, 1964). One species, the manatee, is an oceanic mammal and is federally designated as an endangered species.

Bats constitute the largest group of mammals on Vieques. The only surviving endemic mammal is the red fruit bat, which is now considered an endangered species in Puerto Rico. All other mammals, including the house mouse, the rat, the mongoose, and domestic animals, have been introduced by man.

The coastal waters of the Caribbean are inhabited by an extremely diverse fish fauna that can be generally divided into three associations according to their preferred habitat. These associations include the grassbeds and sandflats, reef fishes, and open water or pelagic fish associations. There is a great deal of overlap among these associations since many of the fishes exploit the resources in the grassbeds, and the pelagic fishes feed in the reefs and grassbeds. The mangroves, swamps, and lagoons are highly valuable nursery areas for both juve-

Table 4-8

RELATIVE ABUNDANCE OF HERPTILES ON VIEQUES

Scientific Name	Common Name	Status
Leptodactylus albilabris	White-lipped frog	Abundant
Eleutherodactylus antillensis	Antillean frog	Common
Bufo marinus	Giant toad	Common
Hemidactylus mabouia	Southern woodslave (gecko)	Uncommon
Sphaerodactylus nicholsi	Pigmy gecko	Uncommon
Sphaerodactylus macrolepis	Common dwarf gecko	Common
Sphaerodactylus roosevelti*•	Littoral gecko	Rare
Anolis cristatellus	Man lizard	Abundant
Anolis stratulus	Salmon lizard	Common
Anolis pulchellus	Sharp-mouthed lizard	Abundant
Anolis cuvieri*•	Puerto Rican giant anole	Rare or extinct
Ameiva exsul	Common ground lizard	Abundant
Mabuya sloanii*•	Slippery back skink	Rare or extinct
Typhlops•	Worm snake	Rare
Alsophis antillensis•	Ground snake	Rare or extinct
Pseyudemys rtejnegeri*•	Antillean painted turtle	Rare
Chelonia mydas†•	Green sea turtle	Endangered
Dermochelys coriacea†•	Leatherback (sea turtle)	Endangered
Caretta caretta†•	Loggerhead (sea turtle)	Endangered
Eretmochelys imbricata†•	Hawksbill (sea turtle)	Endangered
Trimeresurus	Fer-de-lance	Rare or endangered

* = Endangered in Puerto Rico
† = Federally classified endangered species
• = Not observed during study

Source: Ecology and Environment, Inc., 1978.

nile reef and pelagic fishes which characterize the fish life found in the areas. Snook, mullet, needlefish, and mojarras are reportedly the most abundant forms in Puerto Rican mangroves. Spiny lobster, shrimp, and other crustaceans also use the mangroves as nursery areas. Table 4-9 lists fish species found around Vieques.

The submerged prop roots of the mangroves also support an extremely diverse association of epiphytic organisms, including oysters, sponges, flatworms, hydroids, bryozoans, annelides, barnacles, shrimp, amphipods, crabs, snails, clams, mussels, sea urchins, tunicates, and a large variety of algae.

Bioluminescent bays are occasionally found in protected tropical bays with very particular physical, chemical, and biological characteristics. In Puerto Rico these bays are found on the south coast near Parguera, Bahía Fosforescente, and Bahía Monsio José, and on the south coast of Vieques at Puerto Mosquito and Bahía Tapón. The bioluminescence is caused by the permanent bloom of the dinoflagellate _Pyrodinium bahamense_. _Pyrodinium_ emits light only when it is disturbed. Propellers of boats and actions of swimmers and frightened fish result in flashing displays of thousands of disturbed dinoflagellates. All of the bioluminescent bays in Puerto Rico and Vieques are fringed with mangroves. The organic matter produced by the mangroves is believed to be a requirement for the growth and maintenance of the _Pyrodinium_ populations.

Because of the delicate balance of physical, chemical, and biological characteristics in these bays, they represent a rare resource and are especially susceptible to even minor disturbances.

4.2.4.2 Endangered, Threatened, and Rare Species.

4.2.4.2.1 Vegetation. The federal endangered and threatened species list does not include plants from Puerto Rico. However, the Commonwealth of Puerto Rico has published a committee report on rare and endangered flora (Department of Natural Resources, 1977). A comparison between the committee report, the identified plant specimens gathered during the survey conducted by E & E on the island in 1978, and previous papers on Puerto Rican flora yielded 26 species as potential inhabitants of Vieques. These 26 species are listed in Table 4-10.

The majority of the 26 endangered and rare plants occur in two broad habitat categories: (1) moist upland forest and wooded ravines, and (2) coastal thickets and woods. These habitats are found in the NAF area. Lumbering in the past and agriculture have generally destroyed suitable habitat for the 26 species.

4.2.4.2.2 Wildlife. There are 34 wildlife endangered species on land and in the waters adjacent to Vieques. Of these, 24 species are birds, four are terrestrial herptiles, four are oceanic turtles, one is a bat, and one is an ocean mammal. Six species, the brown pelican, hawksbill turtle, leatherback turtle, green turtle, loggerhead turtle, and Caribbean manatee, are on the federal list of endangered species; these six species are discussed below. The remainder are considered endangered by the Commonwealth.

Brown pelicans are the largest, most conspicuous, and most abundant seabird on Vieques. It is endangered because of pesticide poisoning, human interference

Table 4-9

REEF FISH SURVEY ON VIEQUES
FISH SPECIES

Scientific Name	Common Name	Reported in Commercial Fisheries Catch
Ginglymostoma cirratum	Nurse shark	
Gymnothorax moringa	Spotted moray	
Synodus intermedius	Sand diver	
Holocentrus ascensionis	Squirrelfish	X
H. coruscus	Reef squirrelfish	X
H. rufus	Longspine squirrelfish	X
H. vexillarius	Dusky squirrelfish	X
H. marianus	Longjaw squirrelfish	X
Myripristis jacobus	Black bar soldier	
Aulostomus maculatus	Trumpetfish	
Cephalopholis fulva	Coney	X
Epinephelus adscensionis	Rock hind	X
E. guttatus	Red hind	X
E. morio	Red grouper	
E. striatus	Nassau grouper	X
Hypoplectrus indigo	Indigo hamlet	
H. nigricans	Black hamlet	
H. puella	Barred hamlet	
H. unicolor	Butter hamlet	
Petrometopon cruentatum	Graysby	
Serranus tigrinus	Harlequin bass	
Gramma loreto	Fairy basslet	
Priacanthus arenatus	Bigeye	
P. cruentatus	Glasseye snapper	
Apogon maculatus	Flamefish	
A. townsendi	Belted cardinal	
Malacanthus plumieri	Sand tilefish	
Caranx crysos	Blue runner	X
C. ruber	Bar jack	
Elagatis bipinnulata	Rainbow runner	
Seriola dumerili	Greater amberjack	
Scomberomorus regalis	Cero	X
Lutianus analis	Mutton snapper	X
L. apodus	Schoolmaster	
L. mahogoni	Mahogany snapper	
Ocyurus chrysurus	Yellowtail snapper	X
Gerres cinereus	Yellowfin mojarra	X
Haemulon album	Margate	
H. aurolineatum	Tomgate	X

Table 4-9 (Cont.)

Scientific Name	Common Name	Reported in Commercial Fisheries Catch
H. chrysargyreum	Smallmouth grunt	X
H. flavolineatum	French grunt	X
H. melanurum	Cotton-wick	
H. plumieri	White grunt	X
H. sciurus	Bluestriped grunt	X
H. macrostomum	Spanish grunt	X
Calamus bajonado	Jolthead porgy	
Equetus acuminatus	High hat	
Mulloidichthys martinicus	Yellow goatfish	X
Pseudupeneus maculatus	Spotted goatfish	X
Pempheris schomburgki	Glassy (copper) sweeper	
Kyphosus sectatrix	Bermuda chub	
Holacanthus ciliaris	Queen angel	
H. tricolor	Rock beauty	
Pomacanthus arcuatus	Gray angel	
P. paru	French angel	
Chaetodon capistratus	Foureye butterfly fish	
C. striatus	Banded butterfly fish	
Abudefduf saxatilis	Sergeant major	
A. taurus	Night sergeant	
Chromis cyaneus	Blue chromis	
C. multilneatus	Brown chromis	
Eupomacentrus mellis	Honey damsel	
Microspathodon chrysurus	Yellowtail damsel fish	
Pomacentrus fuscus	Dusky damsel	
P. leucostictus	Beaugregory	
P. partitus	Bicolor damsel	
P. planifrons	Threespot damsel	
P. variabilis	Cocoa damsel	
Bodianus rufus	Spanish hogfish	
Halichoeres bivittatus	Slippery dick	
H. garnoti	Yellowhead wrasse	
H. maculipinna	Clown wrasse	
H. caudalis	Painted wrasse	
H. poeyi	Blackear wrasse	
H. radiatus	Puddingwife	
Hemipteronotus novacula	Pearly razor fish	
Lachnolaimus maximus	Hogfish	
Thalassoma bifasciatum	Bluehead wrasse	
Scarus coelestinus	Midnight parrotfish	X
S. coeruleus	Blue parrotfish	X
S. croicensis	Striped parrotfish	X

Table 4-9 (Cont.)

Scientific Name	Common Name	Reported in Commercial Fisheries Catch
S. guacamaia	Rainbow parrotfish	X
S. taeniopterus	Princess parrotfish	X
S. vetula	Queen parrotfish	X
Sparisoma aurofrenatum	Redband parrotfish	X
S. chrysopterum	Redtail parrotfish	X
S. radians	Bucktooth parrotfish	X
S. rubripinne	Yellowfin parrotfish	X
S. viride	Stoplight parrotfish	X
Sphyraena barracuda	Barracuda	X
Ophioblennius atlanticus	Red lip blenny	
Coryphopterus glaucofraenum	Bridled goby	
C. personatus	Masked goby	
Gnatholepis thomsoni	Goldspot goby	
Gobiosoma genie	Cleaning goby	
Acanthurus bahianus	Ocean surgeon	
A. chirurgus	Doctor fish	
A. coeruleus	Blue tang	
Bothus lunatus	Peacock flounder	
Balistes veluta	Queen trigger fish	X
Cantherhines pullus	Orange-spotted file fish	
Melichthys niger	Black durgon	
Lactophrys triqueter	Smooth trunkfish	X
Canthigaster rostrata	Sharpnose puffer	
Diodon hystrix	Porcupine fish	

Source: Survey conducted by Ecology and Environment, Inc., 1978.

Table 4-10

PROBABLE RARE AND ENDANGERED PLANT SPECIES OF VIEQUES

Name	Growth Form	Habitat
Amaranthaceae		
Celosia virgata	Herb	Upland forest
Bignoniaceae		
Enallagma latifolia	Tree	Lowland forest
Bromeliaceae		
Tillandsia lineatispica	Epiphyte	Lowland forest
Witmackia lingulata	Epiphyte	Lowland forest
Caesalpiniaceae		
Caesalpinia bunduc	Woody vine	Beach scrub
Stahlia monosperma	Tree	Lowland forest
Capparidaceae		
Morisonia americana	Tree	Upland forest
Celastraceae		
Maytenus cymosa	Tree	Lowland forest
Compositae		
Baccharis dioica	Shrub	Evergreen scrub
Cyperaceae		
Bulbostylis pauciflora	Sedge	Pastures
Cyperus urbani	Sedge	Pastures
Flacourtiaceae		
Prockia cruis	Tree	Upland forest
Malpighiaceae		
Malpighia fucata	Tree	Beach scrub
M. infestissima	Tree	Beach scrub
M. linearis	Tree	Beach scrub
M. shaferi	Tree	Lowland forest
Tetrapteris inaequalis	Woody vine	Beach scrub
Myrtaceae		
Calyptranthes thomasiana	Tree	Upland forest
Olacaceae		
Schoepfia schreberi	Tree	Upland forest
Orchidaceae		
Epidendrum bifidum	Epiphyte	Evergreen scrub
Papilionaceae		
Sophora tomentosa	Shrub	Beach scrub

Table 4-10 (Cont.)

Name	Growth Form	Habitat
Piperaceae		
<u>Peperomia</u> <u>myrtifolia</u>	Herb	Upland forest
Polypodiaceae		
<u>Adiantum</u> <u>villosum</u>	Fern	Gallery forest
Solanaceae		
<u>Brunfelsia</u> <u>americana</u>	Tree	Upland forest
Urticaceae		
<u>Pouzolzia</u> <u>occidentalis</u>	Shrub	Upland forest
Zygophyllaceae		
<u>Guaiacum</u> <u>officinale</u>	Tree	Beach Scrub

Sources:
- Woodbury, Roy, et al., 1975, Rare and Endangered Plants of Puerto Rico, a Committee Report, U.S. Department of Agriculture, Soil Conservation Service.
- Ecology and Environment, Inc., in 1978.

and low total numbers. The largest nesting colony of brown pelicans in t. Commonwealth is located on Cayo Conejo, just off the southeast coast o. Vieques, and the species is common on rock outcrops along the north coast east of the civilian sector, along all of the south coast except at Esperanza, and along the west coast. Traditional roosting sites are rock outcrops near Punta Vaca and Punta Boca Quebrada on the southwest coast, and on the pilings near Mosquito Pier. The pelican catches fish in the quiet waters of many coves and inlets surrounding Vieques, and also in some of the larger lagoons such as the Laguna Kiani complex at the NAF and Laguna Monte Largo.

Rare and endangered marine species whose range extends into the seas around Puerto Rico include the Caribbean manatee; the green, hawksbill, loggerhead, leatherback, and olive ridley sea turtles; and the blue, finback, humpback, sei, and sperm whales (U.S. Department of the Interior, 1978). Whales are infrequent visitors to the waters around Vieques. However, both the manatee and several species of sea turtles are found in shallow waters off the island.

The endangered Caribbean manatee, Trechechus manatus L., once ranged from Florida to Brazil. At present, it is virtually extinct in the Virgin Islands and Lesser Antilles, and relict populations are found in Puerto Rico, Hispaniola, Cuba, and Jamaica. Its decline is due to hunting, habitat degradation, and more recently, boating accidents. The manatee is a herbivore, and feeds on seagrass. While it is usually found in or near fresh or brackish water, it is not known whether the animal requires access to freshwater.

Aerial surveys were conducted on Vieques as part of the E & E 1978 surve. Forty manatee sightings were made, 38 of which were in the lee of Mosquito Pier, and 21 of which were off the west shore. A possible sighting was made by the survey team near the eastern end of Ensenada Honda, and four sightings were reported by others near Cayo Conejo, Bahía de la Chiva, and two in the lee of Mosquito Pier. The estimated population of manatees observed around Vieques in 1978 was 15 to 25. Manatees were observed feeding only in the large Thalassi meadow off the northwestern end of Vieques. There was some indication that the manatees on Vieques may be a part of the population found at Roosevelt Roads, and that they move back and forth across the Vieques Passage.

The green turtle, Chelonia mydas; hawksbill, Eretmochelys imbricata; loggerhead, Caretta caretta; and leatherback, Dermochelys coriacea, may be found in the waters around Vieques as residents or seasonal visitors. The olive ridley, Lepidochelys olivacea, in Puerto Rican waters is probably a rare vagrant. The hawksbill and leatherback are listed as endangered, and the green, olive ridley, and loggerhead are listed as threatened, on the Federal Endangered Species list.

The decline of these species has resulted from overhunting of these species for food and for their shells, which are used for ornaments. Habitat alienation and destruction are also believed to have significantly contributed to their decline in recent years. The turtles are most vulnerable when they return to their breeding beaches to lay their eggs at night. The leatherback nests mainly in March and April, and the other species nest mostly between June and October. The female turtles lay their eggs in nests dug in the sandy beaches during the night. Nesting requires about two hours, during which about 100 eggs are deposited in the nest. The turtles breed on the average every two to three years.

Most turtles nest several times during a breeding season, at about two-week intervals. Incubation of eggs takes between 45 to 72 days, after which the baby turtles emerge from the nest at night or early morning and return to the sea. Mating of sea turtles usually occurs in the coastal waters off the breeding beaches and can require several hours. Turtles are generally omniverous, feeding on seagrasses, molluscs, crustaceans, tunicates, fish and jellyfish, although adult green turtles prefer seagrasses and the leatherback prefers jellyfish.

Fifteen sea turtles were sighted during aerial and beach surveys conducted on Vieques during the summer of 1978. The highest numbers of sightings per hour occurred along the northeast shoreline. Sea turtle nesting activity, primarily by leatherbacks, was also concentrated along the northeastern coast. A second nesting area was noted on Yellow Beach.

4.2.5 Physical Features

4.2.5.1 Climatology. The climate of the Island of Vieques is of the tropical wet and dry class. Easterly trade winds blow directly across the island year-round. These winds moderate the tropical heat considerably. Showers occur frequently throughout the year, but they are usually of short duration, and there are considerable periods of sunshine.

The mean temperature in Vieques is approximately 80°F, with little variation in mean monthly temperatures. Based on the 28-year period of record up to 1975, the mean annual temperature at the village of Esperanza is 79.3°F; August is the warmest month, at 81.8°F, and February the coldest, at 76.0°F. The small temperature range is attributed to two factors: first, the island is surrounded by water, the temperature of which changes little from the warmest to the coolest season; and second, the island is near the equator, which accounts for the relatively small differences in energy received from the sun from season to season. Monthly extreme temperatures at Esperanza range from 98°F to 60°F for the 14-year period of record. The mean daily temperature range, that is, the difference between the daytime maximum and the nighttime minimum, is estimated to be between 15° and 25°.

There is little data on rainfall patterns on Vieques. The available data indicate that approximately 45 inches of rainfall occur annually.

The outstanding feature with regard to wind patterns around Vieques is the steadiness of the trade winds, which are from an easterly direction, almost without exception, varying from north-northeast to south-southeast. Two wind regimes affect the Island of Vieques, with the trade winds dominating.

4.2.5.2 Topography. The topography of Vieques is characterized by a series of low hills and small valleys. The hills on the western side of the island differ considerably in form and character from those on the eastern end. The hills in the west (except on high ledges) are gentler and more rolling, and have a deeper soil profile than those on the east end, which are angular and rugged in appearance and have a large amount of exposed rock surface. The highest point on the western end is Monte Pirata (elevation 301 meters). The highest point on the eastern end is Cerro Matías (elevation 138 meters). The areas of highest elevation are generally found along the longitudinal axis of the island. These areas exhibit a more angular, blocky appearance than the lower lying hills.

There are several low-lying coastal zones of sedimentary deposits that are erally level and contain lagoons and swamps. The largest of these are loc... in the northwest corner of the island; on the east end, north of Bahía Salina del Sur; and in the southern valley between Esperanza and Bahía Tapón.

4.2.5.3 Geology. Vieques is composed of three major rock types, in terms of age and general lithology. In addition, there are unconsolidated sedimentary deposits on the island. The three main rock types are Upper Cretaceous volcanic rocks, Upper Cretaceous or Lower Tertiary intrusive rocks, and Upper Tertiary and Quaternary sedimentary rocks. The unconsolidated sedimentary deposits are of Quaternary age and consist of alluvial deposits, beach and dune deposits, and swamp and marsh deposits (see Figure 4-4).

The oldest rocks exposed on Vieques are presumed to be of Upper Cretaceous age and are mostly andesites, tuffs, and conglomerates. It is generally thought that these rocks were deposited in a marine environment, and are similar to rocks of the same age found in Puerto Rico and the Virgin Islands. The thickness of these deposits is believed to vary across the island. Alteration of the rocks varies according to proximity to the various intrusive contacts. The least degree of alteration occurs in the eastern end of the island.

During the Upper Cretaceous or Lower Tertiary period, the emplacement of a quartz diorite complex pluton resulted in the deformation and metamorphosis of the Cretaceous volcanic rocks. The quartz diorite plutonic rocks appear as outcrops over a large percentage of the island, but particularly in the western and central portions. The pluton is divided into two major bodies by a narrow belt of metamorphosed andesites and andesite tuffs running from Isabel Segun to Bahía de la Chiva. The western pluton is generally coarse-grained and equiangular in texture, while the eastern pluton is generally finer-grained with a microgranitic texture.

Mafic intrusives are also well distributed throughout the island. Dark, fine-grained dike rock outcrops occur at various locations throughout the island, while coarse-grained outcrops of varying color and texture occur at the western end of the island in the quartz diorite complex.

Limestone outcrops of Upper Tertiary age occur at three major areas on the island. Several peninsulas along the south coast constitute the largest concentration, with other deposits located on the extreme eastern end of the island, and at Desembarcadero Mosquito on the north coast. The limestone is soft, yellowish, and contains an abundance of fossils. On exposure, the limestone forms a hard crust which resists weathering.

4.2.5.4 Soils. The majority of the soils on Vieques are residual. Because of the tropical wet and dry climate type and the relatively impermeable intact volcanic rock, soil development has been severely limited on the eastern portion of the island, resulting in a very shallow soil profile. Generally, soils on the eastern end of the island are fine-grained, with a high clay content. Soils on the western end of the island are somewhat better developed. These have been formed by the weathering of the underlying granite diorite intrusive. They are primarily coarse-grained and contain primarily arkosic material, with subordinate amounts of clay (see Figure 4-5).

The larger valleys of Vieques are filled and blanketed by alluvial deposits of Quaternary age. These deposits, which are stream-laid, consist of clay, silt, sand, and gravel derived from either the parent volcanic rock or intrusive rock. The largest of these valleys are Valle de Resolución on the northwest side of the island, and the large valley stretching from Esperanza to Camp García on the south coast. Although the alluvial deposits vary in thickness, they are generally more than 40 feet thick. In addition to the major soil areas mentioned above, the areas along the shoreline are covered with deposits of beach, alluvial, and wind-blown sand, and lagoon and salt marsh muds.

4.2.5.5 Hydrology. The topography of Vieques consists of a series of low hills and shallow valleys, with an average elevation of about 75 meters above sea level. From the high points of the island, small, normally dry waterways (quebradas) flow in both north and south directions to the sea. This division of the drainage results in many small drainage basins, the great majority of which are less than a mile in length and only a fraction of a square mile in drainage area. Such small basins have no significance for water resource development and only function as drainage ditches to carry flood runoff in periods of intense rainfall.

The largest drainage area is that of Quebrada La Mina, which extends in a southeast-northwest direction from the village of Esperanza, on the southwest coast of the island. The total drainage area of that basin is 2.3 square miles. There are four other basins with drainage areas of one to two square miles.

4.2.5.5.1 Water Quality. The surface waters of Vieques were surveyed for explosive products and by-products in May 1978 by the Naval Surface Weapons Center, White Oak, Silver Spring, Maryland. Samples were collected from crater runoff water, lagoon water, and seawater near large bomb craters and compared to samples from waters outside of the impact zone for TNT, RDX, and tetryl. Results from thin-layer chromatography and vapor chase chromatography analysis indicated that there was no essential difference between the water samples taken outside the impact area and within the impact zone.

Additional analyses were performed for ammonia, cyanide, nitrate/nitrite, perchlorate, and white phosphorus. Results of the study show that cyanide and ammonia were found in most of the bomb craters and swamps inside the impact area. However, both parameters were below the maximum permissible concentration (MPC) of 0.5 ppm for ammonia and 0.2 ppm for cyanide. Nitrate/nitrite was found in every sample taken in the bomb craters and swamps, with values comparable to average seawater (0.05 ppm) and below the MPC of 10 ppm. No detectable concentrations of perchlorate or white phosphorus were found in any of the water samples, including the samples collected in target areas where ammunition containing white phosphorus was used.

The ground water on the island varies from salty to relatively fresh. The relatively high chloride values of the water have resulted from the accumulation of salts from sea spray in the ground water, a condition which is typical of islands with low rainfall, and from saltwater encroachment as a result of ground water withdrawals. The ground water is quite hard. Nitrates were low, ranging from 0.0 to 59 milligrams per liter (mg/l), with a median value of 2.3

mg/l. Iron concentrations were also low, with values below 0.3 mg/l. Sod concentrations ranged from 7 to 1,670 mg/l, with a median value of 157 mg/l.

The two main sources of ground water on Vieques are the Valle de Resolución, located on the western portion of Vieques within the confines of the NAF, and the Valle de Esperanza, located on the south coast near Esperanza.

The quality of the ground water from the Valle de Resolución was good, with low chloride levels. Increased pumping from the Valle de Esperanza resulted in an increase in the chlorides from saltwater encroachment prior to the completion of the pipeline from Puerto Rico.

4.2.5.5.2 Water Supply. The population of Vieques was dependent on ground water for water supply until 1979; since then water has been piped from Puerto Rico. At present, there is a limited dependence on ground water in homes and installations outside the distribution systems.

An eight-inch freshwater pipeline from Puerto Rico supplies the NAF, Isabel Segunda, and Esperanza with potable water. Camp García and the EMA received potable water from two wells located north of Puerto Mosquito near the main gate of Camp García. These wells were in operation 24 hours a day. Four tanks, with a 15,000-gallon capacity, are present at the site for water storage.

The backup potable water source for the Vieques Naval Reservation and the civilian sector of Vieques are two aquifers in the Valle de Esperanza and the Valle de Resolución. These aquifers were the principal source of potable wat for the island before the construction of the freshwater pipeline from Puerto Rico in 1979.

4.2.5.5.3 Industrial Water. The Navy currently operates several sanitary waste treatment facilities on Vieques. These include septic tanks with tile fields at the NAF, Cerro Matías, and Camp García; a secondary treatment stabilization lagoon with post-chlorination and an evaporation pond at Camp García; and a secondary treatment activated sludge plant at the NAF. None of the septic tanks discharge to surface waters. The sewage treatment plant at Camp García used to discharge to the sea near Bahía Tapón; however, this discharge was eliminated and replaced by a land application system. The sewage treatment plant at the NAF currently discharges to a swale that contains surface waters only during heavy rains. The Navy plans to provide a land application system for this facility very soon.

4.2.5.5.4 Agricultural Water. The U.S. Navy has leased land on the EMA and NAF to the local cattlemen's cooperative for pastureland. Water sources utilized for cattle production include rainwater and natural runoff (quebradas), pipeline water from Puerto Rico, and natural springs. A permanent spring located on the NAF property in the area south of Building 422 is used as a year-round source of water for cattle. During the dryer months of the year, this permanent water source attracts large numbers of cattle from the range and the area is used as a central location to herd cattle for range management.

4.2.6 Migration Potential. Contaminants at NAF on Vieques can migrate by surface runoff, subsurface movement, and tidal action.

Surface runoff would occur in the quebradas, which carry surface runoff two or three times a year, depending on rainfall patterns. At these times, the flow may be as much as 10 cubic feet per second, although it is of short duration. The quebrada on the north side of NAF Vieques discharges to the Vieques Passage.

Ground water movement occurs in the quebradas and in the Valle de Resolución, where alluvial deposits of clay, silt, sand, and gravel measure up to 40 feet thick. The ground water moves in a northwesterly and southeasterly direction from the subsurface water divide, which runs in a southwest to northeast direction across the Valle de Resolución just south of Building 422.

Tidal movements in the mangroves would also influence migration of contaminants.

4.3 CULEBRA.

4.3.1 General. The island of Culebra is part of the Commonwealth of Puerto Rico and is located at latitude 18°19' north and longitude 65°17' west, approximately 17 miles east of Puerto Rico. It is 12 miles west of St. Thomas, and nine miles north of Vieques. The AFWTF maintains an observation post on Culebra for the maintenance of the microwave communications system.

Culebra is 7,000 acres in area. This includes the main island and outlying cays, the three largest of which are Cayo Norte, Isla Culebrita, and Cayo de Luis Peña. The distance from Punta Resaca on the north to Punta del Soldado on the south is about four miles. From the cape of Punta de Mounos on the northwest, the Cabeza de Perro cape on the east is about seven miles. The coastline is irregular, and the topography is hilly. There are several summits between 100 and 650 feet. The island has a number of sheltered inlets and sounds on its south coast, and several fine beaches. Exceptional benthic reef structures are found off its Northwest Peninsula, in the waters between Culebra and Culebrita, and southwest of Puerto del Manglar. Exceptional fish and wildlife populations inhabit the island and water in the immediate vicinity. These include several rare and endangered species. The benthic environment includes extensive mangrove communities, Thalassia meadows, reef ecosystem zones, and a small bioluminescent inlet on the south coast of the island.

4.3.1.1 Adjacent Land Use. Adjacent to the Observation Post (OP) and lying generally east of the OP boundary, is a rare form of forest, the boulder forest, under the jurisdiction of the U.S. Fish and Wildlife Service. Directly south of the OP, the National Aeronautics and Space Administration (NASA) has leased land from the Navy for a windmill demonstration project. To the southwest, a spectacular beach shelters the brackish Laguna del Flamenco, which has a considerable population of the endangered Bahama pintail. Some private residences are being built there. Due west of the OP is the excessed Northwest Peninsula, the site of the Impact Area and targets for the old Navy range. The Caribbean Sea is to the north.

4.3.2 History. The original name of Culebra was "Pasaje," meaning passag Later on, during Spanish rule, the island was renamed "San Ildefonso de la Culebra," after the Spanish monarch don Alfonso XII. Culebra was discovered on November 19, 1493, during the second voyage of Christopher Columbus. Unlike many of the other islands in the Caribbean chain, Culebra possessed neither important resources nor a strategic position, and as a result, settlement on the island was slow.

The first recorded inhabitants of Culebra were transient groups of aborigines who fled the Spanish colonization of Puerto Rico in the 16th century. The island later became an occasional base of operations for pirates raiding Spanish commercial ships traveling between Panama and the Old World.

European development of Culebra began in the late 1870s, when the Spanish Crown formulated a system of land grants. Under this system, 83 parcels of land were provided for settlement, each parcel consisting of 25 hectares. The parcels were located on the main island and did not include the surrounding cays. The site of the present AFWTF complex in 1887 was in the northwest corner of parcel number 90, which totaled about 500 acres. At that time it was designated a forest zone. In the following years, the town of San Ildefonso was settled. In 1899 the town had about 206 persons. That same year, Culebra's population was recorded as 704 residents.

After the Spanish-American War, Culebra and its adjacent cays were transferred to the United States under terms of the Treaty of Paris. In 1901, by Presidential Executive Order, all public lands on Culebra were set aside for government use under the jurisdiction of the Navy. A further Executive Order in 19C designated the adjacent cays of the Culebra group as a wildlife preserve, subject to their use for Naval and lighthouse purposes.

Throughout the first quarter of the 20th century, Naval facilities such as coaling stations have operated on Culebra, although at times the operation was minimal. In 1936 an exercise training target range was established, primarily at Peninsula Flamenco, including ship-to-shore, aircraft gunnery, and bombing facilities. A further Presidential Executive Order prior to World War II established a Naval defense area around Culebra. Up to the middle 1970s, the agency primarily responsible for federally owned areas on Culebra was the Navy.

On 5 July 1972 and 26 May 1976, the U.S. Navy declared excess (Excess Notices 2-N-PR-472 and 2-N-PR-472A, respectively) a total of 2,591.8 acres of land on the islands of Culebra, Culebrita, Luis Peña, Ladrones, and Pela (Water Cay) to be under control of the General Services Agency (GSA). The jurisdictional responsibility for all of these islands except Culebra reverted to the U.S. Fish and Wildlife Service as part of the National Wildlife Refuge System. This jurisdictional reversion was in accordance with President Theodore Roosevelt's Executive Order Number 1042, dated 27 February 1909, "which established the islands of the Culebra group, except Culebra, as a preserve and breeding ground for native birds, subject to their use for Naval and lighthouse purposes." Excess lands on these four islands totaled 611 acres. An additional 236.4 acres on Culebra, commonly referred to as the "airport property," has been transferred to the Commonwealth of Puerto Rico through other federal agencies. Two-thousand six-hundred and sixty-two acres were excessed to GSA, which gav

111.72 acres to the Commonwealth of Puerto Rico and the rest to the Department of Interior (DOI), which in turn gave 1,091 acres to the Commonwealth of Puerto Rico.

Currently, all land excessions have been effected and the Navy retains jurisdiction for only the 87-acre AFWTF site at Punta Flamenco.

4.3.2.1 Historical Sites. There are no known historical sites on currently owned Navy land; several cultural resource sites have been identified on land formerly owned by the Navy, now controlled by the U.S. Fish and Wildlife Service.

4.3.3 Legal Actions. The use of Culebra was the issue in the case of Romero-Barceló vs. Brown, explained in Section 4.2.3

4.3.4 Biological Features.

4.3.4.1 Ecosystems. In general, the plant life of Culebra can be divided into three major groups: those associated with man's activities, slope associations, and coastal associations.

Most of the original vegetation on Culebra has been altered by cultivation and grazing. Grasses, such as guinea grass and Angleton grass, Andropogan annulatus, are common on the lower slopes. When pastures are abandoned, thorn scrub of mesquite and mimosa and various species of cactus, including the barrel cactus, prickly pear, and the rare snow cactus, Mamillaria nivosa, take over.

Slope associations consist of evergreen and deciduous forest with figs, cupey, black manpoo, and others. Thorn scrub, acacia, and mesquite are found in the drier areas. The coastal varieties begin at the upper end of sandy beaches, and extend onto the low sand dunes. They consist of coastal hedge, scrub, beach forest, mangrove swamp, and marine meadows. The beach forest is restricted to the lowlands behind the north shore of Bahía Flamenco.

Mangrove stands are usually composed of three species, the red mangrove Rhizophora mangle, the black mangrove Avicennia nitida, and the less common white mangrove Laguncularia racemosa.

Offshore, the Thalassia grass meadows are major underwater plant communities. These are known locally as turtle grass beds and named for the primary plant species, Thalassia testudinum. Thalassia beds grow in the sand and mud bottom, often between coral reefs, and in clear waters to depths of 30 feet or less. The Thalassia meadows provide an important habitat for a variety of marine life.

The most prominent form of wildlife on Culebra is birds. Culebra is one of the most important nesting areas in the Caribbean for sooty terns (an estimated 150,000 mating pairs). The island of Culebrita has a high land bird density, but is less important than the smaller offshore keys (in terms of nesting density) for seabirds. The white-cheeked (Bahama) pintail, which is rare in Puerto Rico, has been observed on both islands. Red-billed tropic birds have been reported to be nesting on Culebrita, the first documented breeding record fo this species for Puerto Rico.

The native mammalian fauna consists of three species of bats. In addition, the Norway rat and the house mouse have reached Culebra and are probably present on Culebrita. White-tailed deer have been introduced on Culebra and appear to be established.

Four species of marine turtles, all federally listed as endangered or threatened species, are found on Culebra and Culebrita, or in adjacent waters (see Section 4.3.4.2).

The richness of the marine environment around Culebra and Culebrita is manifested not only by the spectacular shallow water coral reefs, but also by mobile forms of life. The bays of Ensenada Honda and Puerto del Manglar are the most outstanding breeding grounds in Puerto Rican waters for spiny lobsters and many species of fish. As a result, fishing is excellent off these bays and between Luis Peña and Alcarraza. Mullet, snappers, flounders, bonefish, and anchovies are commonly found in these waters.

4.3.4.2 Endangered, Threatened, and Rare Species. The brown pelican is listed as endangered throughout its range, which includes Culebra and Culebrita. This species utilizes the mangrove areas for roosting and loafing, and the adjacent waters for feeding.

The endangered giant Culebra anole (Anolis roosevelti) is believed to exist only in the Mount Resaca area of Culebra, which has been designated as critical habitat for this species (Federal Register, July 21, 1977). The reptile was last recorded in 1932; however, local people on Culebra maintain that it still survives in the area and claim to still see it. The U.S. Fish and Wildlife Service is currently conducting studies to determine the status of the giant anole.

Four species of marine turtles either nest on Culebra and Culebrita or are found in adjacent waters. Loggerhead and green turtles are listed as threatened, but no critical habitat has been designated for these turtles on the Culebra islands. Leatherback turtles are listed as endangered, though designated critical habitat does not include Culebra or Culebrita. The hawksbill turtle is listed as endangered throughout its range, and critical habitat has been proposed for Culebra, Culebrita, Cayo Norte, and Mona Island. These areas include the beaches of Resaca, Brava, and Larga, on the north shore of Culebra near the OP, and all beachfront areas on the southwest shore, east shore, and northwest shore of Culebrita.

Flora of both Culebra and Culebrita includes a mixture of xeric plants on the lowlands and more mesic species in the valleys and upper slopes. Culebra is characterized by dense, dry, scrub forest on the leeward slopes, merging into a "well preserved" coastal forest on the isthmus.

There are 372 known species of native and introduced plants, representing 76 families and 156 genera. Thirty-three species are considered rare or unique by the Commonwealth, being found only on Culebra or on a few of the other smaller islands.

Smooth yellow nicker (Caesalpini culebrae) and Culebra Island water willow (Justicia culebritae) are both localized endemics found on Culebrita. Culebra Island water willow, a very rare species, is found along a narrow trail leading from the southwestern side of the island across to the southernmost part of the bay on the north coast.

Wheeler's peperomia (Peperomia wheelerii) is found in the boulder forest on the slopes of Mount Resaca as well as on the east-facing slopes near the OP helicopter pad at Punta Flamenco. In the area by the OP helicopter pad this rare endemic is being threatened with habitat destruction by chickens. These birds scratch the rocks bare and destroy the mold and humus accumulations on which Wheeler's peperomia depends. This species is found on the north slopes of the Mount Resaca area all the way down to the coast.

The boulder forest is found in only one other location, on Tortola. The fan leaved palms found on Culebra make up a unique plant community.

4.3.5 Physical Features.

4.3.5.1 Climatology. The climate of Culebra is the principal factor in its character and ecosystem quality. Mean annual rainfall is only 36 inches, ranging from a low of 16 inches in 1967, to the 59 inches recorded in 1942. Almost half of the annual precipitation occurs in a four-month period, August to November. Temperatures are relatively constant throughout the year, ranging between 62 and 93°F, with an annual average temperature of 80°F. Evaporation factors at Culebra total 70 annual inches, and humidity varies from about 65% in daytime to approximately 80% at night.

Cloud cover, storm, and wind factors at Culebra are typical of the West Indies. Prevailing winds blow from the northeast in winter and shift to easterly in the summer months. Wind velocity becomes stronger then, although average winds measure approximately 10 miles per hour. Some storms have generated wind velocities as high as 85 miles per hour at the Punta Flamenco center. Hurricane season, as on Puerto Rico, lasts from June through November, with most storms occurring in July, August, and September. Local storms sometimes form waterspouts at Culebra and Vieques, causing some coastal damage before dying out on the island terrain. Mean annual cloud cover is 0.5%, which reflects the low precipitation record.

4.3.5.2 Topography. The AFWTF site is located on Culebra's north shore at Punta Flamenco. Relief along the area of the AFWTF site is extreme, with elevations ranging from sea level along the rocky shores to the west, north, and east, to nearly 120 meters above sea level at the mountain peak. Because annual rainfall is slight, averaging only 42 inches, there are no freshwater drainage systems located here or elsewhere on the island.

4.3.5.3 Geology. Culebra and its adjacent islands are underlain by volcanic and intrusive rocks of probable Upper Cretaceous age. Andesite lava underlies most of the island, and on many seacliff exposures the lava exhibits pillow structures characteristic of lavas erupted under the sea. This structure is remarkably well-preserved at Punta Seria on Cayo Norte. The andesite lava contains many veins and interpillow fillings of quartz. Andesite lava breccia lies along the straight southwest coast of the island and on Luis Peña (s... Figure 4-6).

Andesite tuff overlies the lava along the north coast of Culebra. It is characterized by a prominent layering, with beds ranging from a few inches to many feet thick. This layering may be seen along the seacliffs between Playa Brava and Playa Larga.

The tuff and underlying lava have been intruded by diorite in north-central Culebra and by diorite porphyry on Luis Peña. The diorite weathers to rounded boulders several feet in diameter which cover much of the steep north-central slope of Culebra. The sandy soil washed down the slope from between these boulders has accumulated to form the small sand deposit behind Playa Brava.

Other alluvial deposits include fine coral sand and coarse gravel in beach deposits, and fine sand and clay underlying mangrove swamps and lagoon basins.

4.3.5.4 Soils. Culebra has a relatively limited variety of soils types, owing to its volcanic origin, small size, rugged terrain, and moderately uniform climate. Its total acreages consist of 75 to 80% soils of the Descalabrado and Rockland series, formed in slopes of 20 to 40%. Such topography is so limited in capability and so subject to erosive forces that it should be utilized only for grazing, wildlife habitat, or forest cover.

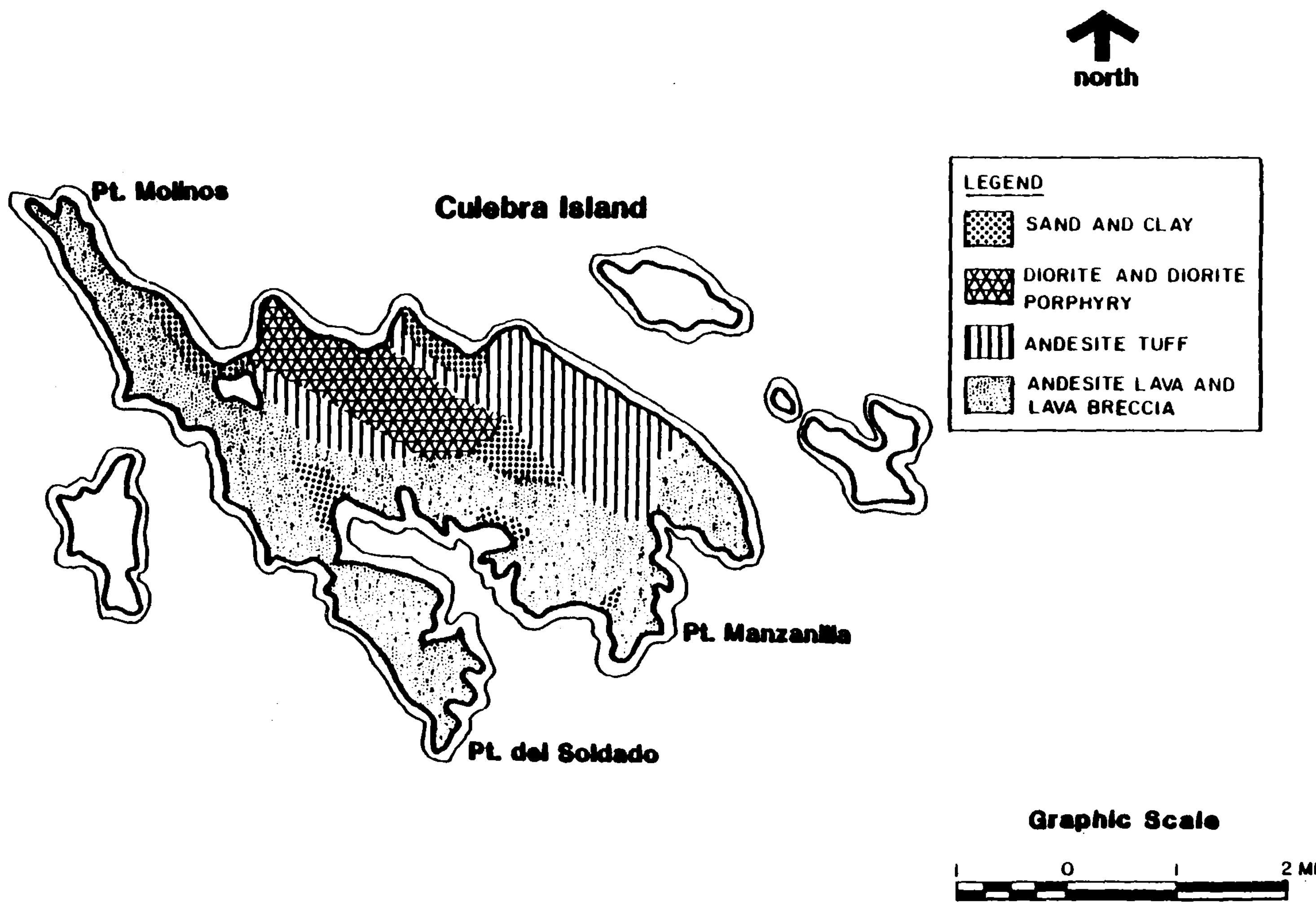
Soils within the area of the AFWTF site consist entirely of Rockland soils. These soils are found in areas where rock outcrops are present over 50 to 70% of the ground surface. Loose diorite boulders and rocks are also common on the ground surface. Very shallow soil material is found lying between the outcrops and the rocks. Slopes for Rockland soils are generally very steep, ranging from 60 to 70%. This land type is found in mountainous areas, and is characterized by scattered low brush vegetation. Areas of Rockland soils have little value for agricultural or engineering uses, and mainly provide wildlife habitat.

In the coastal areas directly to the southwest (Playa Flamenco) and southeast (Playa Resaca) of the AFWTF site, narrow areas of nearly level coastal beaches and Cataño loamy sand are present. Similar to the Rockland soils, these areas also are not suited for agricultural use.

4.3.5.5 Hydrology. Ensenada Honda, Bahía Flamenco, and Puerto del Manglar are drowned valleys whose waters receive intermittent drainage from higher terrain. No permanent watercourses exist, but some saline springheads are present. Shallow wells are used to provide water for livestock, and eight drilled wells supply non-potable water demand. However, such wells are high in chloride concentrations, and most potable water is supplied by cisterns (the OP has one) and the new desalination plant.

Comparatively, the geology and hydrology of Culebra have parallels on St. Thomas and Vieques. Their igneous geology is largely structured of volcanic andesite and intrusive diorite. Therefore, available ground water is stored in fissures and fractures in the rock, and considerable saline intrusion occurs.

Catchment installations were formerly the principal source of potable water on Culebra. However, as a result of the unusually arid years from 1961 through 1969, the catchment system has become a secondary backup source of water.



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 4-6
GEOLOGIC FORMATION OF CULEBRA ISLAND

Catchment storage at three sites totals about 400,000 gallons, a two-w supply for the population at Dewey. Primary supply for Dewey was sought i a field of drilled wells east of the town. Four wells are operative, but only two have acceptably low levels of salinity. Well yield measures about 20 gallons per minute. However, salinity of the best wells has regularly exceeded 400 ppm, while the U.S. Public Health Service maximum is only 250 ppm.

4.3.6 Migration Potential. Contaminants at the OP would migrate by surface runoff due to the steep topography and shallow soils with rocky outcroppings. However, due to the distance (about one kilometer) to the ocean, it is doubtful that surface runoff would have much impact.

4.4 ST. THOMAS.

4.4.1 General. The AFWTF maintains a communications and target tracking and control facility on top of Crown Mountain. The Crown Mountain facility is located about 42 nautical miles east of NAVSTA Roosevelt Roads and provides drone and aircraft tracking capability. The collected data are relayed back to Range Operations Center (ROC) at NAVSTA Roosevelt Roads in real time for evaluation and correction of flight paths if required. Although drone control is exercised by the ROC, the Crown Mountain facility has command control capability in the event the ROC is unable to exercise control.

The Crown Mountain facility is operated and maintained by a civilian contractor and is under the direct control of the ROC. The majority of the facilities at Crown Mountain are relatively new; its tracking capability was greatly improved by the recent addition of the wide area search CAPRI radar. Crown Mountain ca also duplicate various enemy ship and aircraft signatures with its highl sophisticated Threat Platform Simulators (TPS) on the displays of vessels and planes utilizing the range.

4.4.1.1 Adjacent Land Use. Land use adjacent to the Crown Mountain facility is limited to a broadcasting tower which belongs to the Virgin Island Broadcasting Service (due east), the old site (see discussion below), private residences (which belong to contract personnel), and undeveloped areas. The Crown Mountain site is relatively isolated, with little activity around the site.

4.4.2 History. The present facility was occupied in 1975, when operations were moved from the old site about 100 yards to the east. The present site was built by NMCB personnel, with additional construction in 1976, 1977, 1978, and 1983. Plans for 1984 include the installation of electronic items to augment the ITCS system at Pico del Este. The Crown Mountain site, as part of the AFWTF ranges, tracks and controls drones, and tracks surface vessels and aircraft.

4.4.2.1 Historical Sites. There are no historical sites on or near the Crown Mountain facility.

4.4.1 Legal Action. The Crown Mountain site has not been involved in any legal proceedings to date.

4.4.4 Biological Features. Vegetation now growing on the island differs from the original vegetation and differs somewhat in different parts. Uncleared mountainous areas support a fairly dense growth of tropical forest, including a few large trees and a dense undergrowth of brush and vines, but the cleared mountainous areas are covered with thorny brush, which is of little or no value.

Much of the cultivated acreage on the coastal plain has been converted to rangeland. The vegetation is mainly cactus and small thorny brush. There is very little pasture grass. Hurricanegrass, which is considered to be an inferior pasture grass, has spread rapidly over the southern part of the coastal plain and into adjacent mountainous areas.

Hilly areas between the coastal plain and the mountains are covered with thorny brush and poor quality pasture grass. There are only a few trees. The eastern end of the island, which is usually drier than other parts, is covered with a dense growth of cactus and thorny brush.

The ecosystems and biology of St. Thomas are quite similar to St. Croix, the primary difference being species distribution (see Table 4-14 in Section 4.5.4.2). The endangered black-crowned night heron and peregrine falcon found on St. Croix are not present on St. Thomas. Table 4-11 lists those species found on St. Thomas that are not present on St. Croix, and indicates which of these species are rare and endangered. The rare and endangered species are otherwise identical on the two islands.

4.4.5 Physical Features.

4.4.5.1 Climatology. The Virgin Islands extend eastward from Puerto Rico, along the path of the Lesser Antilles, directly in the belt of subtropical, easterly trade winds. The climate is maritime tropical, one of the most equable in the world. It is characterized by generally fair weather, steady winds, and slight but regular annual, seasonal, and diurnal ranges of temperature. A significant feature of the rainfall pattern is the marked variation within short distances with change in terrain and elevation.

Minor seasonal contrasts are generated by outbreaks of cold air from the higher latitudes in winter and by tropical disturbances late in summer and fall. Of greater significance is the diurnal tempering effect of the islands on the surrounding ocean climate. Since the land area is small, the Virgin Islands exert less modification on the surrounding ocean climate than do the islands of the Greater Antilles, which lie to the west.

Lifting of moist air over hilly terrain is the most common cause of rainfall on the islands. The amount of rainfall increases with increasing elevation. The average annual total at the higher elevations is between 50 and 60 inches, and at the lower elevations, between 20 and 30 inches. Whether an exposure is on the windward or the leeward side of a slope is a significant factor in the amount of rainfall received. In general, there is a much higher occurrence of rainfall by day than by night.

There is no sharply defined wet season or dry season on the islands. Records indicate seasons much like those along the southern coast of Puerto Rico. On

Table 4-11

SPECIES FOUND ON ST. THOMAS NOT PRESENT ON ST. CROIX

Common Name	Scientific Name
Man lizard	*A. cristatellus*
Sharp mouthed lizard	*A. pulchellus*
Salmon lizard	*A. stratulus*
Common ground lizard	*A. exsul*
Virgin Islands blind snake	*A. fenestrata*
Tree boa*	*E. monensis*
Ground snake*	*Alsophis portoricensis*
Garden snake*	*Arrhyton exiguum*
Red-billed tropic bird*	*Phaeton aethereus*
Stolid flycatcher*	*M. stolidus*
Red fruit bat*	*Stenoderma rufun*

*Indicates rare, endangered, or threatened species.

St. Thomas, the rainfall is generally lightest in February and March, and heaviest in September and October. The number of days with rainfall equal to or more than one-tenth of an inch ranges from about 75 to 110, depending on location.

Variations in temperature between the coolest and the warmest months are 5° to 7°F at the most. The highest temperatures are in August, and the lowest in January or February. During the warmest months, the highest average daytime temperature is about 87°F. During hot spells, which occur nearly every year, the temperature exceeds 88° or 90°F for several days in succession. The average lowest nighttime temperature during the warmest months is between 74° and 78°F. Nighttime temperatures are somewhat lower at the higher elevations, such as Crown Mountain. During the coldest months, the highest temperature is generally in the low 80s, and the lowest in the high 60s or low 70s. At the higher elevations, outbreaks of cold air into the Caribbean bring nighttime temperatures down to the low 60s or high 50s.

Regularity in direction of the trade winds is one of the most dependable weather phenomena on the islands. Almost without exception the trade winds blow from an easterly direction. The velocity varies daily. A velocity of more than 15 miles per hour occurs more frequently in winter than in other seasons. Leeward slopes are protected against the full force of the trade winds, but the flow is strong enough to pass over the higher terrain without diminishing in velocity. Most locations have a good flow of air movement most of the day.

The islands are affected occasionally by tropical storms and hurricanes. They lie outside the main paths of severe tropical disturbances, except those that occur from August through the first half of October. The storms that develop over the South Atlantic east of the Antilles chain usually move toward the north or northwest and pass north or south of the islands; rarely do they pass directly over them. There is risk of hurricane force winds about once every nine or 10 years.

4.4.5.2 Topography. The topography of St. Thomas in the vicinity of Crown Mountain consists of man-made level ground atop slopes of steep as 60°.

4.4.5.3 Geology. St. Thomas is underlain by indurated volcanic rock and sedimentary rock derived primarily from material eroded from the volcanic core; all of these rocks are of Cretaceous age. The only nonvolcanic rock is a thin bed of limestone of Cretaceous age. Alluvial deposits are present in the major stream valleys and interfinger with beach sand in the coastal embayments.

4.4.5.4 Soils. The following soil associations are found on St. Thomas: the Cramer-Isaac Association and the Dorothea-Victory-Magens Association.

The Cramer-Isaac Association consists of very steep to strongly sloping, well-drained soils, with a clayey subsoil. These soils are shallow and moderately deep over volcanic rock, and are found on mountainsides and foot slopes.

This association is characterized by steep and very steep mountainsides, strongly sloping foot slopes, and narrow alluvial fans and floodplains. The soils are reddish in color. The surface layer is gravelly or stony; between 50 and 70% of the surface is covered with rock outcrops, and boulders and stones are common.

Cramer soils are found on mountainsides. They are steep and very steep, shallow, red or reddish brown soils which are well drained and moderately permeable. Their surface layer is gravelly or stony. They formed in material weathered in place from volcanic rock.

Isaac soils are found on foot slopes. They are strongly sloping, moderately deep, and well drained. They have many angular volcanic rock fragments on the surface. These soils also formed in material weathered in place from volcanic rock.

Minor soils of this association are San Antón, Glynn, and Aguilita soils and Cobbly alluvial land. San Antón and Glynn soils occupy narrow alluvial fans and floodplains below Cramer and Isaac soils. Aguilita soils are found on low hills and foot slopes. Cobbly alluvial land is found on narrow floodplains.

Cramer and Isaac soils have severe limitations, chiefly shallowness over rock and steep slopes, that make them unsuitable for cultivation and for most nonfarm uses. They are limited largely to use for pasture and range, woodland, wildlife habitat, and recreation.

The Dorothea-Victory-Magens Association consists of steep and very steep, well-drained, deep soils, having a clay to clay loam subsoil. These soils are primarily found on mountainsides.

This association is characterized by steep and very steep, rugged, forested or pastured mountains that are slightly rounded at the top. The soils on the highest peaks of the island of St. Thomas--Hawk Hill, Crown Mountain, and Signal Hill--are in this association.

All of the major soils of this association are on mountainsides. Victory and Magens soils are steep; Dorothea soils are steep to very steep. All are deep, well drained, and moderately permeable, and all formed in material derived in place from highly weathered volcanic rock. Dorothea and Victory soils are yellowish brown, and Magens soils are red in the subsoil.

4.4.5.5 Hydrology. The Crown Mountain site obtains water by a catchment system, and on occasion, by trucking in water obtained from the VIWPA.

Periods of deficient rainfall occur almost every year in some parts of the Virgin Islands. Although some of these periods are of short duration, they have a serious impact on farming and dairying activities, on the urban water supply, and on the general economy. The islands have no large rivers and no large storage reservoirs. Consequently, even a few months of drought can be damaging. Droughts are most prevalent in late fall, winter, and early spring.

The severity of drought on the islands has been computed by the Palmer Index, developed by the Environmental Data Service. This computation is based on the difference between the amount of rainfall received and the amount needed to maintain an average for the area. It indicates that mild to extreme drough can be expected about half the time, severe to extreme droughts about 15% o.

the time, and mild to moderate droughts about a third of the time. Since 1931 there have been 14 droughts indexed by the Palmer system. The longest was for 48 months, from February 1945 to February 1949. The drought of 1964-65 was the most recent and the most severe.

Drought is more serious now than ever before in the islands' history. Many springs and wells have gone dry. Subterranean reservoirs have become more and more depleted, even though, according to records, the islands receive about the same amount of rainfall as at any time in the past.

4.4.6 Migration Potential. The shallow stony nature of the soil at the Crown Mountain site, combined with the steep slopes (60°), lead to a high potential for the surface migration of contaminants.

4.5 ST. CROIX.

4.5.1 General. The island of St. Croix has two facilities associated with the Atlantic Fleet Weapons Training Facility (AFWTF), the mission of which is to operate, maintain, and develop weapons training facilities and services. As part of those services, AFWTF has located on St. Croix the Underwater Tracking Range (UTR) Control Complex at Sprat Hall, and the St. Georges Hill complex on top of 864-foot-high St. Georges Hill.

The facilities of the UTR provide approximately 69 square miles of instrumented deep water for three-dimensional tracking of ships, submarines, and underwater weapons. Normal activities include Weapons Systems Accuracy Trials (WSAT); air, surface, and subsurface torpedo exercises (TORPEX); Fleet Operational Readiness Checks (FORAC); research, development, testing, and evaluation projects; and any other trials for which precise in-water spatial measurements are required.

The UTR is located on and in deep water off the western shore of St. Croix and consists of two superimposed ranges. The older Short Baseline (SBL) synchronous range utilizes a 75 KHz MK-72 Pinger and consists of 21 square nautical miles of tracking area. The new Long Baseline (LBL) asynchronous range utilizes a 13 KHz MK-84 Pinger and consists of approximately 69 square nautical miles. The LBL range is normally utilized for all operations; however, the SBL range is available if desired. The boundaries of the SBL range are latitudes 17°47' and 17°41' north and longitudes 64°54' and 65°00' west. The boundaries of the LBL range are latitudes 17°46' and 17°39' north and longitudes 64°54' and 65°02' west. Water depth varies from 200 to 600 fathoms.

The data gathering and processing system at the UTR consists of both state-of-the-art hardware and real-time software, plus a full color integrated real-time display system. This system is made up of four MODCOMP IV-35B computers, a complex network of signal processors and other electronics, three RAMTEX Interactive Display Devices, and additional repeater display devices.

Operations on the UTR are man- and machine-controlled from a shore complex located immediately north of Sprat Hole on northwestern St. Croix. The complex, which consists of a number of large interconnected office-type industrial trailers, is operated and maintained by a civilian contractor. There are no Naval personnel permanently stationed at the range, although during periods of operation, a liaison/range control officer from AFWTF is present. Shops instrumentation, maintenance, and torpedo preparation are located at Roosevelt Roads, as are the administrative offices for the UTR.

The UTR has several tracking modes:

a. Short Baseline (SBL) underwater acoustic instrumentation provides precise spatial relationships between in-water objects via a hydroacoustic interface and the data gathering and processing system (DGPS). Synchronous, spherical, SBL tracking principles are employed to obtain precision three-dimensional positions. The range is able to track over 20 objects in the total range areas or up to eight objects in an individual array area. The tracking is accomplished by 13 bottom-mounted hydrophone arrays which receive signals from a special acoustic device mounted on each object being tracked. The hydroplane array transmits these signals via submarine cables to the computers ashore which provide real-time course and speed, and torpedo firing control solutions. The accuracy of the system over the entire tracking area is approximately 25 feet or less. The accuracy within any particular array is approximately 10 feet or less.

b. Long Baseline (LBL) underwater acoustic instrumentation provides not only additional underwater track area but also another option for track. The system is designed to accept acoustic energy bursts from the phase-coded pingers MK-84 and MK-72-2. These energy bursts can occur at 1/2, 1, 2, and 4 second ping intervals, depending on the type and speed of the object being tracked. Once the system acquires an object or rang the computer and real-time software select automatically the "best" array for track and the best of several algorithms for given conditions. Three-dimensional computations are normally performed.

c. The Optical Tracking System is used primarily when positional information cannot be obtained by the acoustic three-dimensional systems. Precise positions can be determined by triangulation using readings from three theodolites. Under optimum conditions, triangulation closures of less than two feet are possible.

d. The UTR computers can utilize real-time radar track information provided by four radar systems: CAPRI on St. George Hill, St. Croix; NIKE-HERCULES on St. Thomas; CAPRI on St. Thomas; and NIKE-HERCULES on Vieques.

As part of the AFWTF, the Electronic Warfare Range (EWR) St. Georges Hill, provides both a realistic simulated hostile electromagnetic environment for the training of ship and aircrew electronic warfare teams, and a tactical electronic order-of-battle in support of exercises conducted on other AFWTF ranges. The EWR can support either single-ship or multi-ship exercises using its Threat Platform Simulators (TPS) situated throughout the AFWTF complex to provide overlapping coverage to portions of the Outer Range and all Inner and Underwater Ranges. The capabilities of the various electronic devices are shown in Table 4-12. A civilian contractor runs the facility, which is located atop 864-foot-high St. Georges Hill.

Table 4-12

CAPABILITIES OF RADARS AT ST. GEORGES HILL, ST. CROIX

AN/MSQ-51. Target Tracking and Control, Aircraft Tracking

Location	• St. Georges Hill, St. Croix, U.S. Virgin Islands North Delicias Hill, U.S. Naval Station Roosevelt Roads
Frequency	• ACQ: S-Band 3100 - 3500 MHz Track: X-Band 8.5 - 9.6 GHz
PW	• ACQ: 1.3 microsec Track: 0.25 microsec
PRF	• ACQ: 300 or 1,000 PPS Track: 380/1,000 PPS
Power	• ACQ: 1 MW Track: 250 KW
Antenna	• ACQ: 5, 10, or 15 RPM Track: Conical Both: 200 nautical miles

AN/FPS-105 "CAPRI": Missile, Aircraft, and Surface Tracking

Location	• St. Georges Hill, St. Croix, U.S. Virgin Islands
Frequency	• 5.45 - 5.825 GHz
PW	• 0.25, 0.5, 1 microsec
Power	• 1 MW
Antenna	• Cassegranian/Monopulse Feed
Maximum Range	• 16,000 nautical miles

4.5.1.1 Adjacent Land Use. Sprat Hall is an old sugar estate, now used as a guest house and restaurant. Other land uses adjacent to the UTR include recreational beaches and diving areas. Local fishermen and recreational boaters use the waters offshore. Land use adjacent to the St. George's Hill complex includes individual residences and a quarry.

4.5.2 History. For the island of St. Croix, as well as the rest of the Caribbean, the arrival of Columbus at the close of the 15th century marks the beginning of the historic period.

St. Croix was sought after by the Europeans not only for its economic potential as a locality suitable for the production of sugarcane, but also for its strategic position in the Caribbean as a port of trade.

A brief summary of the highlights in the historic chronology of St. Croix are presented in Table 4-13.

4.5.2.1 Historical Sites. Sprat Hall near the UTR has been proposed for listing on the NRHP. Various cultural resources (tools, campsites, middens, and other artifacts) have been found on land immediately adjacent to the UTR, and there is some evidence that the UTR was built on top of a significant archaeological site, which is, of course, now destroyed. There are no historical sites associated with the St. Georges Hill facility.

4.5.3 Legal Actions. In 1971, as a result of a legal action, St. Croix w evaluated as an alternative to the Naval gunnery activities at Culebra. Na activities on the island, however, have not been involved in any legal actions of note.

4.5.4 Biological Features. St. Croix includes a large number of the major terrestrial ecosystems typical of the tropics. Although relatively dry, small, and isolated, the island has a climate which permits the growth of vegetation ranging from near rain forest to near desert. Along the shoreline is a group of specialized ecosystems strongly affected by saltwater and composed of relatively few species. Another group of ecosystems owes its origin and continued existence to the activities of man. These ecosystems, ranging from very low to very high species diversity, are the least stable.

The fauna and flora of the island are distinctive for the high proportion of exotic (non-native) species which have been introduced by man. Plants native to all tropical parts of the world are present. Livestock and mongoose dominate the fauna and are seen in virtually all of the island's ecosystems. In addition to the native avifauna, large numbers of migratory birds use the island twice a year as a stopover in their migrations.

St. Croix was more lush when Europeans first settled on the island. Crop agriculture, especially sugarcane, developed slowly and remained extensive as late as the early 20th century. The availability of water has decreased and the frequency of fire has increased throughout much of the island.

4.5.4.1 Ecosystems. St. Croix has 10 major terrestrial ecosystem types:

- Semi-evergreen forest (St. Croix rain forest),

Table 4-13

HISTORIC CHRONOLOGY OF ST. CROIX*

1493	SPAIN. On his second voyage to the New World, Columbus discovers St. Croix, which he names "Santa Cruz," claiming it for Spain.
1587	ENGLAND. John White, sent by Sir Walter Raleigh as Governor of Virginia, stays on St. Croix for three days; finds evidence of Indian habitation.
1625	HOLLAND AND ENGLAND. Small settlements begun by Dutch at Bassin (Christiansted) and by English on the southwest shore area (near Frederiksted).
1642	Holland increases settlement, causing unrest between themselves, the French, and the English.
1646	ENGLAND. British hold island after Dutch and French are driven out.
1650	SPAIN. English settlement overtaken by Spainards from Puerto Rico. Dutch try to recapture the settlement the same year, but are defeated by the Spanish.
1650	FRANCE. Governor de Poincy of the French West Indies takes possession of St. Croix for the French crown; plans to make it his capital.
1651	DE POINCY. St. Croix and other islands are purchased privately by de Poincy from the French King. As a leading Knight of Malta, he sends other knights and Frenchmen to colonize St. Croix.
1653	KNIGHTS OF MALTA. All of de Poincy's private possessions in the West Indies are granted to this Order of St. John.
1657	French settle St. Croix and, with some difficulty, run sugar, indigo, and tobacco plantations.
1665	FRENCH WEST INDIA COMPANY. All island possessions held by the Knights of Malta, including St. Croix, are purchased by the French West India Company.
1674	FRANCE. King of France pays off company debts and takes possession of the island.
1695	ABANDONED. Maintaining his country's claim over the island, the French King orders all inhabitants removed to Santo Domingo.
1733	DANISH WEST INDIA AND GUINEA COMPANY. St. Croix is purchased from the French crown by the Danish West India and Guinea Company, and shortly thereafter, is divided into 150- and 300-acre plantations to encourage settlement.
1755	DENMARK. Denmark takes possession of St. Croix as a Crown Colony. During the ensuing half century, St. Croix's economy, based on sugar, rum, and the slave trade, rises steadily.
1792	Danish government is the first country in the world to declare slave trade unlawful. (The abolition of the slave trade, however, does not come into force until 1803, and is not completely abolished until 1848).
1795 - 1800	Years of peak prosperity of sugar and rum economy; planters, however, foresee the beginning of the end.

Table 4-13 (Cont.)

1801	St. Croix captured by British; restored to Denmark in a few months.
1803	Denmark abolishes the slave trade completely.
1807 - 1815	St. Croix is held by British during Napoleonic Wars, but is eventually returned to Denmark. Economy worsens over the next 30 years with periods of drought, political upheaval, and war in Europe, and the general depression.
1848	Slaves on St. Croix are freed by Governor Von Scholton, after rioting began.
1866	A disastrous fire occurs in Christiansted.
1867	Earthquake and tidal wave bring further trouble to a declining economy.
1871	Capital moved from St. Croix to St. Thomas.
1872	Severe hurricane destroys crops and buildings.
1875	Danish government provides funds for construction of a Central Sugar Factory, which is begun in 1876.
1876	Severe hurricane and depression years until about 1888.
1878 - 1892	Serious labor riots take place; Frederiksted is partially burned. Financial difficulties result in further rioting in 1892.
1917	UNITED STATES. The United States purchases St. Croix, along with St. Thomas and St. John.

*After Lewisohn (1964).

- Deciduous forest,
- Thorn woodland,
- Thorn scrub,
- Mangrove swamp,
- Littoral woodland,
- Beach ecosystem,
- Savanna,
- Man's monoculture ecosystem, and
- Man's diverse ecosystem

The first four ecosystems are primarily climate-controlled, the following three are controlled by the effects of the sea, and the final three are primarily controlled by the activities of man. These ecosystems, or ecological systems, are combinations of plants, animals, microbes, soil, and atmosphere and their continual interaction. As such, the readily observable differences among the 10 types are the dominant plant species, height of vegetation, type of animals, total species diversity, litter accumulation on the soil, soil moisture, inundation by seawater, water input from the air, salt concentration, fire frequency, livestock density, and cultivation by man. The four climatically controlled ecosystem types represent four fairly distinct stages along a wider moisture gradient from rain forest to desert.

Three major background factors determine the range and nature of ecosystems present on St. Croix. Most important is the highest elevation of approximately 350 meters (1,165 feet), over which the warm, moist, eastern trade winds pass with little cooling and precipitation, therefore making it possible for several dry ecosystem types to succeed in the absence of a well-developed rain forest. Second, the island is 500 miles from South America, 1,100 miles from Florida, 60 miles from Puerto Rico, and 20 miles from the nearest other Virgin Island at the northern end of the Lesser Antilles; this relative isolation makes it difficult for new species to reach the island naturally. Third, the island is small, approximately 20 miles by eight miles (84 square miles), further contributing to low species diversity.

By way of comparison, St. Croix appears to have more kinds of ecosystems and more species diversity within them than nearby St. Martin to the east, which is lower in elevation, smaller, and farther away from species sources. Yet St. Croix exhibits less diversity than the nearby island of St. John to the north, which is smaller, 70 meters higher (and therefore moister), and was once connected to Puerto Rico during the Pleistocene ice age.

More recently, the history of land use by man has dramatically altered the landscape. In 1651 the French reported three rivers and 16 brooks on the island. Near the beginning of this century, sugarcane cultivation covered as much as 35% of the island, and as late as 1914, several streams and rivers were reported to flow year-round. At present, active sugarcane plantations have essentially disappeared, and all streams dry out during part of the year, generally leaving only a few trickles at higher elevations.

Before the cultivation of the island by European colonizers, deciduous and semi-evergreen forests probably covered most of the island, with drier vegetation in the east and southwest. Almost all of the island has been utilized by man at some time; currently the major uses are building and road construction, limited cultivation, and cattle, goat, horse, and sheep grazing As in all dry tropical regions, much of the land area catches fire and bur repeatedly.

Mongoose are common in essentially all ecosystems. Deer are infrequently observed in the forests, woodlands, and savannas. Other mammals include rats, mice, fruit and insectivorous bats, livestock, and dogs. Seabirds and a relatively few land birds are resident species, but numerous migratory species are seen in season. Local herptile populations include dense small lizards, one rare large lizard species, a few frogs, and an introduced toad. Insects are relatively few in kinds and number. A listing of flora and fauna found on St. Croix is included in Appendix B.

4.5.4.2 Endangered, Threatened, and Rare Species. Endangered, threatened, or rare species found on St. Croix are listed in Table 4-14.

4.5.5 Physical Features.

4.5.5.1 Climatology. The climate of St. Croix is dry tropical, with daily temperature fluctuations exceeding the seasonal variation. Average monthly temperatures range from 24 to 28°C (75 to 83°F). Long-term average annual precipitation, which has remained constant over the last 112 years, ranges from about 140 centimeters in the northwest to about 60 centimeters in the eastern end and the southwestern area of the island. Differences in precipitation from year to year are greatest in the rain shadow areas of hilly sections and local ridges from Frederiksted across to Fountain Valley Road, Christiansted, and above Solitude Bay, and are least in the flat central region around the airport and eastward. Average monthly precipitation is fairly even throughout the year, with the driest month, March, receiving about four centimeters of rain (lower in dry regions) and the wettest month, between September and November, about four times as much. Seasonal variability from year to year is least in March and greatest from May to December. Evapotranspiration produces an annual soil-water deficit throughout the island almost every year; for short periods during most years, most of the areas of the island have positive soil-water balances. Hurricanes generally occur in pairs within a 12-year period separated by an average 38-year span. The last hurricane occurred in 1928. In summary, the temperature is warm and constant throughout the year, the driest season is January through April, and the wettest season September through November, though extended dry periods may occur any year at any season.

Throughout much of the year, the wind blows steadily out of the northeast at 10 to 20 miles per hour. Wave action is fairly heavy on exposed sections of the coast during most of the year, and the seas are steep and of short period. Water temperature varies from about 23° to 26°C in the winter months and averages about 28°C in the summer, with higher temperatures in areas of quiet water. The tides average about one foot and are diurnal in character. Low tides usually occur in the night during the winter and during the day in summer. Neap and spring tide periods are about a week in extent and closely follow the phases of the moon.

4.5.5.2 Topography. St. Croix is the largest and southernmost of the U.S. Virgin Islands, located about 40 miles to the south of St. Thomas and St. John. It is about 22 miles long and five miles wide. The island is surrounded by

Table 4-14

ENDANGERED, THREATENED, OR RARE SPECIES OF ST. CROIX

Common Name	Scientific Name
Reptiles	
Scaly sea turtles	Cheloniidae
Green turtle	Chelonia mydas
Hawksbill	Eretmochelys imbricata
Leathery sea turtles	Der mochelidae
Leatherback	Dermochelys coriacea
Iguandids	Iguanidae
Camman iguana	Iguana Iguana
Whiptails	Teiidae
St. Croix ground lizard	Ameiva polops
Skinks	Scincidae
Slippery back skink	Mabuya mobouin (sloanei)
Colubirds	Colubridae
Ground snake	Alsophis portoricensis
Birds	
Grebes	Podicipedidae
Least grebe	Podiceps dominicus
Tropic birds	Phaethontidae
White tailed tropic bird	Phaethon lepturus
Pelicans	Peleconidae
Brown pelican, Alcatraz	P. occidentalis
Boobies and gannets	Sulidae
Blue-faced booby	Sula dactylatra
Red-footed booby, boba blanca	S. sula
Herons and bitterns	Ardeidae
Great blue heron	Ardea herodias
Great (common) egret, garza real	Casmerodius (egretta) albus
Snowy egret	Egretta (leucophoyx) thula
Black-crowned night heron	Nycticorax nycticorax
Least bittern	Ixobrychus exilis
Ibises and spoonbills	Threskiornithidae
Glossy ibis	Plegadis falcinellus
Flamingos	Phoenicopteridae
American flamingo	Phoenicopterus ruber

Table 4-14 (Cont.)

Common Name	Scientific Name
Birds (Cont.)	
Swans, geese, and ducks	Anatidae
West Indian whistling duck	*Dendrocygna arborea*
Bahama duck	*Anas bahamensis*
Ruddy duck	*Oxyura jamaicensis*
Masked duck	*O. dominica*
Caracaras and falcons	Falconidae
Peregrine falcon	*Falco peregrinus*
Rails, gallinules, and coots	Raillidae
Clapper rail	*Rallus longirostris*
Purple gallinule	*Porphyrula martinica*
Caribbean coot	*Fulica caribea*
Plovers, turnstones, and surfbirds	Charadriidae
Snowy plover	*C. alexandrinus*
Woodcock, snipe, and sandpipers	Scolopacidae
Willet	*Catoptrophorus semipalmatus*
Gulls and terns	Laridae
Gull-billed tern	*Gelochelidon nilotica*
Common tern, gaviota	*Sterna hirundo*
Roseate tern	*S. dougallii*
Least tern	*S. albifrons*
Royal tern	*S. (Thalasseus) maxima*
Sandwich tern	*S. (T.) sandvicensis*
Pigeons and doves	Columbidae
White-crowned pigeon	*Columba leucocephala*
Plain pigeon	*C. inornata*
Bridled quail dove	*Geotrygon mystacea*
Typical owls	Strigidae
Puerto Rican screech owl	*Otus nudipes*
Mammals	
Fisherman bats	Noctilionidae
Fisherman bat	*Noctilio leporinus*
Sperm whales	Physeteridae
Sperm whale	*Physeter catadon*
Rorquals	Balaenopteridae
	Balaenoptera spp. (probably 4 species)
Humpback whale	*Megaptera novaengliae*

Source: Philbosian R. and, John A. Yatema, 1977.

deep water on all sides and has a relatively small shelf. The highest point on the island is in the northwest section, which has an elevation of 1,165 feet.

The coastline of St. Croix is regular, with only three deep indentations at Christiansted Harbor, Salt River, and on the south shore at Krause lagoon, now completely taken over by a large refinery and alumina plant. There are only two offshore islands--Green Cay and Buck Island.

4.5.5.3 Geology. The island of St. Croix consists of largely Upper Cretaceous, Oligocene, Miocene, and recent sedimentary rocks at the surface. There is a small surface area of intrusive diorite near the east end of the island and an area of gabbro in the northwestern mountains; these areas are of Tertiary age. The eastern and western parts of the island are separated by a graben filled with altered volcanic ash that is overlain by marl and limestone. The island remained isolated from its nearest neighboring islands during the Pleistocene age due to a deep sea trough to the north. Most of the stream valleys that head in the volcanic uplands were incised during the Pleistocene age, and the coastal reaches of the overdeepened valleys are filled with fine-grained alluvium.

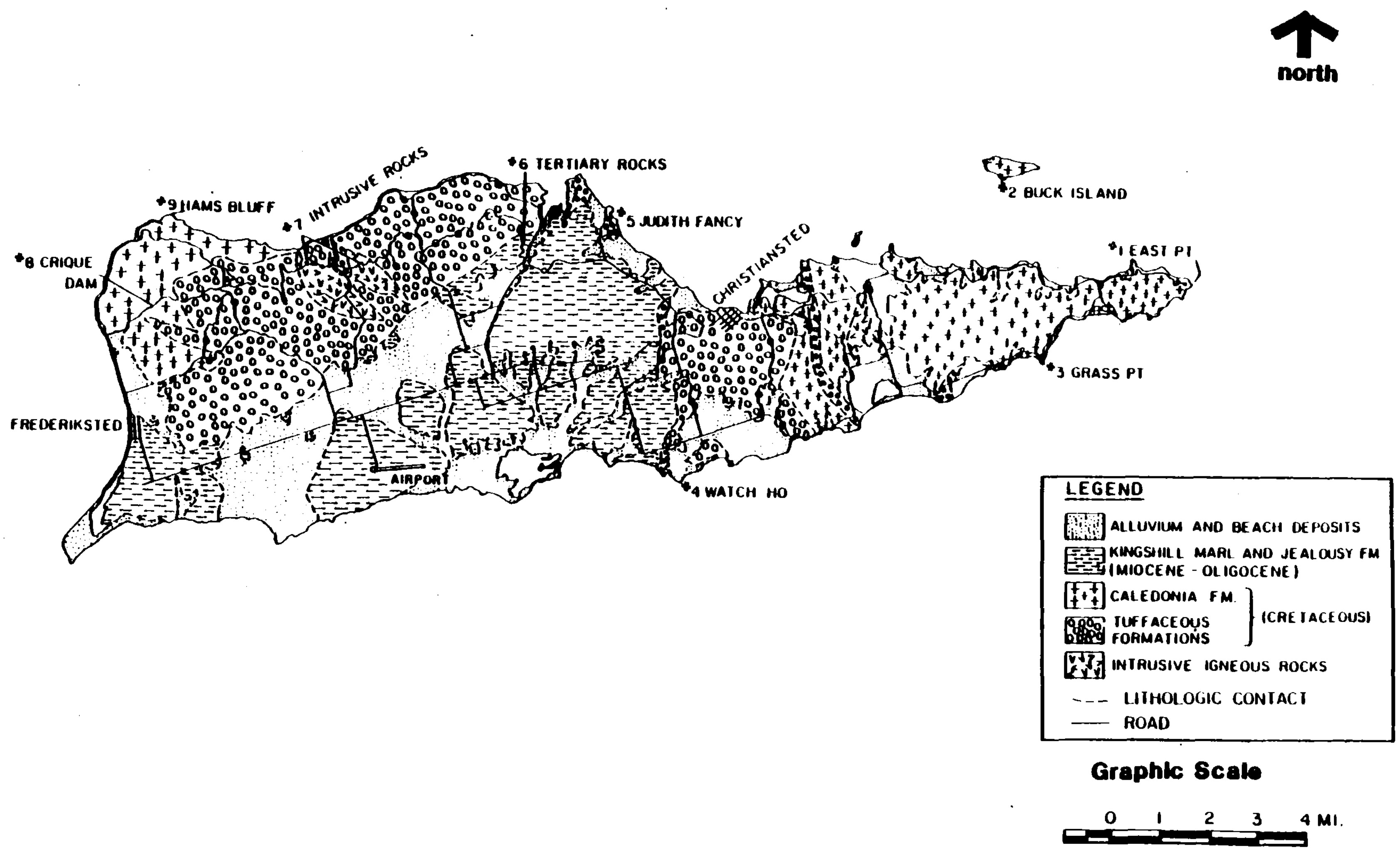
A popular misconception is that St. Croix was formerly a volcano. Although volcanoes are present on many nearby islands, there are none on St. Croix, and there probably have not been for tens of millions of years, if ever. Yet, most of the rocks are originally of volcanic origin.

The rocks underlying the mountain ranges on St. Croix (and probably those deep beneath the Central Valley) are sedimentary rocks derived from the erosion of older volcanic rocks and from volcanic ash spewed out from an erupting volcano. The sediments were deposited on the deep ocean floor in the late Cretaceous age (Campanian--Maestrichtian), and are approximately 80 million years old. The limestone (or marl) exposed at the surface of the Central Valley of St. Croix is considerably younger (lower Miocene, 20 million years), and is probably the remains of a coral reef that formed as the island was uplifted (see Figure 4-7).

4.5.5.4 Soils. The soils of St. Croix are primarily of the Cramer-Issac Association (see Section 4.4.5.4). Historically, the soil has been the most important natural resource of the island. At the height of the sugar plantation era approximately 40% of the island's 84 square miles was under cultivation. At present only a few hundred acres are in crops, although there are still approximately 17,000 acres used for pastureage and range.

Any past abuses of the soil such as overgrazing by goats, sheep, and cattle probably are insignificant compared to the effects of the bulldozer in the past decade. The Virgin Islands Government has acted within the last year to meet the mounting problems of construction-related erosion by requiring "earth change" permits to be approved before the land is altered. Over the past few decades earth dams have been placed on virtually every stream channel on the island to check erosion and to help recharge ground water supplies.

4.5.5.5 Hydrology. Annual rainfall on St. Croix ranges from up to 60 inches on the northwest coast to 25 to 30 inches on the east end of the island. Although there is generally a rainy season from August through November, the



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 4-7
GEOLOGIC FORMATION OF ST. CROIX ISLAND

amount of precipitation is highly variable from year to year. Agriculture on the island has been plagued by occasional droughts since the first settlers arrived. A roof-catchment and cistern are required for all houses, although municipal well water and desalted water have largely supplanted these systems. The central lowland province, underlain by the Kingshill Marl, contains the principal ground water reserves. In 1970, this area was estimated to contain 130 billion gallons, of which only about one third has a sufficiently low content of dissolved solids (less than 6,000 mg/l) for watering plants or improvement by electrodialysis. Potable water is obtained only from shallow wells, as the chloride concentration increases rapidly near sea level. Much of the water for the public system in Christiansted is obtained from wells at Concordia (Salt River). However, this water is mixed with distilled water from the desalting unit at the power plant to improve its quality. Most of the shallow, sweet-water wells elsewhere on the island have been overpumped, resulting in reduced yields (or dry wells) and intrusion of seawater or brackish connate water.

Only about 3% of the total rainfall reaches the water table, owing to the high losses by evaporation and transpiration. Evaporation is enhanced by the typical pattern of brief intermittent showers. Transpiration by the abundant scrub thorn vegetation is particularly effective in blocking recharge of ground water because these plants have root systems that may extend 20 or more feet below the surface. In recent years many acres of shallow-rooted sugarcane and other grasses (roots two to three feet deep) have given way to the scrub thorn. Lowering of the water table by pumping, and the reduction of recharge by changes in vegetation, may account in large part for the virtual disappearance of running streams in the last 40 years.

Recharge of the main Kingshill Marl aquifer by rainfall was estimated to be at an average rate of 1.75 million gallons per day (mgd). Pumpage in 1970 was estimated at 700,000 gallons per day for the municipal supply and 300,000 gallons per day for private use, a total of 1,000,000 gallons per day. Since 1970 pumpage almost certainly has increased substantially in response to the increased population, and to new industrial demands. Figures for current pumpage are not available.

There are two ground water wells near the UTR. One lies on Navy property, but not within the fence line, south of the entrance gate to UTR. The well is 50 to 60 feet deep, and at one time was used for drinking water. Within the last five years the water has become too brackish for any other use than in the sanitary system. Wells along the south shore of St. Croix are also experiencing saltwater intrusion.

Except as noted above, all water for all uses at both the UTR and St. Georges Hill complex is rainwater caught in cisterns or, primarily, water trucked in by the VIWPA.

4.5.6 Migration Potential. The potential for surface migration of contaminants at the UTR on St. Croix is excellent due mainly to location. Perched on a small bluff directly on the Caribbean Sea, any contamination from past polluting practices would have rapidly entered the ocean, or infiltrated the sandy soil to the ground water. Currently, oil spills at the generator building can be seen to migrate off Navy property and enter the sea almost immediately. situation is compounded by continuing erosion of the shoreline.

At St. Georges Hill, any contamination would enter the soil and travel only a short distance before meeting bedrock. With a heavy vegetative cover to detain surface runoff, no surface water, and a considerable distance to the sea, it is unlikely that any contaminants have migrated from the St. Georges Hill complex.

4.6 PICO DEL ESTE. The AFWTF site at Pico del Este is located in the Luquillo National Forest at an elevation of 3,450 feet and is approximately 10 air miles northwest of the station. The primary function of the Pico del Este site is to provide air and surface search radar coverage for the AFWTF operating areas. Systems located at the site include the Integrated Target Control System (ITCS), the Wide Area Active Surveillance System (WAAS), the Noise Jammer System (NJS), and the Electronic Warfare Range (EWR) Threat Platform Simulator (TPS). One of the facilities is shared with the Federal Aviation Administration (FAA), which provides aerial traffic control for the San Juan area.

4.7 NAVSTA ROOSEVELT ROADS, WEST ANNEX, AGUADILLA. NAVSTA Roosevelt Roads currently owns 11 buildings at the former Ramey Air Force Base in Punta Borinquen. The Navy acquired the buildings in 1973 when the U.S. Air Force excessed Ramey. The majority of the buildings are leased to the Commonwealth of Puerto Rico, which in turn leases the buildings for commercial use.

Buildings 504, 505, 506, 509, and 531 are leased to the Puerto Rico National Guard. Building 506 is currently the headquarters of the 20th Battalion, 65th National Guard, and was formerly the station commissary. Building 504 was the station bakery and is currently used as a storage compound by the National Guard. Building 531, which has been partially demolished by the National Guard, was formerly part of the Air Force civil engineering office and the carpentry material storage. Building 505 was also used by the Air Force civil engineering office.

Buildings 528 and 530 were the Air Force exchange gas station and vehicle maintenance shop prior to Navy acquisition. Building 528 was the gas station office and store, while Building 530 served as the garage for vehicle maintenance and repair. The station was operated by Texaco until 1973, and has been closed since then. The property is currently leased to an oil company which is in the process of renovating the facility. There has never been any occupation of these buildings by the Navy.

Building 571 is used by the Department of Education for band exercises and folkloric dances. The Air Force previously used this building for servicing the fuel tanks of B-52 Bombers. The fuel was drained from the aircraft prior to entering the hangar. The Navy has never utilized this building.

Buildings 706 and 703 (Building 703 is leased to the Commonwealth) were formerly the Air Force, and then the Navy, Exchange. A theatre was located in Building 706, which has been abandoned. A cafeteria, airline ticket office, beauty shop, and post office were part of the exchange located in Building 706. The building is currently a small shopping plaza which is subleased to commercial uses, including a restaurant, bakery, pharmacy, and legal office.

Building 561 is leased to the Commonwealth, which subleases it to MASCO Industry, a manufacturer of communications equipment. This building has never been occupied by the Navy.

All of the buildings owned by the Navy at Ramey have been declared excess and are awaiting disposal through GSA.

CHAPTER 5. WASTE GENERATION

5.1 GENERAL. The following sections describe waste generation processes associated with industrial, ordnance, and radiological operations at NAVSTA Roosevelt Roads.

5.2 INDUSTRIAL OPERATIONS.

5.2.1 Machine Shop. The Public Works Machine Shop in Building 31 performs all sheet metal and welding operations, including toolmaking work. Shop activities include repair and maintenance of pumps and other dynamic equipment. Wastes generated by this operation consist of metal pieces, welding material, small grease and oil containers, and small equipment parts. All waste materials are discarded at the base landfill. It is estimated that during the period 1960 to the present this shop has generated approximately 23 tons of waste per year.

5.2.2 Degreasing and Solvent Cleaning. Degreasing and solvent cleaning operations are located at many locations, including the AFWTF Drum Shop at Building 860, the Naval Exchange Repair Shop at Building 519, the Hobby Shop, Camp Moscrip, the Torpedo Shop in Building 395, and Surface Operations in Building 44. However, the most extensive operations are located at the Public Works Department, Aircraft Intermediate Maintenance Department (AIMD), and Fleet Composite Squadron Eight (VC-8). Cleaning operations are a result of maintenance and corrosion control requirements to remove grease and grime accumulations which occur during use.

5.2.2.1 Public Works Department. The Transportation Division of the Public Works Department performs routine maintenance of equipment and corrosion control of machinery. During 1960 to 1973, solvent and cleaning solutions were mixed with waste oil, brake fluids, and other oil derivatives and discarded at the landfill at an estimated rate of 2,500 gallons per year. From 1973 to the present, solvents were reclaimed through a filtration system.

5.2.2.2 Aircraft Intermediate Maintenance Department (AIMD). Cleaning operations occur in all AIMD shops, and vary from minor use of electrical contact solvent sprays in the Avionics Shop to parts dipping at the Power Plant Shop, Ordnance Shop, and Tire Shop, and at Aircraft Washdown and Ground Support Facilities. These shops are located in Buildings 379 and 826.

At the Power Plant Shop two small baths (10 cubic feet each) containing the degreasing chemical PD-680 are used for dipping engine parts. Small cleaning tanks, containing PD-680, are also used at the Tire Shop to degrease wheel housings, bearings, and associated hydraulic mechanisms. Solvents used by the Ordnance Shop include methyl ethyl ketone (MEK), PD-680, Freon, and corrosion inhibiting compounds, which are applied to tow wheels, racks, holders, and release mechanisms. At the Ground Support Facility, large equipment is cleaned over a wash rack which drains into an oil-water separator. Smaller parts are cleaned in small shop tanks. For aircraft washdown, a large wash rack located adjacent to the Building 379 hangar is used. This wash area has a special drain system which discharges to the sanitary sewer. Dry cleaning solvents (PD-680) and alkaline cleaning compounds are used at this facility.

Since the early 1970s, most of the spent solvents have been disposed of in bowsers for ultimate disposal (reclamation or sale) off-base by a contractor. However, some materials, both diluted and non-diluted, are released to the sewer system to adjacent drainage ditches via floor and hangar drains. This was common practice before the 1970s. A listing of the degreasing and solvent cleaning materials and associated quantities used at AIMD is found in Table 5-1.

5.2.2.3 Fleet Composite Squadron Eight (VC-8). The degreasing and solvent cleaning activities conducted at VC-8, located in Building 1625, are similar to AIMD but on a smaller scale, since VC-8 performs only routine and minor maintenance. Disposal practices are similar to those used by AIMD. Since the 1970s, the majority of recoverable solvents are placed in a bowser for ultimate disposal (reclamation or sale) off-base. Some material is eventually released to the sewer system or to surface drainage ditches via floor, hangar, and washdown drains. The types and amounts of cleaning materials disposed of by VC-8 are presented in Table 5-2.

5.2.2.4 Torpedo Shop. The Torpedo Shop assembles MK 30, MK 46, and MK 48 torpedoes for AFWTF and the Weapons Department. The shop has been run by contractors for 20 years.

If a torpedo fails to function, or immediately following a "run" by one of the target or practice torpedoes, the torpedo is recovered, the fuel removed, and the torpedo washed with Agentine, a dry cleaning solvent.

This operation generates the following types of waste: OTTO Fuel II, clothing contaminated in assembly and maintenance of the torpedoes (boots, booties, trousers, shirts, aprons, gloves), detergent, Agentine, alcohol (Neosol), sodium sulfide, denatured ethyl alcohol, acetone, oil, and silver cell batteries (MK 30 Torpedo Shop only). OTTO Fuel II consists of propylene-glycol dinitrate (76%), dibutyl sebacate (22.5%), and nitrodiphenylamine (1.5%). The by-products created from combustion of this fuel are carbon monoxide, carbon dioxide, hydrogen cyanide, methane, and hydrogen. MK 46 and MK 48 torpedoes are propelled by OTTO Fuel II, while the MK 30 torpedo is battery operated.

Between 1967 and 1970 the MK 46 and MK 48 Torpedo Shop burned water-contaminated OTTO Fuel II and contaminated clothing at various locations throughout the base landfill. It was estimated by shop personnel that a maximum of three barrels of OTTO Fuel II and contaminated clothing were burned each month during this period, totaling a maximum of 108 drums. Of this waste, OTTO Fuel II made up approximately eight to 10 55-gallon drums a year, totaling between 24 and 30 drums. During this period, a small but undetermined amount of liquid waste was disposed of in Ensenada Honda by ships conducting torpedo operations.

Beginning in 1968, all contaminated OTTO Fuel II, Agentine, and associated liquid and solid waste generated by the activity have been placed in 55-gallon drums in a permitted storage area behind the Torpedo Shop and shipped off-base for disposal. Shop personnel estimated that the activity generates approximately 10 55-gallon drums of waste per month. The waste was originally shipped to Naval Weapons Station Earle; since 1980 Naval Weapons Station Keyport ha directed disposal which is handled by shipping to Cape Canaveral, Florida, with final disposition at Lenoir, North Carolina.

Table 5-1

AIMD DEGREASING AND SOLVENT CLEANING MATERIALS

Material	Monthly Quantity Used (gallons)
Isopropyl alcohol	33
Naphtha aliphatic	1
Freon	40 to 46
Aircraft surface cleaning compound	60
Ethyl alcohol	1
Xylene technical	1.25
Methanol technical	Seldom used
Dry cleaning solvent (PD-680)	36 to 40
Naphtha	4
Methyl ethyl ketone (MEK)	4
Propanol ACS	Seldom used
Trichlorothane	11 to 11.5
Freon 22	15
Aircraft cleaning compound with water	30

Sources: Inventory of hazardous materials held in AIMD, submitted to Public Works Department, Environmental Director, 22 June 1982.

AIMD Quality Assurance Memorandum, Submitted to Naval Station Safety Officer, 9 January 1984.

Table 5-2

VC-8 DEGREASING AND SOLVENT CLEANING MATERIALS

Material	Monthly Quantity Used (gallons)
Dry cleaning solvent	5
Alcohol	0.25
Aliphatic naphtha	1
Technical xylene	1
Methyl ethyl ketone (MEK)	2

Source: Hazardous Waste Annual Report, 1982, prepared by Fleet Composite Squadron Eight (VC-8), submitted to Public Works Department, Environmental Director.

A drum of liquid waste weighs approximately 394 pounds, while a drum of solid waste weighs about 180 pounds. The majority of liquid waste consists of OTTO Fuel II and Agentine. Five gallons of Agentine are used per torpedo run. Based on 300 runs annually, the activity generates about 1,500 gallons of used Agentine per year.

In total, approximately 120 55-gallon drums of solvent and fuel waste are generated yearly by the Torpedo Shop.

The contaminated OTTO Fuel II and other waste is stored temporarily in Building 248, which has been recently approved for storage by Naval Sea Systems Command. Waste that has been palletized and banded for shipment to Cape Canaveral is temporarily stored in Building 832. The frequency of shipment to the Cape is governed by the scheduled launching of the space shuttle and other rockets.

In 1983, the Hazardous Waste Manifest report stated that the Torpedo Shop generated 3,420 pounds of hazardous liquid waste and 5,776 pounds of hazardous solid waste. The Hazardous Waste Annual Report, for calendar year 1982, presents a breakdown of liquid waste for the activity as follows (quantities approximate):

OTTO Fuel II	450 gallons
Super Agentine	795 gallons
Sulfuric acid	3 gallons (added to batteries)
Engine degreaser	100 gallons
Corrosion preventative	800 gallons
Cleaning fluid	550 gallons

The silver cell batteries used in the operation of the MK 30 torpedo are shipped to Keyport, Washington, for silver reclamation.

Disposal of inoperable explosives generated by the Torpedo Shop is carried out by Explosive Ordnance Detachment (EOD) personnel. These materials are shipped to the Eastern Maneuver Area (EMA) on Vieques Island and properly disposed of there. In the last three years, three ignition separator assemblies (ISAs) and 20 propellant charges were transported and disposed of on Vieques (see Section 5.3.1).

5.2.3 Paint Shops. Paint shops are located at the Public Works Department, AIMD, and VC-8. Painting activities range from general interior and exterior painting of base structures, to vehicle and equipment repair, to aircraft maintenance and corrosion control by AMID and VC-8.

5.2.3.1 Public Works Department. The Carpentry Shop and Housing Maintenance Shop handle the painting activities within the Public Works Department.

The Carpentry Shop performs wood building and masonry work for all buildings and structures and all interior and exterior painting, other than housing. This shop generates a total of approximately 20 tons of waste per year, consisting of scrap wood pieces, sawdust, and empty paint cans (200 per year), mostly five gallons in size. About 40% of all paint used is water-based, with lead-based paints estimated at 1% and the remainder oil-based. A small amount of paint thinners, mostly mineral spirits and others (xylene), are included. All wastes have been disposed of at the landfill since 1962. Usable paints are turned over to DPDO for resale. However, in 1982, approximately 40 gallons of unsellable oil-based paint were discarded at the landfill.

The Housing Maintenance Shop, located in Building 1755, performs house renovation, electrical repair work, plumbing and structural repair work in the housing area, and all interior painting. Wastes generated consist of screens, scrap wood, pipe pieces, etc., plus empty cans of paint, mostly water-based. Small amounts of paint thinner are disposed of at the work place or at the base landfill. It is estimated that over the last 15 years (1969 to the present), waste generation has been fairly consistent at 15 tons per year. In addition, it is estimated that some 1,800 empty paint cans were generated during this same time period.

5.2.3.2 Aircraft Intermediate Maintenance Department (AIMD). Painting activities conducted by AIMD, located in Buildings 379 and 826, primarily consist of painting aircraft components. Full-scale painting of aircraft is not routinely performed. Depending on the size of the component, painting may be conducted within a shop area or in an open area such as a hangar.

The majority of paints are applied from spray cans, which are used until the contents have been depleted. Other paints come in two-component kits which require mixing of both components prior to use. Application of two-component paints is by either a "Spray Tool" or paint gun provided by the paint manufacturer. Whatever is mixed, is applied. The unmixed portions of paint a stored for further use. Overaged paints and thinners are returned to t. Supply Department, which turns them over to DPDO. Table 5-3 presents the types of paints and thinners used by AIMD, as well as the amounts of waste generated as established during a 1982 survey.

5.2.3.3 Fleet Composite Squadron Eight (VC-8). Paint activities conducted at VC-8, located in Building 1625, are limited to touch-up painting. Large component and full aircraft painting are not routinely performed. In a manner similar to operations at AIMD, all paints are consumed and overaged paints are returned to the Supply Department, which turns them over to DPDO. Table 5-4 lists the types of paints and thinners used at VC-8, as well as the amounts on-hand in a 1982 survey.

5.2.4 Paint Stripping. Paint stripping shops are located at the Public Works Department, AIMD, and VC-8. Paint stripping operations are a result of the maintenance requirements to prolong the life expectancy of equipment and aircraft.

5.2.4.1 Public Works Department. Paint stripping at the Public Works Department involves scraping paints from pumps, motors, vehicle parts, and other mechanical equipment by hand or with the use of machinery. Small amounts of paint scrapings are mixed with the rest of the trash for final disposal.

5.2.4.2 Aircraft Intermediate Maintenance Department (AIMD). Paint stripping operations conducted by AIMD, located in Buildings 379 and 826, primarily consist of stripping the paint from aircraft components. Full-scale paint stripping of aircraft is not routinely performed. Depending on the size of the com-

Table 5-3

AIMD PAINTS AND THINNERS

Item	Amount of Waste Generated
Enamel	550 gallons/year
Lacquer	200 gallons/year
Pigmented epoxy resin	12 gallons/year
Acryllic nitrocellulose	12 gallons/year
Primer	225 gallons/year
Toluene/methyl	12 gallons/year
Advanced C & C hardener compound	200 gallons/year
Xylene/toluene lacquer thinner	250 gallons/year

Source: Inventory of hazardous materials held in AIMD, submitted to Public Works Department, Environmental Director, 22 June 1982.

Table 5-4

VC-8 PAINTS AND THINNERS

Item	Amount On-Hand
Lacquer	12 gallons
Epoxy paint	60 gallons
Enamel	36 gallons
Dope/lacquer thinner	24 gallons
Enamel thinner	24 gallons
Toluene	12 gallons

Source: Hazardous Waste Annual Report, 1982, prepared by Fleet Composite Squadron Eight (VC-8), submitted to Public Works Department, Environmental Director.

ponent, paint stripping is conducted either within a shop area or in an open area such as a hangar. Stripping operations consist of hand scraping or the use of several compounds which are applied by either brush or spray. When using removing compounds, the raised and semi-dissolved paint skin is rinsed from the component with water. Depending on the location of the stripping operation, rinse water containing paint skins and excess stripping compound is flushed to the sewer system or to a surface drainage ditch via floor drains and hangar or pad grates.

In addition to paint removal, the application of corrosion prevention and metal conversion coatings is also performed as an intermediate step between stripping and painting operations. These compounds are applied in a similar manner as paints and are used until consumed. If overaged, they are turned over to DPDO. A list of the paint stripping and corrosion/conversion coating compounds used at AIMD is presented in Table 5-5.

5.2.4.3 Fleet Composite Squadron Eight (VC-8). Paint stripping activities conducted at VC-8, located in Building 1625, are limited touch-up painting or corrosion/metal conditioning, as required, on a small scale. Large component and full-scale aircraft stripping is not routinely performed.

In a manner similar to such activities at AIMD, all paint stripping and coating compounds are consumed or turned over to DPDO when overaged. Paint stripping and coating compounds used at VC-8 include paint epoxy remover and polyurethane paint coating (1982 Hazardous Waste Annual Report prepared by VC-8).

5.2.5 Navy Publications and Printing Service Office, Southeastern Division. The publications and printing service provides publications, printing, and reproduction services to all Naval activities in accordance with the Navy Industrial Fund. The shop began operations in 1967 at its present location in Building 583, later expanding to Building 584 in 1972, when the Naval Air Station San Juan Publications and Print Shop was consolidated with the Roosevelt Roads shop. Building 584, currently used for office space and storage of supplies, was previously used by the Navy Hospital for office space. Prior to 1957, both buildings were used for office space by the U.S. Army (Fort Bundy).

The main operations of the printing service are located in Building 583, which houses four presses (two of which are operational), a cutter, and a Xerox machine. Prior to the early 1970s, oil-based ink was used in the printing process, which necessitated cleaning the presses every night with Blankrola solvent containing perchloroethylene and petroleum naphtha. The rags used to wipe down the presses were thrown in the dumpster and disposed of at the station landfill. Approximately one quarter pound per week of ink sludges produced during the printing process was also disposed of in this manner.

Since the early 1970s the shop has been using rubber-based ink and the presses are wiped down once a week, sometimes more often if colored ink is used. Approximately 62 gallons of roller wash is consumed every six months in cleaning the presses. The wipes which are used to clean the presses are disposed of in the station landfill. The electrostatic solution and developer and process gum are consumed in the printing process. Approximately 10 quarts of lubricating oil are used every four months for the maintenance of the machines and presses. Incidental spillage of oil on the floor is wiped up with rags. Two hydraulic

Table 5-5

AIMD PAINT STRIPPING AND COATING COMPOUNDS

Item	Amount of Waste Generated
Epoxy paint remover	15 gallons/year
Alodine	5 gallons/year
Corrosion prevention compound	50 gallons/year
Corrosion prevention; water displacing	50 gallons/year
Coating solution (epoxy polymide)	5 gallons/year
Polyurethane coating	None
Corrosion removing and metal conditioning compound	5 gallons/year
Urethane aliphatic isocyanate coating	None
Aledyne metal conversion solution	60 gallons/year
Phosphoric acid metal conversion solution	60 gallons/year

Sources: Inventory of hazardous materials held in AIMD, submitted to Public Works Department, Environmental Director, 22 June 1982.

AIMD Quality Assurance Memorandum, submitted to Naval Station Safety Officer, 9 January 1984.

fluid spills have occurred due to a hose breaking on the cutter machine. The first spill involved approximately three gallons, and the second, one gallon, both of which were wiped up with rags which were then disposed of in the dumpster.

The roller wash solvent comes in 55-gallon drums, which are stored outside of Building 583, and in one-gallon cans, which are stored in a flammable locker located between Buildings 583 and 584. There is no record of any spills or accidents involving these solvents.

5.2.6 Photo Shops: Fleet Audio Visual Center, Caribbean (FLTAUDVISCEN). The mission of the Fleet Audio Visual Center, Caribbean (FLTAUDVISCEN), is to provide official photography and coordination of photographic activities for the Naval establishment in the Caribbean area. Support is supplied to Navy Security Group Activity (NAVSECGRUACT) at Sabana Seca, AFWTF facilities throughout the Caribbean, and Naval Communications Station (NAVCOMSTA) facilities both on and off the island of Puerto Rico. The FLTAUDVISCEN also provides photographic services to other elements of the U.S. Armed Forces, and other governmental agencies as directed.

Housed in Building 790 since 1959, the center developed 1,275 36-shot rolls of black and white film, 650 36-shot rolls of color film, and 650 36-shot rolls of color slides in 1983. This represents the heaviest production schedule within the last 10 years. For the last six years, since 1977-78, the FLTAUDVISCEN has recycled all film for silver recovery through DPDO.

Prior to 1977-78, all wastes were disposed of in the base landfill. While no records of waste disposal were kept, personnel interviewed at the facility stated that, based on their experience at other Naval photographic facilities both stateside and overseas, it would not be unusual for some processing and developing solutions to have been "dumped out the back door." Such solutions would have included Kodak "EKTAFLO" fixer, Hunt Graph-O-Lith developer, and aluminum hydroxide, ammonium thiosulfate, formaldehyde, potassium bichromate, potassium permanganate, and sodium hydroxide. Fixer and developer wastes were most likely combined, then diluted and discharged to the sewer system connecting to the industrial area sewage treatment plant.

5.2.7 Calibration Shops. Electronic and gauge calibration shops are located at the Aircraft Intermediate Maintenance Department (AIMD), Fleet Composite Squadron Eight (VC-8), and Naval Electronics Engineering Office. Activities conducted at each calibration shop simulate field use by fine tuning electronic components against signal generators and frequency standards, or by testing the accuracy of various pressure and vacuum gauges. No major repair work is performed.

5.2.7.1 Aircraft Intermediate Maintenance Department (AIMD). AIMD electronic and gauge calibration shops are located in Building 379. Calibration of avionic components does not generate wastes. Penetrating liquids or contact cleaners are occasionally used on components in small quantities. These compounds are applied from spray cans and excess amounts are wiped off.

For testing gauges and hydraulic components, several instruments are used which contain small quantities of oil. As an example, one generator test instrument contains an oil-flow gauge which has a one-quart volume of oil. The oil changed every six months. Waste oil is placed in a bowser and sold to a private contractor for recycling. This practice has been carried out since the early 1970s. Other instruments used to test large hydraulic components contain larger volumes of fluids. Although not a routine occurrence, components have failed on the test units (the exact number of failures or rates of failures are not known). When this has occurred, hydraulic fluid (less than 100 gallons total over the years) flowed freely from the test unit into a catch basin and floor drain and was released into the surface storm drainage.

5.2.7.2 Fleet Composite Squadron Eight (VC-8). VC-8 calibration shops are located in Building 1625. Activities performed are similar to AIMD, but on a smaller scale. Wastes generated from calibration of avionics and from hydraulic testing are negligible in quantity.

5.2.7.3 Naval Electronics Engineering Office. The Naval Electronics Engineering Office has been located in Building 377 since 1975, when it was moved from San Juan. The primary function of this office is to calibrate equipment for the entire Caribbean fleet. In addition, the office calibrates equipment for the local U.S. Coast Guard and U.S. Army units on a non-priority basis. The office has facilities for 44 electrical engineers and technicians. Currently, seven electronic experts are used on a full-time basis.

Equipment is calibrated against signal generators and frequency standards. These procedures do not generate any appreciable amounts of waste. Some penetration and contact cleaning compounds are used in small quantities. The compounds are applied from spray cans and any excess is wiped off.

Twice a year, usually in June and December, radiological instruments are calibrated. A radiological source in a closed trailer, located separate from the building along the northern boundary line of the facility, is maintained and checked by the Department of Energy. Interviewees stated that calibration sources are low-level isotopes, possibly of cesium and plutonium.

5.2.8 Electrical and Electronics Shops. Electrical and electronics shops are located in the Public Works Department; AIMD; VC-8; and Air Operations Department, Ground Electronics Division. Activities conducted at these shops include repair and maintenance of electrical motors, generators, switching units, etc., by the Public Works Department as well as repair and maintenance of navigational, communications, avionics equipment, etc., by the Air and Ground Support Facilities.

5.2.8.1 Public Works Department. The Electric Shop of the Public Works Department maintains and repairs intercommunication cables, electrical motors, and appliances. It repairs, installs, and replaces electrical systems up to 600 volts. Electric transformers are handled separately by the Power Distribution Shop. Wastes generated by this activity consist of cables, wires, conduits, receptacles, ballast, bulbs, a small amount of grease and oil containers, etc., all of which are disposed of at the station landfill. Waste generation, which has not changed significantly during the last 15 years, has produced a total of approximately 10 tons of waste material per year.

The Power Distribution Shop maintains and repairs the electrical distribution system, including servicing of transformers of over 600 volt rating, and as such, maintains 13 main transformers in eight substations located at the Airfield, Industrial Area, Bundy Area, and the Capehart Housing Area.

Maintenance of transformers was conducted by the Power Distribution Shop at the Power Plant, Building 38, from 1956 through 1964, and then at Substation 2, Building 90, up to the present. As part of the maintenance of the transformers, the transformer oil was drained to facilitate repair of the inner cores and coils. It was routine practice to drain the transformer oil on the ground at the work area until 1978, when the dangerous properties of PCB were recognized.

Shop personnel interviewed stated that Askarel transformers were the only exception to this practice. Employees stated that the reason for this was that employees developed skin rashes from direct contact with the Askarel, and sometimes required medical attention. Transformer oil drained from these transformers was placed in 55-gallon drums, which were then disposed of at the station landfill.

Since 1978, any transformer fluid which is drained from a transformer is placed in 55-gallon drums and disposed of through DPDO. Approximately 200 gallons per year of transformer oil is used by the Power Distribution Shop in the servicing of transformers.

5.2.8.2 Aircraft Intermediate Maintenance Department (AIMD). The AIMD Electronic/Avionics Shop is located in Building 379. The primary function of this shop is to provide avionics maintenance and repair services to all military aircraft as required. Services range from minor calibration to the complete overhaul of avionic components. However, AIMD does not service luminescent dials. These units are sent statewide for servicing.

Most of the materials used during these activities are consumed in the process. These materials include solder, lead, flux, and wire. Minor amounts of solder and lead are recovered and discarded each day.

Other activities include cleaning and repair of gauges. Cleaning fluids such as Freon are used at a rate of one quart per month. Replaced hydraulic fluid is disposed of at a rate of five gallons per month. Waste fluids are placed in a bowser for collection and sold to a private contractor for recycling.

5.2.8.3 Fleet Composite Squadron Eight (VC-8). The VC-8 Electronic/Avionics Shop is located in Building 1625. The VC-8 shop has the capability to provide similar type services as AIMD but is responsible only for squadron aircraft. Waste types and disposal methods are similar to AIMD but on a smaller scale.

5.2.8.4 Air Operations Department, Ground Electronics Division. The Ground Electronics Division's primary function is to maintain airfield electronics and ground communications for base operations and security. Ground electronic shops are located in Buildings 377 and 426. These shops generate wastes similar to those found at AIMD and VC-8, consisting of minor amounts of solder, lead, and spent cleaning fluids. In addition, small electronic transformers (no PCBs), low voltage batteries, and power tubes containing beryllium insulators, a total of 12 per month, are placed in the dumpster and ultimately disposed of in the base landfill. Approximately 10 to 15 years ago mercury switches were also disposed of in the landfill as well as vacuum tubes possibly containing radiu which may have emitted low levels of radioactivity. Larger pieces of equipment such as transceivers are returned to the Supply Department, which turns them over to DPDO.

5.2.9 Pest Control Shop. The Pest Control Shop, under the cognizance of the Public Works Department, is responsible for insect and rodent control in station buildings and on station property, as well as weed control along streets, sidewalks, and buildings. Prior to 1983 the Pest Control Shop was located in Buildings 258 and 113. Building 113 was used for office space and was recently demolished. The main work area was located in Building 258, where pesticides were stored and mixed. Table 5-6 contains a list of pesticides which were stored and used in the past in Building 258. Other pesticides which were used but discontinued include DDT and Paris Green.

Herbicides were mixed outside of Building 258, where there is still evidence of stressed vegetation. In general, Building 258 did not have adequate facilities, as evidenced by the 1977 Environmental Engineering Survey. This report cited problems of pesticide application equipment being washed out over a storm drain that emptied into a drainage ditch behind the shop. The survey stated that numerous aquatic kills had occurred due to pesticides entering the ditch, and recommended a pollution abatement project to construct a concrete wash pad with a connection to the sanitary sewer for washing pesticide application equipment.

In 1979 Building 258 was cited as being structurally inadequate. A request for pollution abatement funding for construction of a more suitable facility was submitted. Construction of the new Pest Control Shop was completed in the summer of 1983. When the shop moved out of Building 258, the Naval Hospital used the building for storage of metal beds and miscellaneous large objects. Before moving the hospital property into Building 258, the Public Works Department conducted a washdown of the interior of the building.

A small (four-foot by two-foot) in-ground concrete-lined trench known as the Chemical Dog Bath, was located between Building 258. The ditch was used in the past as a flea and tick dip tank for dogs. The dip tank also drained to the ditch behind Building 258. It was also used for housing infested animals used in various experiments by the hospital staff.

In the past, empty pesticide containers were rinsed and then disposed of at the station landfill. The rinse water went into the ditch behind Building 258. In 1978 Pest Control Shop personnel began collecting the rinse water that was generated from cleaning the equipment for use as dilute pesticide in the next application, or applied the rinsates to the application area.

A strong pesticide odor was noted outside and around the building during the IAS site visit.

The new Pest Control Shop, which opened in the summer of 1983, is equipped with modern facilities. There are separate storage areas for pesticides, herbicides, equipment, and pesticide mixing. A concrete-bermed equipment wash pad connected

Table 5-6

PESTICIDE INVENTORY/REQUIREMENTS, NAVAL STATION ROOSEVELT ROADS (1980)

Common Chemical Name	Percent Active Ingredient	Estimated Annual Requirements (lb/gal)	On-Hand (lb/gal)	On-Order (lb/gal)	Used Against
<u>Insecticides</u>					
Malathion	95.0	220 gal	155 gal	110 gal	Adult mosquitos
Diazinon	48.0	10 gal	5 gal	None	Roaches
Dursban	41.0	10 gal	10 gal	None	Roaches
Chlordane	72.0	120 gal	105 gal	None	Termites
Pentachlorophenol	5.0	20 gal	15 gal	None	Wood treatment
Malathion	57.0	15 gal	104 gal	None	Fleas, pests (stored products)
Baygon	1.0	50 gal	8 gal	12 gal	Roaches (food handling building
Altosid SR-10	100.0	100 gal	75 gal	25 gal	Mosquito larvae
Carbaryl	80.0	1,000 lb	600 lb	None	White grub
Diazinon	47.5	100 gal	300 gal	None	Household pests
Dursban 10CR	10.6	100 lb	150 lb	50 lb	Mosquito larvae
FLIT MLO	100.0	1,000 gal	2,000 gal	None	Mosquito larvae
Malathion	57.0	25 gal	55 gal	None	Flies

Table 5-6 (Cont.)

Common Chemical Name	Percent Active Ingredient	Estimated Annual Requirements (lb/gal)	On-Hand (lb/gal)	On-Order (lb/gal)	Used Against
Insecticides (Cont.)					
Malathion	95.0	50 gal	110 gal	None	Adult mosquitos
Propoxur (Baygon)	13.9	40 gal	10 gal	30 gal	Household pests
Herbicides					
Bromacil	80.0	150 lb	200 lb	50 lb	Weeds and brush
Diquat	35.1	50 gal	20 gal	30 gal	Aquatic weeds
Bromacil	80.0	800 lb	225 lb	None	Weeds, all vegetation
Prometone	25.0	100 gal	50 gal	None	Weeds, all vegetation
Glyphosate	41.0	35 gal	35 gal	None	Weeds, annual and perennial
Rodenticides					
Anticoagulant	0.025	20 lb	20 lb	20 lb	Rats
Anticoag	0.025	400 lb	120 lb	None	Rodents
Other					
Paradichlorobenzene	100.0	100 lb	200 lb	None	Bats

Source: NAVSTA Roosevelt Roads Public Works Department, Pest Management Plan, 1980.

to the sanitary sewer system is located adjacent to the building in the parking lot.

A new pest control facility was recently completed by NMCB at Camp Moscrip. The new facility is a small (20-foot by 24-foot) concrete block building with separate facilities for mixing and storage of pesticides. The old facility was demolished because it failed to meet safety and environmental requirements which require separate storage and mixing areas for pesticides. Both the old and new pest control shops were connected to the sanitary sewer system.

The Pest Control Shop at Camp Moscrip is operated by two certified operators from the Bravo Company. Management and technical assistance is provided to the NMCB by Public Works Pest Control Shop personnel in the area of pesticide application and equipment utilization. Registered pesticides utilized at the camp include diuron, malathion, baygon, and warfarin.

A Pest Control Shop is also located at the golf course. In the past Special Services conducted the pest control operations at the golf course. Since no golf course personnel are certified, Public Works Pest Control Shop personnel have taken over the function of procurement and usage of pesticides at the golf course. Moderate amounts of Dursban 5% mole cricket bait and various herbicides for crabgrass control are applied on the nine golf greens.

Household pest control is primarily provided by private pest control companies hired by the housing residents on an individual basis.

5.2.10 Boiler Plants. Boiler plant (power heating) operation and maintenance is a function of the Utility Shop. There are 16 boilers located around the base in several buildings, varying in design pressures from 15 pounds per square inch (psi) at the hospital vegetable cooker (Building 1790) to 150 psi in the laundry at the Navy Exchange (Building 1683). Boilers are used for making steam and hot water. The boilers are fueled, for the most part, by diesel No. 2 fuel, except for the hospital boiler and the boiler located at the laundry in the Bundy area, which use JP-5 fuel. Fuel is stored in underground tanks adjacent to the boilers.

Waste generated by this operation is rather small, amounting to 500 pounds per year, and consists of soft boiler sludge and soot from the heating tubes from regular maintenance. No acid cleaning is required to remove scale due to the excellent soft characteristics of the water supply. As part of routine maintenance, during the period 1962 to 1972, loose asbestos chipping from pipe insulation was removed; the material was disposed of at the landfill. About two barrels a year of loose asbestos chipping were discarded at the landfill.

5.2.11 Power Plants. Electric power has been supplied to the Naval Station for the last 30 years by the Puerto Rico Water Resources Authority. However, for emergency use, 42 fixed standby generators are located throughout the base in strategic areas. Some generators in key areas are provided with automatic start-up and transfer of load. These units vary in size from six kilowatts (KW) at each entrance gate to 850 KW at the Ship Refuel Station (Building 1940). In addition, there are 18 portable generating units ranging from 3.5 to 100 KW ready for use in an emergency.

All units operate on Navy diesel fuel. The 11 larger units (150 KW and up) a supplied from underground tanks, which vary in size from 250 to 2,500 gallons. Other units obtain fuel from day tanks.

Maintenance of the engines results in about 1,300 gallons of waste oil a year, which is turned over to the Transportation Division of the Public Works Department for final disposition to a private contractor for recycling. It is estimated that during 1960 to 1972, about 1,000 gallons per year of waste oil were discarded at the landfill. Other wastes, consisting of wires, meters, gauges, windings, etc., amounting to one ton per year, are also disposed of at the landfill. It is suspected that the non-electric temperature gauges have a small amount of mercury.

During the period 1940 to 1949, electric power was provided by a steam turbine plant with a generating capacity of 60 megawatts located at Building 38. The water intake was located at Puerca Bay in the vicinity of the present site of the Enlisted Beach; the outfall for the discharge was located at Ensenada Honda.

The plant used Bunker "C" fuel, which was stored in two 50,000-gallon underground tanks located directly northeast of the building.

In the 1970s there were several incidents of Bunker C fuel entering the manholes and discharging to the Enlisted Beach during heavy rainfalls. A contractor was hired twice to drain the Bunker C fuel from the inground tanks and to clean up the area of the spill.

The Power Plant was used by the Power Distribution Shop for the maintenance of transformers from 1956 through 1964; these activities are discussed further in Chapter 8.

From 1964 through 1978 the Power Plant was used for storage of canned goods by the base exchange and commissary. In 1978 the building was closed off at the direction of the Public Works Environmental Coordinator due to the asbestos and PCB hazard. In June 1982 a contractor was hired to drain the two transformers located inside the building. The transformer fluid was placed in 18 55-gallon drums. Before the fluid was drained, it was tested for PCB contamination. One transformer had a concentration of 394 ppm PCB and the other 413 ppm PCB. There are also two 55-gallon drums of PCB-contaminated solid material generated by the cleanup contractor located in the building.

The 55-gallon drums of PCB-contaminated material were still in storage at Building 38 when the IAS team conducted the on-site survey. The building is not a permitted hazardous waste storage facility. Approximately eight gas cylinders ranging in length from two feet to six feet were also observed by the IAS team in the vicinity of the building. The contents of the cylinders could not be identified. Areas of stressed vegetation were noted on the northwest and southwest perimeters of the site.

5.2.12 Air Conditioning and Refrigeration. The Refrigeration and Air Conditioning Shop, located in Building 1788, is responsible for the preventive maintenance and repair of air conditioning units as well as household, commercial, and industrial refrigeration equipment. Small compressor parts tubing, air filters, wire pieces, window air conditioners, and empty cans of cleaning solution make up most of the waste generated by this activity. Larger compressor and mechanical equipment is turned over to DPDO for disposition.

The landfill receives the bulk of the waste material generated by this activity, including an average of 36 window air conditioners per year, 48 empty five-gallon cans of cleaning solution, most of which is commercially known as Power Bright Cleaner, and 2.5 tons per year of small parts, tubing, filters, and wire. Operation during the past 20 years is estimated to have generated waste at approximately the same rate.

5.2.13 Battery Shops. Battery shops are located at the Public Works Department, AIMD, and the Weapons Department. Primary operations in the battery shops are disassembly, reassembly, drainage, rinsing, recharging, and cleaning of batteries.

5.2.13.1 Public Works Department. The Transportation Division of the Public Works Department is responsible for battery replacement and maintenance of all station vehicles. All discarded batteries (approximately 20 per month) are drained free of acid and delivered to DPDO for disposition. Acids are neutralized at the shop in special acid-resistant containers. Containers and batteries not accepted by DPDO are picked up by private contractor. During past operations, from 1960 to 1973, batteries were discarded at the landfill. It is estimated that an average of 180 batteries per year were disposed of in the base landfill during this period, for a total of approximately 2,300 batteries.

5.2.13.2 Aircraft Intermediate Maintenance Department (AIMD). Two battery shops are operated by AIMD in Building 379. One battery shop services small nickel-cadmium (NICAD) rechargeable-type batteries, while the other handles lead/acid batteries. Operations at the battery shop consist primarily of cleaning and charging. No acids are handled in this shop. Batteries which will no longer hold an adequate charge are returned to the manufacturer. No batteries are disposed of by the shop.

At the lead/acid battery shop, operations consist of cleaning, draining, rinsing, and recharging. Wastes generated by this shop include concentrated sulfuric acid, acid-contaminated rinse water, and potassium hydroxide electrolyte. Common practice has been to neutralize acids with baking soda, and along with acid-contaminated rinse waters, discharge them through the shop drain to the sewer system. About 30 batteries a week are serviced. Old batteries having no further use are drained and sent to DPDO. The battery shop does not remove plates for metal recovery.

5.2.13.3 Weapons Department. The mission of the Weapons Department is to provide logistical support to the tenant activities and those units assigned to Roosevelt Roads for training. The Weapons Department has been located in Building 378 for 20 years. According to interviewees, no wastes associated with the silver cell batteries used in the MK 30, 37, 44, or 45 torpedoes were disposed of on Roosevelt Roads. The silver cell batteries were returned to Kingsport, Washington (since about 1980), or to Naval Weapons Station Earle (prior to 1980). The batteries were either reworked at these facilities, or scrapped and the silver recovered. Interviewees also stated there were no battery wastes generated or disposed of by any operations associated with the Advanced Underwater Weapons (AUW) Division.

5.2.13.4 Underwater Weapons Support, Atlantic Fleet Weapons Training Facility (AFWTF). The Underwater Weapons Support Facilities at Roosevelt Roads prepare and maintain most of the weapons and ancillary electronic assemblies that are used in the AFWTF ranges. These include MK 46-1/2/5 torpedoes, MK 42-1/2/5 exercise torpedoes, MK 48 torpedoes, MK 84 and MK 72-2 phase coded non-synchronous pingers, and the MK 30-MA and MK 30-Mod 1 Mobile Anti-Submarine Warfare Target (MASWT). Interviewees stated that a small number of nickel-cadmium and alkaline batteries have been disposed of in the station landfill, but that no significant wastes have been associated with these items.

5.2.14 <u>Vehicle Maintenance Shops</u>.

5.2.14.1 Public Works Department. The Transportation Division of the Public Works Department provides maintenance of all vehicles, trucks, bulldozers, and tractors. Operation has been contracted to a civilian contractor for the last year; previously, the Maintenance Division of the Public Works Department had been responsible for all vehicle maintenance.

The Transportation Division is responsible for the maintenance of 850 vehicles. Considerable amounts of waste products are generated by this operation, principally waste oil at the rate of 150 gallons per month. Waste oils are stored in drums and picked up by the Fuels Division to be sold to a private contractor. Cleaning and solvent solutions are reclaimed at the operation site through a filtration system. Filters are cleaned every six months and the residue, about 10 gallons, is mixed with the waste oil for disposal.

In addition to liquid wastes, approximately 20 sets of brake shoes and clutches are replaced monthly. These contain asbestos lining and are sprayed with water prior to removal. The old sets are reclaimed by a private contractor.

The current operation does not include painting of vehicles, which is done off-base. Used tires are generally recapped; others are delivered to DPDO for disposition at the rate of approximately 100 tires per month.

Small equipment and parts make up the balance of waste generation, together with some rags, wire, metal pieces, etc. This material is discarded at the landfill at the rate of 500 pounds per week, or 13 tons per year.

From 1960 to 1973, over 1,000 vehicles were handled by this activity on the average. Waste oil generated for that period was 25% higher than at present, since oil was changed more often than the 6,000-mile interval in practice now. During this period, all waste oil, solvents and brake fluids, and other currently segregated material were taken to the landfill in barrels, where the containers were emptied and returned for future use. Over 2,500 gallons per year of oil and oil derivatives were disposed of at the landfill, plus the balance of material not acceptable to DPDO. This material included 80 asbestos-lined brake shoes a month. Empty cans of paints and solvents were discarded also during this period at the rate of 500 one-gallon cans per year.

5.2.14.2 Naval Mobile Construction Battalion (NMCB). The NMCB is located adjacent to the Public Works Department shops and the dry dock area. Construction of Camp Moscrip was started in 1968 and completed in 1969. Every six months a new battalion arrives at Camp Moscrip to perform operational readiness training to meet contingency commitments; this battalion is also the Atlantic Fleet Alert Battalion. The Alpha Company provides support to Roosevelt Roads through its heavy construction capability. There are approximately 370 pieces of heavy construction equipment maintained by the Alpha Company.

Waste oil generated from the maintenance of construction equipment is temporarily stored in a 500-gallon underground tank, which was installed in the beginning of 1983. When the tank becomes full, usually once every two months, the Fuels Division of the Supply Department is contacted and a commercial waste oil contractor comes and drains the tank. The original design of the waste oil tank was deficient in that the inlet port to the tank was set at too low an elevation, so that when it rained, rain water would enter the tank causing an overflow. There were two incidents in the past where rain water entered the tank, causing it to overflow. On both occasions, the Public Works Department was contacted and the spills were cleaned up using sorbent material. The inlet port has since been modified to prevent any further overflowing of the tank.

Prior to the installation of the 500-gallon tank, waste oil was stored in 55-gallon drums, which were also picked up by a private contractor for disposal. Today, waste oil is occasionally stored in 55-gallon drums when the contractor does not empty the tank in time. When this happens, the drums are used until the tank can be emptied, and are stored in the equipment yard.

The majority of solid wastes generated by the Alpha Company are disposed of through DPDO. Old batteries are collected on pallets in the equipment yard. When the pallet is full (usually 30 to 40 batteries every six months), it is taken to DPDO for disposal. Approximately 50 to 60 old tires and 5,000 pounds of scrap metal are sent to DPDO every six months. Construction debris which is generated at the various sites where the NMCB is working is disposed of at the station landfill.

5.2.15 Fire Fighting Training. The Fire Division of the Air Operations Department provides fire protection and crash rescue response at Roosevelt Roads. The structural fire station, Building 798, was built in the early 1960s and is located on Forrestal Drive. The aircraft crash rescue station, Building 827, is located on the north side of Runway 6 between the 3,000- and 4,000-foot runway markers. This area has been used for fire fighting training since the early 1960s.

Section 8.17 gives the location of the fire fighting area. The old fire fighting training pit was an unlined gravel pit approximately 40 feet in diameter which was used for fire training once per month by two fire crews from the early 1960s through the beginning of 1983. Approximately 250 gallons of waste fuel, oil, and solvents including JP-5, JP-4, and diesel fuel obtained from Hangar 200, VC-8, AIMD, NMCB, Surface Operations, and the Fuels Division were used for each session. The various departments supplying the waste would call beforehand to see if the Fire Division needed the fuel. Wastes received in bowsers were drained directly to the fire training pit, and 55-gallon drums of waste fuel were dumped in 3,000- to 4,000-gallon aboveground storage tanks.

Over the useful life of the old fire training pit, estimated to be about years, approximately 120,000 gallons of contaminated fuels and solvents were burned in the area. Also burned were wood, trash, fuel filter elements, plastic, oily rags, and other debris. The fires were extinguished with water; aqueous fire-fighting foam (AFFF) was used when the fire got out of control. Purple K (potassium bicarbonate) was used in the past but is currently used only once every six months as a maintenance check on the Twin Agent Unit.

The old fire fighting training pit was closed in the beginning of 1983 due to oil washing into the drainage ditch near the airfield. The new fire training pit was built in the same location as the old pit. During construction of the new pit, fire fighters used a temporary, unlined gravel pit for practice. It is estimated that this pit was used five or six times. A total of 3,000 gallons of contaminated fuel, oil, and solvents were burned in this area. When the new facility was finished in late 1983, minor structural deficiencies needed to be corrected before the pit could be used properly. At the time of the IAS visit in January 1984, the new facility was ready for use and the fire training staff had been instructed to discontinue using the temporary pit.

The new fire training pit is concrete lined and is connected to an oil-water separator. A concrete bermed area has been built for the storage of the 3,000-gallon waste fuel tank which will be connected directly to the pit. Before the new pit was constructed a soil sample was taken from the curbed barren soil area where contaminated fuels and spent solvents were burned during past fire fighting exercises. The laboratory report showed no detectable levels of PCB at the site. No other contaminants (e.g., dibenzofurans, TCDD) were tested for, since EPA required the base to test only for PCBs.

5.2.16 Medical and Dental Facilities. Medical and dental facilities are located in Buildings 1790 and 593. These units provide full health care services to all base and Caribbean military personnel.

5.2.16.1 U.S. Naval Hospital. The Naval Hospital opened in November 1973 in Building 1790. The hospital provides general clinical and hospitalization services for active duty Navy and Marine Corps personnel as well as eligible dependents. Acute and long-term cases are sent off base to larger, better equipped hospitals. Solid wastes produced at the hospital are disposed of in plastic bags and sent to the station landfill. Pathological and biohazardous wastes are burned at the permitted hospital incinerator. Laboratory wastes are disposed of through DPDO, with the exception of small amounts which are washed down the drain to the sanitary sewer system. X-ray solutions are processed for silver recovery and then disposed of down the drain to the sanitary sewer system.

The hospital was previously located in "Barracks C," Building 204, from the early 1950s through 1958. It was next located at the present site of the COMNAVFOR, Caribbean, Headquarters Building 598, until the new facility was built. Services offered at these past locations were much more limited; therefore, the types of wastes produced were limited and small in volume. Wastes produced then were disposed of at the station landfill.

5.2.16.2 Dental Facilities. Dental facilities are located at both the hospital and at the U.S. Naval Regional Dental Center. Dental care provided at the hospital includes oral surgery and some routine dental services. Wastes associated with these operations include X-ray fixing solution, developing solution, and scrap amalgam. Spent fixing solution and scrap amalgam are sent to DPDO for metals recovery at a rate of about one gallon per week and eight ounces per year, respectively. Developing solution is poured down the drain at the rate of one gallon per week.

Routine dental services for the entire base are provided at the Naval Regional Dental Center. Similar types of wastes are produced at the center as at the hospital. X-ray fixing solutions are sent to DPDO for silver recovery at a rate of about two gallons per month. Scrap amalgam containing mercury and silver is sent to DPDO at a rate of about one pound per month for metals recovery.

5.2.17 Water Treatment Plants. The base has been served for over 30 years by the present treatment facility. The plant (Building 88) has a capacity of four million gallons per day (mgd). The flow is by gravity into a 45-million gallon raw water storage basin, from which the plant draws its supply at a rate of 1.3 mgd on the average.

Treatment consists of pre-chlorination, coagulation sedimentation, filtration, and post-chlorination. The water is naturally soft with low turbidity requiring a small dosage of chemicals, namely aluminum sulfate for clarification and lime for pH control. Treated water is stored in two clear wells, from which it is pumped into the various storage tanks and the distribution system.

The plant has been in service for over 30 years producing approximately the same amount and type of waste as at present. Water from filter backwash and sludge from the sedimentation tanks comprise the bulk of the waste generated by this operation. One of the four filters is backwashed daily, discharging approximately 20,000 gallons per day into the adjacent lagoon constructed for this purpose and for receiving sludge from the sedimentation basins. The design provides for returning the decanted backwash water to the front of the plant. This feature enables the recovery of approximately one-half of the wash water, for a net waste of some 10,000 gallons per day. Sludge is also discharged into the sludge lagoon at a rate of 150 tons per year of dry sludge. This sludge consists of aluminum sulphate and calcium oxide.

Chlorine gas is delivered in cylinders from an off-base source and used in its entirety.

5.2.18 Specialized Installation Operations.

5.2.18.1 Veterinary Services, U.S. Naval Hospital, Roosevelt Roads. The Veterinary Services Section, commanded by a U.S. Army officer, conducts meat and food inspections at the Navy Exchange and the commissary. The unit offers small and large animal treatment.

For the last three years, approximately 25 dogs or other small animals per month have passed through Veterinary Services prior to disposal in the station landfill. Interviewees at the facility stated that this was a fairly consistent average. The interviewees also estimated that two horses a year die at the stables. These animals are disposed of by the Public Works Department which buries them on stable property in trenches approximately eight deep.

5.2.18.2 Special Warfare Group, Detachment 2, Caribbean. The mission of the Special Warfare Group, Detachment 2, Caribbean (SPECWARGRUTWO) is to provide training scenarios for the neutralization of objects and acquisition of intelligence, performing singly or in small groups. SPECWARGRUTWO has air, sea, and land operating capabilities.

SPECWARGRUTWO was formed in 1976, when all special underwater operations, such as the SEALS, the Naval Inshore Warfare Group, and the Underwater Demolition Teams, were combined under one command. The training activities of the SPECWARGRUTWO include use of diving equipment, which takes place in and around the unit's compound, and the use of small arms, explosive devices, and demolition charges, which takes place on Pineros Island and Dogs Head Island. Some training has occurred on Vieques, Culebra, and St. Thomas in the past, but has been conducted almost exclusively on Pineros and Dogs Head islands for the last 25 years.

Pineros Island was originally intended for use by the British Royal Family if the evacuation of the Royal Fleet and family was necessitated by German advances in World War II. The extensive bunker system built for the evacuees is still present, and is used primarily by bats.

Training activities on Pineros Island include boat-to-shore engagements using 50-caliber machine guns and 40-millimeter cannon, small arms practice on shor (M-79 grenade launchers, light antitank weapon (LAW) rockets, hand grenade M-16 rifles, and 45-caliber pistols), and the use of various demolition devices and explosive charges (bangalore torpedoes, C-4 plastique explosive, detonation cord, TNT, and shaped charges).

The average use of Pineros Island for the past 22 years has been once weekly, with approximately 10 uses of Dogs Head Island in the last four years.

SPECWARGRUTWO personnel blew up the existing buildings on the island for practice, then constructed dummy buildings, which were removed by persons unknown. Until 1980, the majority of demolition work was conducted in the northwest corner of the beach. Following complaints received by the Public Works Department, the blows were reduced from the previous limits of 400 pounds of TNT equivalent for underwater blows and 200 pounds of TNT equivalent on land to 300 and 100 pounds, respectively.

There are no fuels or other materials stored on the island. There are a number of unexploded ordnance items dating back 25 years; since the island is still active, and will remain in use for the forseeable furture, no plans exist for cleaning up these items. While the island is off limits to all but personnel who have obtained approval from AFWTF, which controls use of the area, locals have been seen boating and swimming in the area of Pineros Island.

5.2.18.3 Public Affairs Office. This office publishes a monthly base newspaper, El Navigante. The paper provides base personnel with internal information, command policy, achievements, Navy-wide news, stories and featured articles. Depending on the importance of an issue, the office also acts as liaison in civilian-Navy matters.

Production activity consists of news gathering, page lay-out, and product distribution. No printing is done on-site; an off-base printer is used. As a historical information center, the office resources are limited to the past two years. Material dating prior to this (i.e., copies of "Mira Que Pasa," the predecessor to El Navigante) is discarded if no orders are given to retain it.

5.2.18.4 Navy Exchange Garage and Gas Station Facilities. The Navy Exchange operates two service areas: a garage and gas station facility in the Bundy Area, and a gas station near the base fire department, north of the Industrial Area.

At the Bundy facility, fuel for the station is held in two 12,000-gallon tanks and one 10,000-gallon tank, all of which are underground. The tanks are about 20 years old and have never shown problems of leakage. Routine measurements of tank volumes are conducted each month. The same procedure is performed at the industrial area station, which has three 10,000-gallon underground tanks.

Servicing of private vehicles is performed solely at the Bundy facility, although the industrial area station does have a 600-gallon underground waste-oil tank similar to that at the Bundy facility. These tanks were installed a few years ago. Two hundred vehicles per month are serviced at the Bundy garage. Service activities range from oil changing to complete engine overhaul. Waste oil, including lube oil and transmission oil, is generated at a rate of 75 gallon per month. A private contractor removes the oil for reclaiming. Until recently, waste oil was placed in four to five 55-gallon drums located on a concrete catch basin with six-inch sides. Oil was removed by the Public Works Department for transport to the base disposal area (landfill or waste oil burner). During periods of heavy rain, these drums would overfill and stain the immediate area. Similarly, oil spilled when drums were being filled or removed.

Other material presently discarded from the garage included about 50 batteries (with acid) per month, 50 to 60 tires per week, cardboard, and approximately 200 empty quart oil cans per month. A private contractor removes the batteries and about 10 tires. The remaining tires are disposed of at the base landfill. Radiator fluid is allowed to drain onto the ground. Machinery or resellable parts are turned over to the DPDO.

5.2.18.5 Water Security Patrol (WASP). The Water Security Patrol is under the command of Surface Operations and is responsible for waterfront security. The WASP operation was established in April 1983. Currently, two patrol boats are used. No fuel storage is present on-site. Fueling is done at the fuel pier loading facility. Waste generated from routine maintenance of boats and outboard motors is minimal, consisting of small amounts of oil, solvents, soaps, etc., all of which is disposed of at the base landfill.

5.2.18.6 U.S. Army Reserves - 390 Terminal Transfer Company. The mission of the 390 Terminal Transfer Company is to train reserves on weekends in material handling and transport, and for qualification for various motor vehicle class licenses. Although training in cargo handling is conducted, no cargo is actually handled. However, about one 55-gallon drum of waste oil from vehic maintenance is turned over to DPDO every three months.

5.2.18.7 U.S. Army Reserves - 699 Engineering Company. The mission of the 699 Reserves Engineering Company is to provide port construction training. Four landing craft-type units as well as land vehicles are available to the reserves. Maintenance of the watercraft is handled by Surface Operations. Land vehicle maintenance generates about five gallons of waste oil per month, which is turned over to DPDO.

5.2.18.8 U.S. Navy Courier Service Detachment. The mission of the detachment is to provide transportation and handling of special classified documents in a manner similar to a private service such as Federal Express. Wastes generated from this service are minimal, consisting of general office waste and shredded paper.

5.3 ORDNANCE OPERATIONS.

5.3.1 Torpedo Shop. The Torpedo Shop, operated by AFWTF, is located in Building 395, in which MK 46 and MK 48 torpedoes are prepared and serviced, and in Building 378, in which MK 30 torpedoes are prepared and serviced. The activity prepares two types of MK 46 torpedoes: the dummy configured MK 46-1/2/5 and the MK 46-1/2/5 exercise torpedoes. The MK 46-1/5 torpedo can also be configurated for launching from aircraft.

All ordnance for disposal from the Torpedo Shop is taken by EOD to the Vieques Naval Reservation for proper disposal. Ordnance items include propellants, igniters, carbon dioxide bottles with squibs, explosive bolts, rocket motors ignition separator assemblies (ISAs), and piston motors. About 20 propellan charges and three ISAs have been disposed of in the last three years by EOD on Vieques. Formerly, ISAs were burned off in the office ashtrays. Before 1968, explosives from this activity were disposed of in the landfill or in the ocean. None of the torpedoes prepared by this activity are armed with warheads.

5.3.2 Weapons Department, Naval Station Roosevelt Roads. The Weapons Department has the following functions: (1) to receive, store, maintain, assemble, checkout, inspect, modify, protect, and issue conventional ammunition, torpedoes, and other underwater munitions, specified weapons systems, missiles, technical items, and components; (2) to operate a facility to tranship ordnance materials; (3) to provide support for the on- and off-loading of ammunition and miscellaneous services for foreign and domestic ships; (4) to provide logistic and administrative support regarding ordnance materials for tenant activities and temporary duty units; and (5) to assist in the disposal of munitions and other ordnance items. (See also Section 4.2.1 for a description of Weapons Department activities on Vieques NAS).

The Magazine Field Office (Building 4041 and various storage bunkers) handles the receipt, storage, inspection, maintenance, and issue of munitions used by tenant activities, and the temporary receipt and storage of munitions offloaded by units engaging in exercises at the various AFWTF facilities. Any ordnance items that are excessed, that have an elapsed shelf life, or that fail quality control checks, are turned over to EOD for disposal. Other material, such as pallets, shipping containers, and dunnage, is turned over to DPDO for demilitarization as required, and ultimate disposal.

The Missile Assembly Building (Building 4086) assembles missiles for use on the AFWTF ranges. The missiles are shipped to Roosevelt Roads in reusable metal containers; only "nut-and-bolt" (no first-line) assembly is accomplished. The missiles themselves are expended during range operations, or very occasionally following a failure, turned over to EOD for disposal. The containers are sent back to the munitions plants for reuse. No leaks or spills of fuels have been noted in the past 22 years. The Advanced Underwater Weapons (AUW) Shop receives torpedoes in reusable metal containers. No spills or wastes associated with the OTTO Fuel II used in the weapons was ever noted by interviewees. No other waste has been associated by the interviewees with the AUW operations.

5.4 RADIOLOGICAL OPERATIONS. Radiological operations are limited to the Naval Electronics Engineering Center and the base medical and laboratory facilities.

5.4.1 Naval Electronics Engineering Center. Small radiological sources are located in a closed trailer at the electronics center. The trailer is separated from Building 377, along the northern boundary line of the facility. These sources are used twice a year for calibration of fleet electronic instruments, and are maintained and checked by the Department of Energy. The calibration sources are low-level isotopes.

5.4.2 Medical and Laboratory Services. The X-ray machines used at the Naval Hospital and Naval Regional Dental Center are of the electron-generator type, and therefore no radiological wastes are produced. The hospital laboratory uses small amounts of low-level radioisotopes such as iodine, which has a short half-life. The laboratory is certified to use these materials.

CHAPTER 6. MATERIAL HANDLING: STORAGE AND TRANSPORTATION

6.1 INDUSTRIAL. Material storage is generally a function of the Public Works Department. Since segregation of certain materials classified as hazardous was started in 1973 and fully implemented in 1976, materials such as PCBs, chemicals, oil products, pesticides, etc., have been isolated and monitored for compliance with standing regulations. Public Works as well as the other departments assigned with the responsibility of material storage are discussed in this chapter.

6.1.1 Materials Storage: Defense Property Disposal Office (DPDO). The DPDO located at Roosevelt Roads handles material from all base operations, other DOD facilities throughout the island, and Puerto Rico National Guard units. Materials are transported to DPDO on Navy and Army vehicles, or barged from the outlying islands. DPDO ensures that the materials are correctly packaged against damage or leakage during transport and handling. DPDO storage includes a warehouse facility, fenced lot, and a hazardous and flammable storage locker (Building 2009). Material is placed in the appropriate storage area depending on the material characteristics. All materials are numbered, and movement is controlled by a manifest system.

Material received by DPDO has been designated by the activities turning it in as "excess" or no longer of use, and ranges from office furniture and drained vehicle batteries, to PCB-filled transformers and demilitarized weapons. Materials most commonly received include approximately 1,000 gallons per month of acid, bases, paints, thinners, and sealing compounds, and 10 to 15 55-gallon drums of waste oils. Since DPDO's philosophy is that a hazardous material is not a hazardous waste until a use for it cannot be found, every attempt is made to find uses for such substances (i.e., they are offered to every possible government agency at no charge). If no agency wants the material, DPDO will either sell the material via an auction system, or send the material to private contractors for recovery of precious metals, etc., or for disposal of hazardous materials such as PCB-contaminated oil or non-usable pesticides (e.g., DDT). Generally, all materials are sellable items, and DPDO has not had much difficulty marketing them, including transformers which have less than 50 ppm PCBs. Transformers containing PCBs greater than 50 ppm are handled by an outside contractor.

6.1.2 Supply Storage. Storage of supplies occurs at all levels of base operations, from large warehouses to small shop lockers. The Supply Department has primary responsibility for storing supplies as well as for receiving and distributing materials used and needed by the base.

The Supply Department uses two large warehouses (Buildings 1207 and 27) as well as the storage yards adjacent to both buildings. These areas are used for storage primarily of Public Works Department material. The Public Works Department maintains and operates the cold storage facility at Building 53 and aviation storage at the airfield (Building 20) for the Supply Department. Scattered about the base are many smaller operational storage units containing material needed by the particular industrial operation at that location. These storage facilities usually contain a one-month supply. Storage lockers are also found in various shops in which small quantities of materials are readily availat for immediate use.

In addition to the storage of Public Works and industrial-type material, the Navy Exchange operates three warehouses: Buildings 40, 41, and 42. These warehouses contain wholesale products, consumables, household furnishings, etc., which can be easily distributed to the various commissaries and exchange services.

6.1.3 Chemical and Hazardous Materials Storage. According to Supply Department personnel, chemical and hazardous materials are not stored in large quantities in any one single area, but are moved quickly when received from the Supply Department to the small out-building storages of the industrial operations area. These out-b ilding structures are generally kept separate from industrial operations afety precaution. The materials stored at each structure include flamm iquids, solids, acids and bases, paints, solvents, industrial gases, or whatever is required by a particular operation. The arrangement of how materials are placed within each storage unit varies from well segregated storage practices to avoid reactions, as at DPDO, to a general assemblage of potentially non-compatible materials, as found at AIMD.

The storage structures themselves also vary, ranging from concrete bunker-type structures, to metal sheds with no flooring, to converted Quonset huts such as those found at Gun Storage Area 112.

6.1.4 Petroleum, Oil, Lubricants (POL). The Naval Station Fuels Division pr vides facilities necessary for the receipt, storage, and issue of aviati fuels, lubricants, gasoline, and diesel fuel marine (DFM).

The Fuels Division maintains 22 POL storage tanks located throughout Naval Station Roosevelt Roads. Of these storage tanks, seven contain DFM fuel, two contain MOGAS (regular), one contains MOGAS (unleaded), eight contain JP-5 fuel, and six contain AVGAS. Table 6-1 lists for each storage tank its number, fuel type, capacity, type of construction, and the direction and eventual location of the fuel if a spill were to occur.

Two bladder-type storage tanks containing approximately 50,000 gallons total of JP-5 fuel are currently in use near the airfield. These tanks are bermed and are not subject to periodic flooding or washout. Plans for anticipated long-range use are as yet unclear.

The fuel storage facilities have major connecting supply lines from Pier 1 and Pier 3. At Pier 1 there are fuel line outlets for AVGAS, JP-5, and DFM; and at Pier 3, for diesel fuel, JP-5 fuel, MOGAS, and AVGAS. Pier 1 is the primary fuel receiving point for the station, while fueling of vessels is accomplished at Pier 3. AVGAS and JP fuels are pumped directly into their respective storage tanks. The JP fuel is pumped from Tank 429 to the high-speed refueling hydrants on the north side of the flight line, where aircraft are refueled. AVGAS is supplied to aircraft by refueler vehicles.

All buried metallic storage tanks and transfer lines are cathodically protected. Public Works personnel monitor cathodic readings monthly. Fuels Divisi personnel are responsible for routine pressure checks, tank soundings, a

Table 6-1

FUEL STORAGE TANKS AT
NAVAL STATION ROOSEVELT ROADS

Facility	Type of Fuel*	Exact Volume (Bbls)	Type of Construction	Probable Direction of Flow of Spill
Tank 56A	DFM	227	Underground, steel-welded, horizontal	Southwest to harbor via storm drainage
Tank 56B	DFM	227	Underground, steel-welded, horizontal	Southwest to harbor via storm drainage
Tank 82	DFM	50,364	Pre-stressed concrete	South/southwest to retaining wall and controlled drainage
Tank 83	DFM	27,552	Pre-stressed concrete	South/southwest to retaining wall and controlled drainage
Tank 84	JP-5	13,920	Underground, steel-welded, vertical	Southwest to retaining wall and controlled drainage
Tank 85	JP-5	27,433	Underground, steel-welded, vertical	Southwest to retaining wall and controlled drainage
Tank 105	Unleaded MOGAS	121	Underground, steel-welded, horizontal	Southwest to retaining wall and controlled drainage
Tank 210	MOGAS	---	No longer in service	
Tank 211	MOGAS	---	No longer in service	
Tank 212	AVGAS	1,127	Concrete, latex-lined, vertical	Northeast to mangrove swamps
Tank 213	AVGAS	1,127	Concrete, latex-lined, vertical	Northeast to mangrove swamps
Tank 214	AVGAS	5,783	Concrete, latex-lined, vertical	Northeast to mangrove swamps
Tank 215	AVGAS	5,783	Concrete, latex-lined, vertical	Northeast to mangrove swamps
Tank 216	AVGAS	5,775	Concrete, latex-lined, vertical	Northeast to mangrove swamps

Table 6-1 (Cont.)

Facility	Type of Fuel*	Exact Volume (Bbls)	Type of Construction	Probable Direction of Flow of Spill
Tank 217	AVGAS	5,807	Concrete, latex-lined, vertical	Northeast to mangrove swamps
Tank 381	JP-5	27,373	Underground, steel-welded, vertical	Northeast to mangrove swamps via drainage system
Tank 429	JP-5	4,743	Underground, steel-welded, vertical	To mangroves via drainage ditches
Tank 470	MOGAS, regular	595	Underground, steel-welded, horizontal	Southwest to retaining wall and controlled drainage
Tank 471	MOGAS, regular	595	Underground, steel-welded, horizontal	Southwest to retaining wall and controlled drainage
Tank 1080	DFM	27,078	Underground, steel-welded, vertical	South/southwest to retaining wall and controlled drainage
Tank 1082	DFM	27,067	Underground, steel-welded, vertical	South/southwest to retaining wall and controlled drainage
Tank 1084	JP-5	27,404	Underground, steel-welded, vertical	Northeast to mangrove swamps via drainage system
Tank 1086	JP-5	27,404	Underground, steel-welded, vertical	Northeast to mangrove swamps via drainage system
Tank 1088	JP-5	9,751	Underground, steel-welded, vertical	Southwest to harbor
Tank 1995	JP-5	100,000	Aboveground, steel-welded	Northeast to mangrove swamps via drainage system
Tank 1996	DFM	100,000	Aboveground, steel-welded	Northeast to mangrove swamps via drainage system

*Key:

DFM = Diesel fuel marine
JP-5 = Jet propulsion aviation fuel
MOGAS = Motor gasoline, both regular and unleaded
AVGAS = Leaded aviation gasoline

system preventive maintenance. A Facilities Control Inspection of all fuel storage and transfer systems is conducted by Public Works personnel annually.

Bilge and ballast wastewater in vessels nested or anchored at Roosevelt Roads is collected and treated by the oil waste collection and treatment system. This system consists of a waste oil raft (donut); two Ships Waste Offload Barges (SWOBs), 75,000-gallon capacity each; and a special skid-mounted oily waste, waste oil, and water handling unit, known as the Donut Servicing Sub-system (DSS) on-shore.

The oil spill removal system is used for cleaning oil spills in the harbor. This system comprises floating oil containment booms, oil skimmers, and support equipment to contain and remove an oil spill. The oil and water mixture removed by the skimmer may be temporarily stored or treated before final disposal.

The majority of oil spills which have occurred at the station are transportation related. However, non-transportation spills occur. In 1976 three spills occurred at Pier 3 as the result of leaks in fuel lines and transfer lines. It is estimated that 4,000 gallons of diesel fuel and an unknown amount of JP-5 fuel escaped into the harbor.

Tanks 84 and 381 overflowed in 1977. Approximately 200 gallons of JP-5 fuel were lost at Tank 84 and over 5,000 gallons of JP-5 fuel at Tank 381. In both instances it was reported that the vast majority of the fuel either evaporated or was cleaned up, and that no long-term damage has resulted to the environment.

6.1.5 Pesticide Storage. Pesticides are stored in two locations at Roosevelt Roads. Table 6-2 lists the pesticides, herbicides, and rat poisons currently stored in the new Pest Control Shop. The facility provides separate storage space for pesticides and herbicides. Building 121 is an EPA-permitted hazardous waste storage facility which is used for the storage of outdated pesticides. Table 6-3 contains an inventory of pesticides which were in storage in Building 121 when the 1980 Pest Management Plan was prepared. In 1981 the DDT listed in Table 6-3 was overpacked in 74 85-gallon drums which included DDT from Fort Buchanan and San Juan, and shipped to Fort Gillem, Georgia, for proper disposal. Pest Control personnel interviewed were unaware of the exact quantities and types of pesticides currently stored in Building 121; from the appearance of the building it is possible that pesticides remain there undisturbed since 1981.

Prior to the opening of the new Pest Control Shop in 1983, pesticides were stored in Building 258, a 1,150-square foot Quonset hut. The building did not provide adequate storage space, and pesticide containers were often stored outside the building. The 1977 Environmental Engineering Survey prepared by Atlantic Division, Naval Facilities Engineering Command (LANTNAVFACENGCOM), stated that drums of waste and unidentified pesticides were being stored on the parking apron at the Pest Control Shop. It further stated that most of the drums had rusted to the point where they were ready to collapse. These drums were later moved to Building 121, and are awaiting disposal by DPDO. Former Pest Control Shop employees remember incidental spillage of pesticides in and around Building 258. An incident occurred in 1976 when a 55-gallon drum of malathion, which was stored outside the building, ruptured and the contents

Table 6-2

PESTICIDES INVENTORY FOR ROOSEVELT ROADS

Common Chemical Name	Percent Active Ingredient
Pesticides	
Baygon	7.0
Baygon	2.0
Baygon	1.0
Baygon 1.5	1.5
Chlordane	72.0
Diazinon 4E	47.0
Diazinon	48.0
Malathion	95.0
Pyrethrum	1.4
Pyrethrum 10-8	1.4
Pyrethrum Buto Bip	1.0
Pyrethrum ULD BP-300	3.0
Wasp and Hornet	
10.0 Prex	
20.0 PB	
0.5 Bay	
Vapona	20.0
ULV Flushing Solution 5.1	NA
Pentachlorphenol	5.0
Dursban 4E	92.0
Bird Repellent	48.0
Paradichlorobenzene	100.0
Wasp-B-Gone	85.0
Snail and Slug	2.75
Herbicides	
Bromacil	80.0
Diuron	80.0
Diquat	35.3
Karmex	80.0
Hyvar X	80.0
Spreader sticker	NA
Glyphosate (Round-up)	41.0
Pramitol	25.0
Rat Poisons	
Warfarin	0.025
Diphacinoe	0.005
Stiktite Rodent Glue	NA

Source: Pest Control Shop, Naval Station Roosevelt Roads, 5 January 1984.

Table 6-3

PESTICIDES IN STORAGE AT BUILDING 121*

Common Chemical Name	Date Declared Excess	Quantity (lb or gal)	Container Condition
Paris Green	20 June 78	25 lb	Good
Malathion	20 June 78	300 lb	Good
DMAG	20 June 78	45 lb	Good
DDT	20 June 78	600 lb	Good
DDT	20 June 78	380 gal	Good
Maldane	20 June 78	15 gal	Good

*Prior to disposal at Fort Gillem, Georgia, the DDT had been stored in Building 121. All other pesticides are still in storage awaiting disposal.

Source: Table is taken directly from the 1980 Pest Management Plan, Naval Station Roosevelt Roads.

spilled on the ground, eventually washing into the drainage ditch in back the shop.

6.1.6 PCB Storage. PCB-contaminated transformer fluids and transformers have been stored at the pole yard storage area, located approximately 150 feet north of Building 42, since 1975. The yard is an EPA-permitted hazardous waste storage facility. Some of the transformers and 55-gallon drums of PCB-contaminated material are stored on concrete pads, while the majority are stored on the ground in a fenced yard.

In the past, five-gallon cans of PCB transformer fluid by the trade name Askarel were stored at Substation 2 (Building 90) and the Public Works storage yard (Building 31). In 1968, the Public Works Power Distribution Shop disposed of approximately 65 five-gallon cans of Askarel, 40 of which were disposed of at the station landfill and 25 at the dry dock wharf. The cans had been stored at Building 31 and were in a rusted condition at the time of the disposal.

PCB-contaminated material is also stored at the old Power Plant, Building 38. A contractor was hired in June 1982 to drain the two transformers located in the building. This resulted in 18 55-gallon drums of PCB-contaminated transformer fluid and two 55-gallon drums of PCB-contaminated solids.

6.1.7 Storage Lots and Scrap Yards. Large storage lots and scrap yards are found around the Public Works Transportation Division, Supply Department, Camp Moscrip, the DPDO facility, and the dry dock area. For the most part the storage lots at the Public Works Transportation Division and Supply Departme contain vehicles and construction-type equipment. The same is true at the Naval Mobile Construction Battalion (NMCB), which also stores other types of materials including fuels, oils, and construction chemicals.

Other Public Works storage yards include open storage area 112 and the pole yard storage area located adjacent to Navy Exchange Warehouse 42. Materials stored at open storage area 112 in Quonset huts 249 and 250 include unused and spent construction chemicals, lubricants, industrial gases, and flammable/hazardous materials. Around the yard and along the fence perimeter, there is evidence of old and recent spillage. At the pole yard, electrical distribution equipment is stored, including telephone poles, transformers, and condensors. There is evidence of periodic spillage of transformer oil, some of which contains PCB.

At the DPDO facility, the storage yard is used for the display of marketable material. This material includes vehicles, large equipment of various uses, scrap metal, etc. The paint and flammable storage building is located within the yard boundary. This storage unit is well organized and maintained.

In the vicinity of the dry dock, materials have been scrapped in and around Building 145 (Site 11) and Building 25 (Site 10), now collapsed. Materials found include office furniture, 55-gallon drums with varying contents, asbestos, and construction rubble.

There is one fenced storage yard located around Building 28. Across the road from Building 28 another larger fenced yard is located. These yards are operated by Base Security and primarily contain confiscated vehicles. However, at the larger yard, other materials such as tires and drummed waste oils are also stored. The waste oil is used by local fire departments for training.

6.1.8 Materials and Waste Transportation. Both military operations and private contractors handle station material and transport wastes within and from station property. Incoming materials are received by the Supply Department and then distributed to the proper recipients by military vehicles. The majority of station wastes are collected and transported by private contractors. Private contractors are selected by a bidding system.

All garbage and domestic wastes as well as commercial and industrial refuse, up to a certain size, are collected by a private firm. For the most part, these wastes are disposed of at the base landfill, which is also operated by a private contractor. Wastes which are recoverable or resalable and oversized waste are collected by the Transportation Division and by various Public Works shops. Recoverable wastes such as waste oil, dirtied fuels, batteries, tires, and scrap metals are all handled by private contractors. Resalable wastes are transported by military vehicle to DPDO. The DPDO at Roosevelt Roads receives designated waste from all Puerto Rico Naval activities.

6.1.9 Nuclear Biological Chemical (NBC) Decontamination Agents Storage. NBC decontamination agents stored at Roosevelt Roads have included Super Tropical Bleach (STB) and Decontaminating Solution Two (DS-2). STB is used for decontamination of equipment and material contaminated with "mustard gas" (Lewisite, H, HD, HN, or HT), and for decontamination of certain types of contact or liquid nerve agents. STB is comprised of chlorinated lime and calcium oxide, yielding 30% available chlorine, and is commonly mixed with water to form a solution or slurry, depending on its intended use. STB can also be used in a dry form in a shuffle pit, or to create a path through a contaminated area. STB is commonly stored and shipped in eight-gallon steel cans containing 50 pounds of agent.

DS-2 is a liquid used for decontaminating materials contaminated with nerve agents (GA, GB, GD, or V, or their equivalents) and mustard gas. It consists of 70% active agent (diethylene tri-amine), 20% solvent (ethylene glycol monoethyl ether), and 2% booster (sodium hydroxide). DS-2 is shipped and stored in 1-1/3 quart and five-gallon cans. It is used by spraying DS-2 over the contaminated object, usually using a special hand-held sprayer charged with a carbon dioxide cylinder. DS-2 is flammable. A third less commonly used decontaminate, DANC, is comprised of a classified material (RH195) dissolved in acetylene tetrachloride. RH195 is shipped in small cans that attach to the three-gallon can of solvent for use against mustard gas and persistent nerve agents.

At Roosevelt Roads, the Public Works Department was given primary responsibility for storing decontamination agents. In 1976, the Public Works Department was directed to dispose of, by shipping to the United States, several thousand pounds each of DS-2 and STB which had elapsed shelf life, were improperly stored, and were rusting through, creating the strong possibility of a violent reaction by mixing. The materials remained stored in Building 1788 until 1980, when NAVSEA personnel determined the items were too badly decomposed to ship stateside. Accordingly, the DS-2 was trucked and barged to Vieques, where a day-long, EOD-supervised burn destroyed an estimated 1,500 gallons of DS-2.

Three hundred 55-gallon cans (1,750 gallons) had been stored in Warehouse 1; the 250-gallon discrepancy in stored versus burned DS-2 is not considered significant.

No records exist of the disposal of the 3,550 pounds of STB. Interviewees stated that it was generally assumed the material had been disposed of in the station landfill.

No records exist of the presence or disposal of any DANC decontaminating agent.

6.2 ORDNANCE. Ordnance storage and transportation is handled by the Weapons Department on Roosevelt Roads. Many of the munitions used are shipped in re-useable metal containers, which are returned to the production center. Dunnage and pallets used in munitions shipping are turned over to DPDO, while any ordnance items or waste for disposal have always been turned over to EOD (see Sections 4.3.1 and 5.3.2) and stored in magazines at NAF.

6.3 RADIOLOGICAL. The handling, storage, and transportation of radiological materials are limited to medical and electronic calibration facilities. The X-ray units at the hospital and dental clinic are of the electron-generator type, and therefore no radioactive wastes are produced. The X-ray machines are maintained by trained and certified technicians. Low-level radioisotopes such as iodine, which has a short half-life, are used in the Naval Hospital laboratory, which is certified to use and dispose of these materials. The radiological calibration source stored at the Naval Electronics Engineering Center is checked and maintained by representatives of the Department of Energy. On' trained personnel have the authority to use the radiological standards dur calibration operations, which occur twice a year.

6.4 CHLORINE STORAGE AND DISPOSAL. Twenty-one compressed gas cylinders (J type) containing chlorine were stored in Building 87 until 1982, when EPA Region 2 granted a one-time deep ocean disposal permit. The cylinders were jettisoned into a 1,200-foot deep area of the Atlantic Ocean.

CHAPTER 7. WASTE PROCESSING

7.1 INDUSTRIAL. The Public Works Department generates and processes most of the wastes classified as industrial. Some military operations also produce wastes which are processed prior to disposal. All processing operations pertinent to this study are discussed in the following subsections.

7.1.1 Wastewater System. The present wastewater system provides for separate storm and sanitary sewage systems. The storm sewer system consists of catch basins, a piping network, and natural and man-made open canals and ditches which discharge to the coastal waters. The sanitary sewer system comprises a network of gravity sewers and 17 pump stations. The entire flow of wastewater from the base, including ship-generated sewage, is processed through three treatment plants which provide secondary treatment prior to discharge to the ocean through short submarine outfalls.

Until 1973 there were some 40 septic tanks in service, varying in size from 500 to 4,000 gallons. Since that time an active septic tank elimination program has reduced the number to 10, most of which are too distant for connection to the sanitary system. As an example, the old Pest Control Shop (Building 258) was serviced until recently by a 500-gallon septic tank, which is suspected of having received pesticide waste while the old Pest Control Shop was active.

7.1.1.1 Capehart Area Wastewater Plant. The wastewater plant (Building 1691) serving the Capehart housing area has a total capacity of 0.46 million gallons per day (mgd) divided into two parallel units, one having a 0.30-mgd capacity, the other a 0.16-mgd capacity. Both units are similar extended aeration plants. Chlorinated effluent is discharged to the adjacent coastal waters through a submarine outfall.

The plant provides secondary treatment generally meeting EPA National Pollutant Discharge Elimination System (NPDES) standards. Digested sludge is dewatered in two drying beds and hauled periodically to the landfill. Sludge generation is estimated at 70 tons per year (10% moisture).

7.1.1.2 Bundy Area Wastewater Plant. With a capacity of 0.655 mgd, this plant (Building 1757) uses the trickling filter process with anaerobic digestion of sludge.

The plant provides secondary treatment consistently meeting NPDES standards. Plant effluent is chlorinated prior to final discharge to the ocean through an underwater outfall line.

Sludge production is estimated at 6.5 tons per year of anaerobically digested sludge (90% solids), which is dewatered in sludge drying beds and occasionally disposed of at the site, with most sludge going to the sanitary landfill (Site 7).

7.1.0 Industrial Area Wastewater Plant. This plant (Building 1758) has a capacity of 0.937 mgd using the trickling filter system with anaerobic digestion. It serves the southeastern section of the base, including the

Public Works Complex, and has received all ship-generated sewage since 1980. Little, if any, wastewater other than domestic sewage is processed here.

Sludge dewatering is accomplished in the sludge drying beds, and is delivered to the adjacent landfill at a rate of 60 tons per year (dry sludge).

Chlorinated secondary treated sewage meeting local water quality standards is discharged to the adjacent coastal waters through a 14-inch submarine outfall line.

7.1.3 Waste Fuel and Solvent Processing. This function was accomplished by the so-called "thermo-digester" located adjacent to the landfill entrance, near the Transportation Division of the Public Works Department. The present unit, installed in 1982, is a Vent-O-Matic incinerator which has not yet been placed in service as it is pending confirmation of stack emission tests meeting local air pollution regulations. The previous plant, installed in 1973 and dismantled in 1982, was used to burn classified material, contaminated diesel oil, JP-5 fuel usually mixed with some lube oil, solvents, and sludge residue. Contaminated fuel was brought two to three times a week to a fixed tank truck adjacent to the incinerator. During this period, it is estimated that 600 gallons of oil per week were processed through this plant.

Cleaning and solvent solutions used by the Transportation Division are reclaimed through a filtering system. Filters are reusable after periodic cleaning. Residue from filters is mixed with waste oil for disposal off-base.

7.1.4 Incinerators. Currently there is one incinerator at the station. Located at the hospital (Building 1790) it is a package incinerator with burners located in the main chamber at the base of the stack. The unit operates in compliance with all Commonwealth of Puerto Rico air pollution regulations. It is used exclusively to burn pathological waste generated by the hospital.

7.1.5 Garbage Cooker. This plant (Building 1936) boils foreign garbage from incoming ships prior to disposal into the adjacent landfill. A York-Shipley boiler generates steam at 90 pounds per square inch (psi) pressure and boils the water for a minimum of two hours in the specially constructed garbage containers.

Operation is intermittent in that garbage is cooked as it is received, but averages 1,200 pounds of wet garbage per day. A 1,000-gallon underground storage tank supplies DFM to the boiler, which burns 500 gallons of fuel per month.

This operation was started in 1972. An interview with the former caretaker (1972-1982) indicated that the present operation is at the same level as previously, when five containers (four cubic yards) of garbage per day were processed.

7.2 ORDNANCE.

7.2.1 Ordnance Incinerations: OTTO Fuel II. From 1966 to 1968, the Weapon Support Department of AFWTF disposed of OTTO Fuel II and Agentine solvent by burning in the station landfill. The OTTO Fuel II burned was left over from a torpedo run, and was usually contaminated with saltwater. Table 7-1 presents the components of OTTO Fuel II. Agentine, a dry cleaning solvent, was used to wash down the torpedoes after a practice run. In addition to the OTTO Fuel II and Agentine, various rags and items of protective clothing (shirts, coveralls, booties, pants, aprons) contaminated with OTTO Fuel II were also disposed of by burning at the dump. An estimated maximum of three barrels per month of fuel, Agentine, and contaminated materials were poured into holes in the landfill and burned. Wood was used to maintain the combustion.

Typically, the waste consisted of very small amounts of OTTO Fuel II, and larger amounts of solid waste and Agentine. Since cleanup of a torpedo after a run would generate approximately one cup of OTTO Fuel II and five gallons of Agentine wash, it can be concluded that the greatest amount of material was Agentine. Estimates of the total amount of material burned vary. Interviewees stated that fuel burning was conducted from 1966 to 1968, for a total of 72 drums; other interviewees stated that the first year's burning was very low (no more than four drums per quarter), and that only eight to 10 drums of waste were ever burned at the landfill. The IAS team assumed that a reasonable estimate would be approximately 50 drums of OTTO Fuel II and Agentine burned at the landfill.

All explosives (propellants, carbon dioxide bottles with squibs, explosive bolts, ignition separator assemblies (ISAs), rocket motors, and piston motors) were either burned off in ashtrays (ISAs), or more commonly, sent to EOD for disposal.

7.2.2 Explosive Ordnance Disposal (EOD) Operations. The disposal of ordnance related wastes is handled by the EOD detachment, which is responsible for the disposal of all malfunctioning ordnance from AFWTF-related activities, the disposal of any ordnance discovered below the high-tide mark, and the disposal of ordnance and ordnance wastes generated by the operations of the Weapons Department.

There are no known EOD ranges on Roosevelt Roads proper. Various EOD and other demolition activities have been carried out on, and in the waters around, the islands of Piñeros, St. Thomas, and Culebra. The property upon which these activities occurred has been excessed and lies outside the scope of this IAS, or is still in active use (Pineros) and is regulated.

The majority of EOD operations have occurred on Vieques. Several ranges have been used. Extensive retrograde disposal operations (blows) were conducted in the Eastern Maneuver Area (EMA). This area is still in active use as a target area. EPA has granted an interim status RCRA permit for thermal treatment of ordnance waste in this area.

The primary disposal area was located on the west end of Vieques, on NAF property, generally within one-half mile of the bridge (now gone) at Punta Boca Quebrada. The range had a 40,000-pound explosive limit. In 1976 three youngsters entered the area without authorization, and unknowingly used a photoflash cartridge as a windbreak for the fire they started. The resulting detonation injured all three. The range was swept by EOD shortly after, cleaning up an area in a one-half-mile radius around the site. Use of the range was stopped.

Table 7-1

OTTO FUEL II COMPONENTS

Composition
ene-glycal di-
22.5% dibutyl sebacate
1.5% nitrodiphenylamine
By-Products
Carbon monoxide
Carbon dioxide
Hydrogen cyanide
Methane
Hydrogen

The range was swept again, at least twice until 1979, when it was abandoned. The old range had been in use since at least 1969, and it probably had been in use since the 1940s.

Material disposed of at the site included eight-inch rounds which were fired from the peninsula where the lighthouse was located into the Surface Impact Area (SIA) in the EMA over Cerro Matías, the location of the Observation Post. 175-millimeter munition was fired from Punta Cerejo into the SIA, and duds were disposed of by EOD; 105 and 106-millimeter munitions were also fired into the area and disposed of by EOD (see also Section 4.2.1).

Currently, the EOD range on Vieques has a 3,000-pound explosive limit (7,000 pounds of bombs, with a 0.4 explosive equivalent multiplier). "Off-spec" and old munitions are disposed of here. Such munitions are generated when the munitions on base are subjected to and fail the three-year quality assurance field testing at Roosevelt Roads, or when entire manufactured lots of ammunition are declared excess or determined to have exceeded the useful shelf life. Excess munitions from ship off-loadings or the return of units are also disposed of. Munitions from Roosevelt Roads are trucked to the LST loading ramp, barged to Vieques, stored awaiting disposal, and then trucked to the range for thermal treatment.

AFWTF monitors operations on the range, and grants approval for blows.

Munition wastes are also generated on Vieques. Twice yearly (usually December/January and June/July), the AFWTF ranges are closed for target refurbishing. Before work crews enter the area, EOD teams sweep the range roads, the landing beaches, the transit and target access roads, and a 100-foot circle around each target. The sweep is a surface visual sweep only; bore hole magnetometers or mine detectors are not used. Each ordnance item found is uncovered to the point that a positive identification can be made. The area around the item is cleared for a counter charge, and the object blown in place. Very few "render safe" procedures are used. Some special effects explosives are employed to cut munitions in a limited "render safe" procedure. Following the clearing of the targets, EOD personnel will enter the outlying areas and practice "render safe" procedures on the munitions found as part of their training.

Underwater detonations were commonplace at one time when waterborne targets were used by AFWTF. However, in 1979, an agreement was reached with the Commonwealth in which water targets were no longer used; no "water shots" were initiated by EOD after this. If munitions are found in shallow water at the landing beaches where they might endanger the Marines practicing landings, EOD personnel will blow the item in place.

Items primarily found during the target refurbish sweeps are flares and cartridge-activated devices. Three shots occurred in January 1984 during the sweeps; none occurred in June and July 1983. Other disposal operations result from Naval Air Reserve Unit (NARU) visits and activities. In January 1983, 5,000 pounds of smokeless powder were burned on a pad at the NAF. The powder came from semi-fixed rounds stored on Vieques that were reworked by NARU in July, August, and September 1982.

The EOD was responsible for the burning of 1,500 gallons of DS-2 decontaminating agent. Material was stored in rusted containers on top of STB container creating a fire hazard. The material was ordered disposed in 1976 by returning it stateside. In 1980 the material had not been moved, and was determined to be too unsafe to move stateside. The DS-2 was barged to Vieques and burned at the new range in a day-long burn supervised by EOD and the Roosevelt Roads Fire Chief.

EOD personnel also assisted in clearing the demolition range, pistol range, machine gun range, combat range, and hand grenade range. These ranges were severely overgrown; to refurbish them, 10,000 gallons of diesel fuel were applied and the areas burned.

7.3 OUTLYING FACILITIES.

7.3.1 Crown Mountain, St. Thomas. The Crown Mountain site has been in its present location since 1975. Prior to that date, the functions of the complex were performed at a site roughly 100 yards to the east, but one-half mile by road, of the present site, on a slightly higher portion of Crown Mountain, now occupied by the Virgin Islands television station. The Crown Mountain complex retains a tower, trailer, and standby generator for communication services. A septic tank has been in use at the "old site" since 1978; no problems have been noticed with either the septic system or the fuel storage for the generator, other than very slight leaks during filling.

The new site was first occupied in 1975. Various structures on the site were erected in 1976, 1977, 1978, and 1983, with the microwave tower erected in August of 1983. (The ITCS tracker for the towers is focused on Pico del Este and is part of the AFWTF surface vessel and aircraft tracking system.)

Waste generating activities at both the old and new sites have been extremely limited. Both areas have generators for ancillary power in the event of a malfunction of the VIWPA; such occurrences, while not common, would have a disastrous effect on the operations of the facility. The old site shows evidence of some spills from refueling the 1,000-gallon diesel tank, but no major events had been noticed by the interviewees in over 21 years.

At the present site, the 5,000-gallon underground diesel tank is checked on a fairly continual basis. Only one leak has been noted, when a six-inch fuel line was crushed by the construction of soundproof walls in the exhaust room attached to the generator building. Approximately 100 gallons of fuel leaked to the ground; no cleanup was attempted. Some very small areas of stressed vegetation remain in the immediate vicinity of the building.

Oil for the generators is changed on an irregular basis. Samples of the oil are sent out for spectrum analysis, and the oil is changed according to the results. This has happened two or three times since 1979; approximately 50 gallons of oil were changed, with the VIWPA claiming the used oil. VIWPA also reclaims oil from the two on-site vehicles through the civilian dealer that conducts all vehicular maintenance.

Water is trucked to the site to supplement water catchments, cisterns, and individually procured water supplies. All sanitary wastes are handled through a septic system, or the new minimum energy self-digesting "Cyclette" system, which suffers from lack of load. With a capacity of 240 flushes per day, the "Cyclette" system is underused.

Solid waste is transported to the VIWPA landfill at Bahonney, a one- to one and one-half hour drive away. Trash is stored in the exhaust room, which serves to keep pests down, then hauled by facility vehicle to the landfill. The vast majority of the load is paper trash and brown bag lunch remnants; no significant wastes are generated.

7.3.2 St. Georges Hill, St. Croix. Wastes generated at the St. Georges Hill facility in the past include oil from the on-site generator. The oil is changed after every 350 hours of operation of the generator. Ten gallons of oil are changed every two or three months, depending on the number of hours the generator is run to provide electricity to the EWR TPS and communication devices. The oil was formerly burned or dumped; it is now reclaimed by the VIWPA. The generator has a 500-gallon day tank and a 4,000-gallon underground diesel storage tank. A spill from the day tank occurred in 1980 or 1981 as the result of overfilling; the diesel soaked into the ground and was never cleaned up. A stain can be seen today.

Other chemicals used at the facility include alcohol, Agentine, and trichloroethylene. These solvents are used for cleaning electronics. Only small amounts (five-gallon cans and spray cans) are used; the empty cans are disposed of in trash cans on the facility.

The St. Georges Hill facility burned all solid waste in open cans from at least 1968 to 1980, when the practice was halted. Some carbonless paper, possibly the PCB containing type, was burned in these drums. Currently, the solid trash is handled by the VIWPA. Facility workers carry the approximately seven cans a month to the island's solid waste facility. More solid waste may be generated during construction activities; VIWPA also disposes of this material.

One "dry" transformer, owned by the Navy, is located at the facility. The VIWPA has three "wet" transformers; it is not known if these transformers contain PCBs. Any batteries that require servicing are sent to the Underwater Tracking Range (UTR).

Water is trucked in or brought in by individual workers; a cistern is present at the facility. Sanitary wastes are handled by a septic tank, which has not been cleaned in the 12 years it has been in operation. There has never been an overflow or backfill problem associated with the system.

All vegetation control is accomplished by hand cutting; pesticide usage is limited to spray cans.

The activities at St. Georges Hill generate little if any waste; no potential pollution problems exist.

7.3.3 Underwater Tracking Range (UTR), St. Croix. At the UTR, the mission such that little hazardous waste, if any, has been generated at the si There are no transformers on site; no ordnance materials; no torpedo storag refitting, or refueling; and only two 200-KW generators. Some sonar bu refurnishing occurred in the past, in which small amounts of paints and solve were used. There are two (a 5,000-gallon and 2,500-gallon) diesel tanks, a some 55-gallon drums of POL. Leaks from the diesel tanks and drums ha stained the soil in places and have migrated off the fenced portion of the si down a small bluff and possibly into the sea. No adverse impacts have be noted, and plans have been drawn up to mitigate this situation by berming.

The photographic laboratory processes, on the average, less than 1,000 blac and white photos per year, and fewer than 200 36-shot rolls of color slides The processing chemicals total about 30 gallons for each of the 15 to 2 tracking exercises per year. The bleach used in processing is neutralized an allowed to sit for one hour; then it and the other processing chemicals ar dumped down the sink. A five-foot hose runs from the sink to the ground belo the photographic laboratory trailer, where it is allowed to splash on th ground. The only noticeable effect is a three-foot circle devoid of vegetatio at the splash point. The vegetation appears to have been killed by th puddling of the neutralized chemicals.

All used oil is given to the VIWPA.

In the past, pesticides provided by Naval Station Roosevelt Roads were use weed control around the fence line. The material was locally known as 1," and was used from 1966 to 1970. After that, the vegetation was controlled by hand cutting or by spraying with diesel fuel.

For some years, from about 1966 to 1972, a small pit (10 feet by five feet) was used for the disposal of trash and garbage generated by the facility. The material was primarily paper, the remains of brown bag lunches, and other garbage. The material was also disposed of by dropping it into the sea. The pit was near Building 201; no evidence of it remains today and no effects are apparent. Since 1972 all such material is picked up by the VIWPA and disposed of. Until 1974 solid wastes were pushed into the sea by VIWPA at the St. Croix dump, just east of the Alexander Hamilton Airport. Wave action on the dump polluted the coastal waters with dissolved and floating materials. Partial burning on the dump led to periods of intense air pollution over the airport. In early 1974 the Virgin Islands Government closed the old dump and began a sanitary landfill operation on nearby land. Meanwhile, the old dump remains a source of water pollution from leaching of the exposed trash. There also exists a danger that the old dump deposits might be dispersed by waves from a tropical storm. The amount of material contributed by Navy activities is minimal.

7.3.4 Observation Post (OP), Culebra. The contractor-operated facility has one person manning the three generators, whose primary responsibility is changing over the generators and refueling them as necessary. There is a 3,500-gallon and a 1,300-gallon diesel fuel tank, with a 1,100-gallon gasoline-filled "water buffalo." Some small spills have occurred, the most recent a 25-gallon spill. No cleanup was attempted. Oil from the generato is collected as it is changed and then trucked and barged to Roosevelt Roa when a sufficient quantity has been collected. The refueling of the diesel tanks is by a 1,500-gallon tank, once monthly, as needed, from Roosevelt Roads; no one could remember the last waste oil shipment.

Some rags, paper, and other waste is open-air burned in 55-gallon drums; usually a burn takes 10 minutes once a week.

7.3.5 Pico del Este. Solid waste generated at the site is placed in a dumpster which is picked up by a private contractor and disposed of at the Roosevelt Roads station landfill. Sewage treatment is provided by two 1,000-gallon septic tanks which are cleaned and maintained on a regular basis by the Public Works Department. Electric power is provided commercially by the Puerto Rico Electric Power Authority (PREPA), with backup power provided by four emergency generators. Diesel fuel for the generators is stored in an aboveground 1,000-gallon tank, an inground 3,000-gallon tank, and a 500-gallon day tank. The aboveground 1,000-gallon diesel fuel tank, which is located behind the generator building and adjacent to the NJS, has leaked in the past, resulting in stressed vegetation and black oil stains in the vicinity of the tank. The exterior surface of the tank is blistered, and for this reason, has been scheduled for replacement.

An incinerator is used for the destruction of classified material.

7.3.6 NAVSTA Roosevelt Roads, West Annex, Aguadilla. NAVSTA Roosevelt Roads currently owns 11 buildings at the former Ramey Air Force Base in Punta Borinquen. The Navy acquired the buildings in 1973 when the U.S. Air Force excessed Ramey. Two of the buildings (Buildings 561 and 703) are leased to the Commonwealth of Puerto Rico, which in turn leases the buildings for commercial use.

All of the buildings owned by the Navy at Ramey have been declared excess and are awaiting disposal through GSA. An on-site survey was conducted in 1982 to determine PCB compliance. NAVSTA Roosevelt Roads, West Annex, Aquadilla, is in compliance with the PCB regulations as set forth in 40 CFR Part 761.

CHAPTER 8. DISPOSAL SITES AND POTENTIALLY CONTAMINATED AREAS

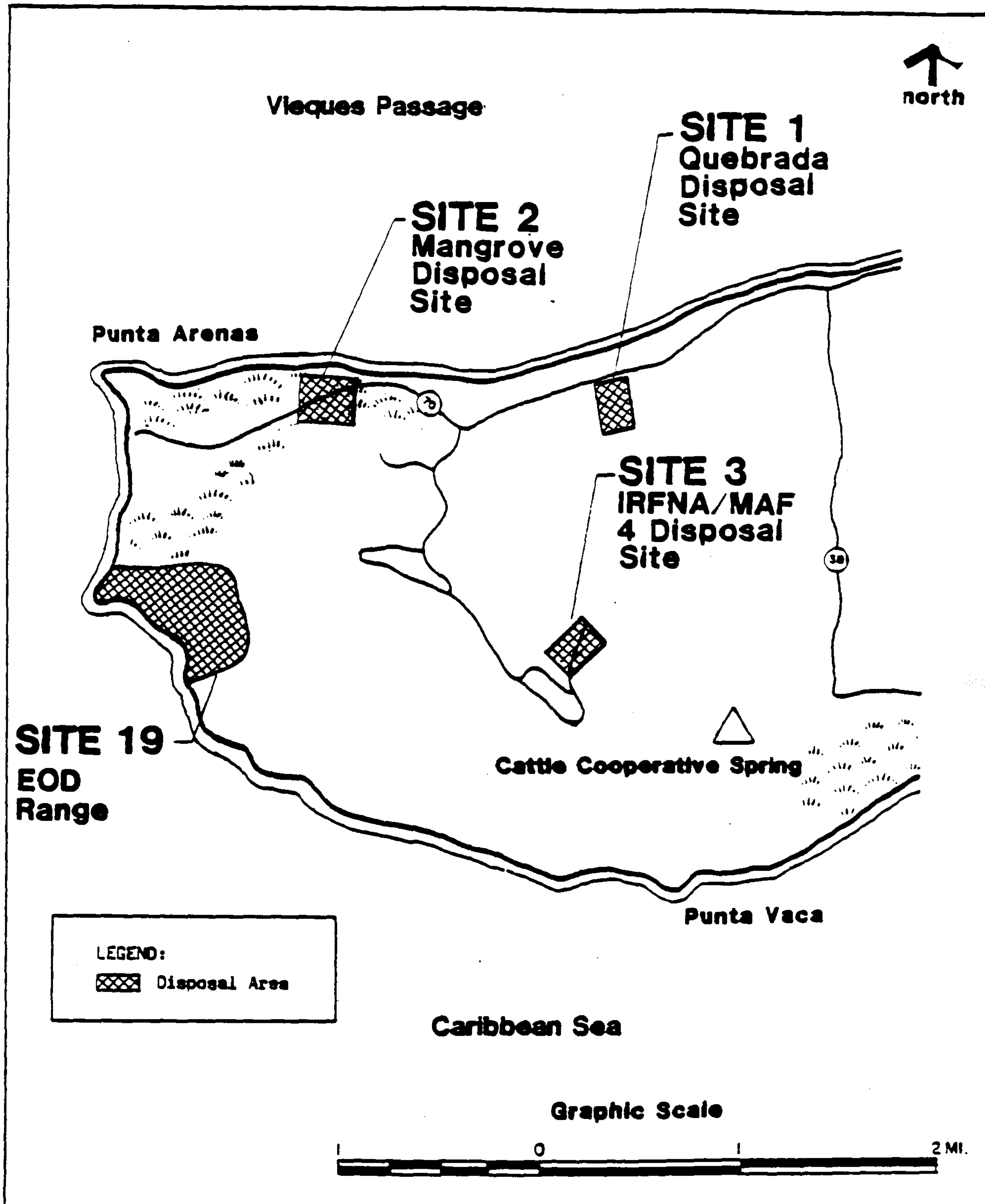
8.1 SITE 1, QUEBRADA DISPOSAL SITE, VIEQUES. This disposal site is located in a quebrada (an intermittent drainage area) south of North Shore Road in the north-central portion of the Naval Ammunition Facility (NAF), Vieques. A dirt road, present along the east side of the quebrada, facilitated easy access to the site. The site was in use from the early 1960s to the late 1970s by both civilian and U.S. Navy personnel (see Figure 8-1).

No records of the disposal site were found at the archives or in the base files; none of the base personnel were aware the site existed. The site had not been previously noted during the various environmental surveys done on the islands. This is not surprising, since the site is impossible to see from Route 70, and nearly invisible even from a helicopter. The U.S. Fish and Wildlife Service representative at NAF Vieques found the site solely by accident.

Site boundaries extend approximately 500 feet along the quebrada in a southerly direction from North Shore Road. The quebrada varies from 20 to 30 feet wide and 10 to 20 feet deep. It is estimated that there are over 1,500 cubic yards (500 feet x 20 feet x 4 feet) of material present at the site, including buried and exposed apparently empty 55-gallon drums, ordnance carriers (2.75-inch rocket launchers), POL, solvent and paint cans, rubble, fluorescent light fixtures, and cars as well as all types of base trash including glass, metal, tires, wood, etc. The material had been tumbled over the side of the quebrada, apparently beginning at the southern end of the quebrada and moving northward along the east side of the quebrada. Attempts had been made to shore up the sides of the quebrada where the material had been deposited. Several steel posts, usually used by combat engineers to string barbed wire or other fencing material, had been driven into the sides of the quebrada apparently to stabilize the mass of disposed material. Some of the material, especially solvent containers, have become detached from the main pile and were lying in the silt and sand at the bottom of the quebrada, where they had apparently been washed to when water was flowing in the quebrada.

Estimating the amount of potentially hazardous material that may have been disposed of at this site is difficult. The assumption will be made that no more than one percent of the material is hazardous, based on the low level of industrial-type activity at NAF, Vieques. One percent of 1,500 cubic yards is 15 cubic yards; using the figure of roughly 800 pounds per cubic yard for municipal garbage (Tchobanoglous et al., 1977), approximately 12,000 pounds or six tons of hazardous material may have been disposed of at this site.

8.2 SITE 2, MANGROVE DISPOSAL SITE, VIEQUES. The mangrove disposal site (see Figure 8-1) is located in an 18-acre oceanside mangrove swamp in Laguna Arenas along North Shore Road (Route 70) on the NAF, Vieques. This site was used as a base disposal area during the 1960s and 1970s. Materials present at the site include all types of base trash (glass, metal, wood, etc.), POL, solvent and paint cans, and rubble. These materials extend northeast from the Laguna Kiani Bridge approximately 300 feet, and into the mangrove swamp for about 100 to 120 feet in a northerly direction and about 10 feet in a southerly direction from North Shore Road. The IAS team estimated that there are 800 cubic yards



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 8-1
SITE MAP
SITES 1, 2, 3, & 19

(100 feet x 75 feet x 3 feet) of materials at the site. The material was apparently piled up, burned, and then bulldozed into the mangrove area. This practice continued to 1978.

Using the parameters mentioned above, as much as eight cubic yards of material weighing 6,400 pounds could be considered potentially hazardous. The fact that the material was burned increases the likelihood of contaminant migration.

These materials are in an existing mangrove. Two previous environmental studies (TAMS/E & E, 1979 and Lewis et al., 1981) recommended that the material be removed from the site to eliminate it as a source of contamination.

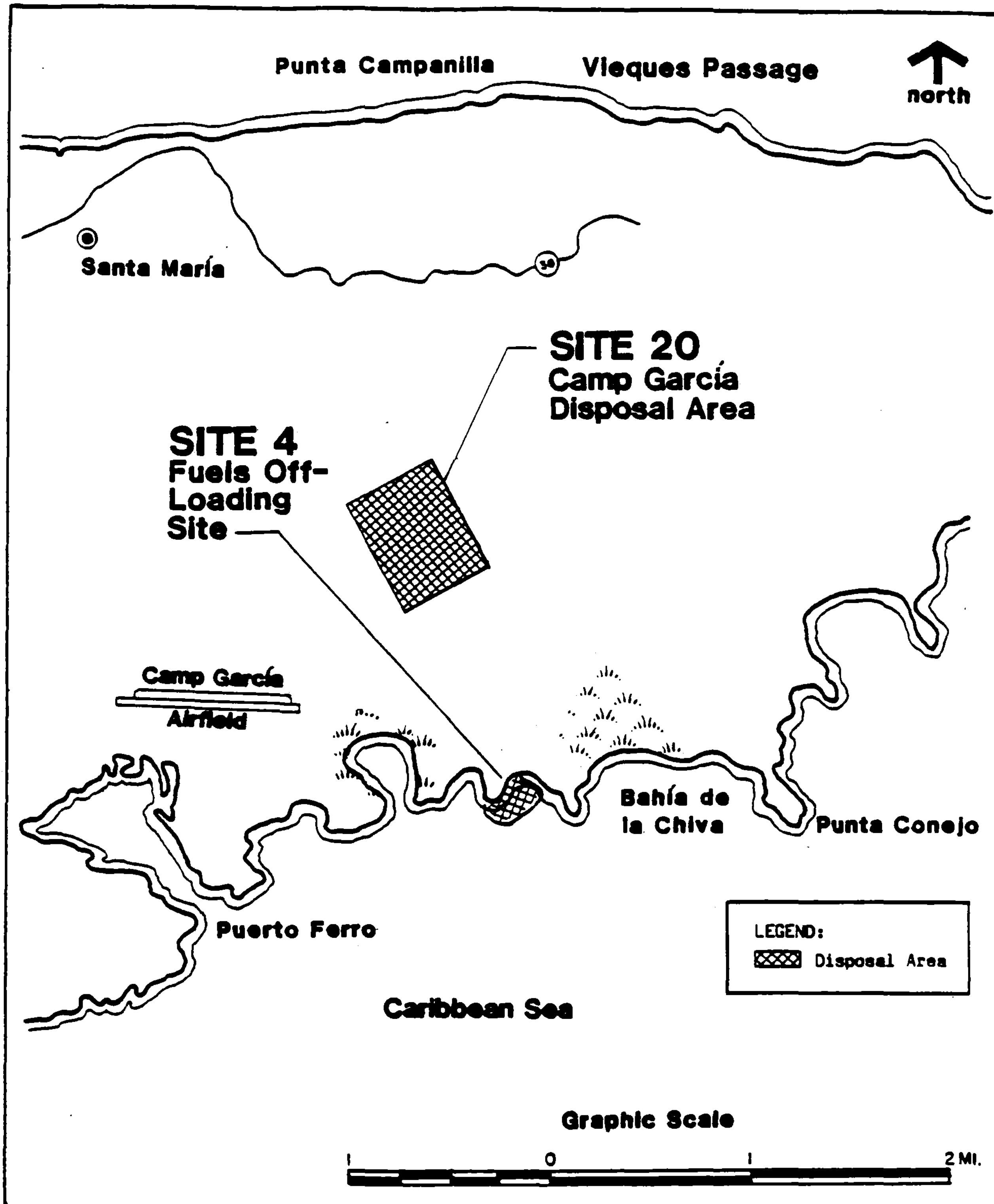
8.3 SITE 3, IRFNA/MAF-4 DISPOSAL SITE, VIEQUES. In 1975 Weapons Department personnel at NAVSTA Roosevelt Roads disposed of 25 AQM-37As on and near the island of Vieques (see Figure 8-1). The AQM-37A is a target drone capable of supersonic speeds. The 25 drones were found to be leaking. The fuel, consisting of 71 pounds of mixed amine fuel (MAF-4) and 211 pounds of inhibited red fuming nitric acid (IRFNA) per drone, was drained into a quebrada at the low spot in the road near Building 422 on the NAF, Vieques. A maximum total of 1,775 pounds of MAF-4 and 5,275 pounds of IRFNA were emptied into the quebrada, and the drone bodies were disposed of by dropping them into the ocean off a deep water ledge, where other ordnance items had been disposed of in the past.

The quebrada where the disposal took place is in the probable surface recharge area for one of the few naturally occurring springs on Vieques that runs year-round. The spring is currently used by the Cooperativa de los Ganaderos, a livestock raising cooperative, and is supplemented by water obtained from the pipeline from Vieques. The spring is frequently used by cattle, horses, and various birds and other wildlife. When the cooperative wants to count or brand the livestock, all supplemental water sources are withdrawn so that the livestock are attracted to the spring and can be easily captured. At these times, which correspond to the dry season, the spring is used extensively by livestock and wildlife.

Examination of the area where the fuel releases occurred disclosed no extensive areas of vegetation damage or any other indications of the incident. Indeed, interviewees stated that livestock were seen drinking from the puddles of fuel immediately after the release. The IRFNA most likely dispersed rapidly; however, the amines in the MAF could, given proper conditions, be somewhat persistent in the sandy soil present at the site.

8.4 SITE 4, FUELS OFF-LOADING SITE, VIEQUES. The fuel off-loading site (see Figure 8-2) is located off the south coast of Vieques at Camp García east of Bahía de la Chiva (Blue Beach). Four aboveground fuel tanks were constructed on a hill to the west overlooking the cove. The tanks were in use from 1953 to the late 1970s. They were removed between 1978 and 1979, and sold for scrap metal on the commercial market. A small amount of rubble is present at the former fuel tank site on the hilltop overlooking the off-loading site.

While in use, the tanks were filled with diesel fuel, unleaded gasoline (MOGAS), AVGAS, and JP-5 fuel. Two tanks had a capacity of 20,000 gallons; the other two tanks had a capacity of 30,000 gallons. Each tank was filled from an offshore barge every three months for approximately 25 years (to 1974). Fuel was pumped from the barge through an eight-inch submarine line to the tanks.



INITIAL ASSESSMENT STUDY NAVAL STATION ROOSEVELT ROADS, PUERTO RICO	FIGURE 8-2 SITE 4, FUELS OFF-LOADING SITE SITE 20, CAMP GARCIA DISPOSAL AREA, VIEQUES ISLAND

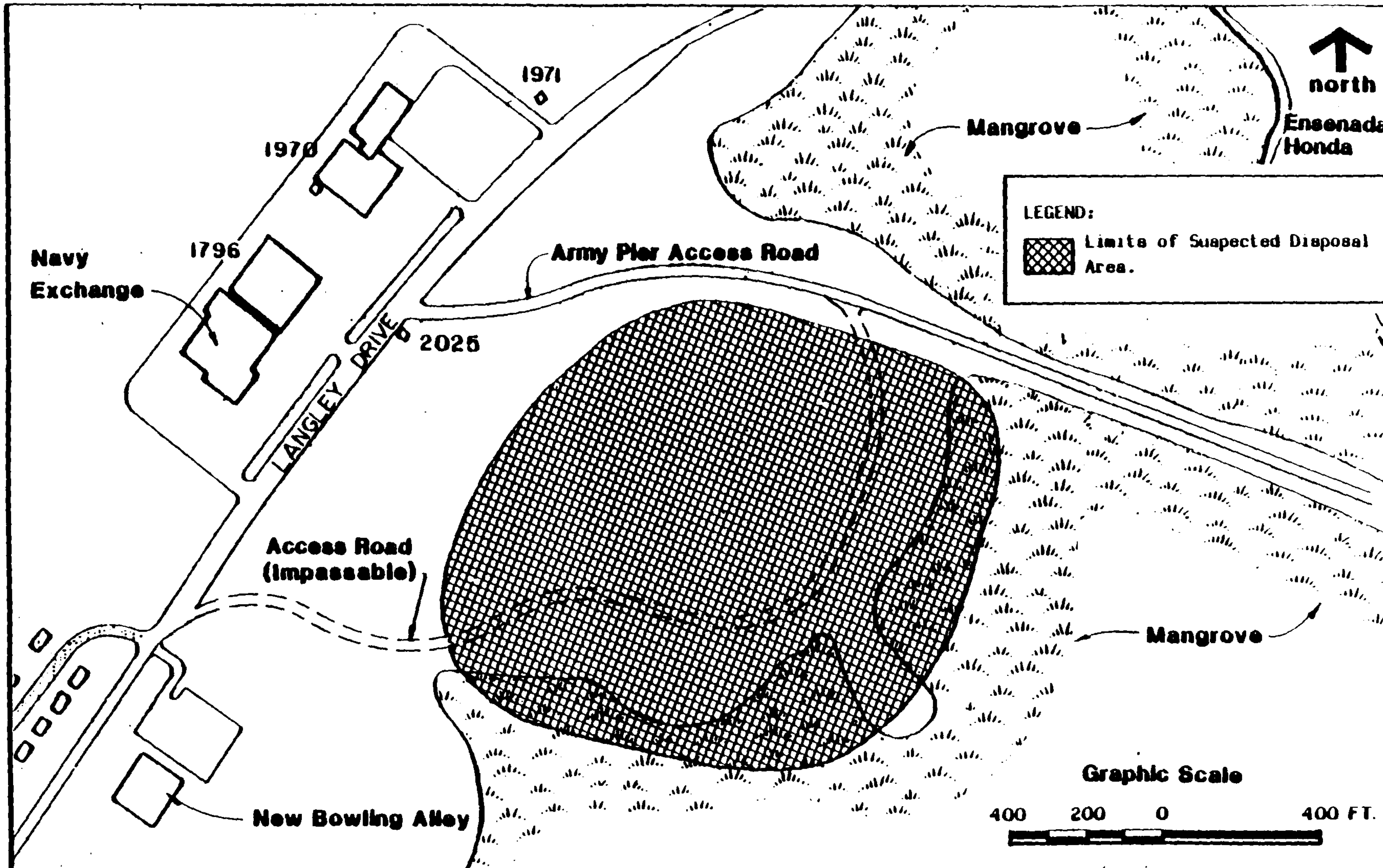
The line ran from the tanks to a buoy about 1,500 feet from the shoreline. During each refueling period it was necessary to flush the seawater from the hoses. This resulted in the discharge of approximately 1,000 gallons of fuel to the land and sea per refueling period. The tanks were filled a maximum of four times a year for about 25 years, resulting in a maximum of approximately 100,000 gallons (4 refueling periods x 25 years x gallons spilled per refueling operation) of fuel discharged to the ocean. While the total amount of fuel spilled seems significant, several factors contributed to the mitigation of the spills. The timing of the refueling operations (once every three months), combined with the relatively small amounts (estimated at 250 gallons) of each spill, allowed sea and wind currents to disperse and dilute the fuel. No accumulative effects were noticed, even during the intensive and extensive environmental assessment of the area conducted in 1978.

8.5 SITE 5, ARMY CREMATOR DISPOSAL AREA. This site was used as the primary station landfill from the early 1940s, when the Naval Station was first established, to the early 1960s (see Figure 8-3). The site was also used by the U.S. Army from the early 1940s through 1957 for the disposal of wastes from Fort Bundy. Early base maps labeled this area the "Army Cremator." The landfill was operated by the Public Works Transportation Division, with an individual stationed at the landfill on a full-time basis. Access to the landfill was made via a dirt road which began at Langley Drive just north of the location of the new bowling alley and looped to the Army Pier access road. Disposal activities occurred on both sides of the access road right up to the perimeter of the Ensenada Honda mangrove area.

All wastes generated at the station were disposed of at this landfill. Some segregation of metals and ordinary refuse was attempted, although no one interviewed could remember the exact locations of the specific disposal areas. The trash was dumped in mounds and burned every afternoon, and the remains were compacted with a bulldozer. No trenches were used and no daily cover was applied.

It is estimated that 10 to 20 tons per day of refuse were disposed of in this area. Material disposed of at the site included scrap metal, inert ordnance, old batteries, tires, appliances, cars, cables, dry cleaning solvent cans, paint cans, gas cylinders, construction debris, dead animals, and residential wastes. No records of the quantities of hazardous waste that may have been disposed of at the site were kept. However, using a factor of 1% for hazardous waste, a range can be estimated thus: (10 to 20 tons/day) x (200 working days/ year) x (20 years) x (1% hazardous waste) = 400 to 800 tons of hazardous material in this area.

Also, during the IAS team's overflight, several large mounds of drums were detected from the air. The drums were in a rusted condition; some appeared to be intact. The mounds were located near the mangroves. An on-ground visual inspection of the drum areas was attempted by the IAS team, but vegetation in the area was too dense and the drums could not be located. Based on the types of material found in other discarded containers throughout the base, the intact drums probably contain solvents, paints, and other material that could be considered flammable or otherwise hazardous.



INITIAL ASSESSMENT STUDY
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ROOSEVELT ROADS, PUERTO RICO

FIGURE 8-3
SITE 5, ARMY CREMATOR DISPOSAL AREA

8.6 SITE 6, LANGLEY DRIVE DISPOSAL SITE. The Langley Drive disposal site (see Figure 8-4) is located approximately 2,000 feet north along Langley Drive from the Navy Exchange Complex and 300 feet east of the drive towards Ensenada Honda. The site is within the perimeter of the Ensenada Honda mangrove area, with heavy to moderate vegetation cover. Sparse ground cover exists within the immediate area of the disposed material. The site is inhabited by a population of rather large land crabs. The site allegedly had been used between 1939 and 1959. No record exists of its use; the IAS team was led to the site by a Public Works person who knew of the site.

Review of historical aerial photographs and general development maps show that the area along Langley Drive had once been clear of brush vegetation from the road to the mangrove perimeter. On an aerial photograph dated 8 January 1951, an unmarked dirt road is evident from Langley Drive to the mangrove area. Areas of surface disturbance indicative of a landfill operation extend from this dirt road. The total area of disturbance is estimated at 15,000 square feet. Other smaller areas of disturbance were also identified north along the Langley Drive corridor on the bayside.

A 15 January 1964 aerial photograph of the area shows an established vegetative cover. However, in the previous area of disturbance, the developing vegetation is limited to light ground cover. By 1972 brush type vegetation was established, except at a small location which was shown to be also disturbed in 1951.

Materials found during the site inspection included approximately 10 to 15 full 55-gallon drums, large metal and concrete objects, various sized sample containers (one containing pellets), old fuel lines, flexible metal hoses, steel cables, hardened tar, and rubble. Most of the materials were partially buried, with only a few items lying free on the surface. Most of the drums and other metallic objects showed deterioration and corrosion. The solid contents of some of the drums had become exposed. This exposed material had a discolored green crust about 1/2-inch thick, encasing a whitish compound with the consistency of semi-dry plaster.

With the exception of the 55-gallon drums, little if any of the other material could be classified as hazardous. The majority of the material seems to be construction debris or demolition rubble; the other items share the characteristics of being rather large and unwieldy objects (hoses, fuel lines, cable). The rubble debris and larger items seem to have been disposed of in a manner consistent with filling in the mangrove swamps to create new land. The drums, on the other hand, rest on the surface of the made land for the most part, and seem to have been disposed of at a later date.

The volume of material in the immediate area of investigation was estimated to be 300 cubic yards. However, within the 300-foot distance between this area and the Langley Drive corridor, smaller disposal piles (approximately two to five cubic yards in volume) are scattered. At these sites similar types of materials were found, consisting of metal and concrete objects, piping, and rubble. Much of this material was also partially buried. The IAS team found it impossible to fully investigate this area. It is likely that other material is present in the area. The IAS team considers the contents of the drums to

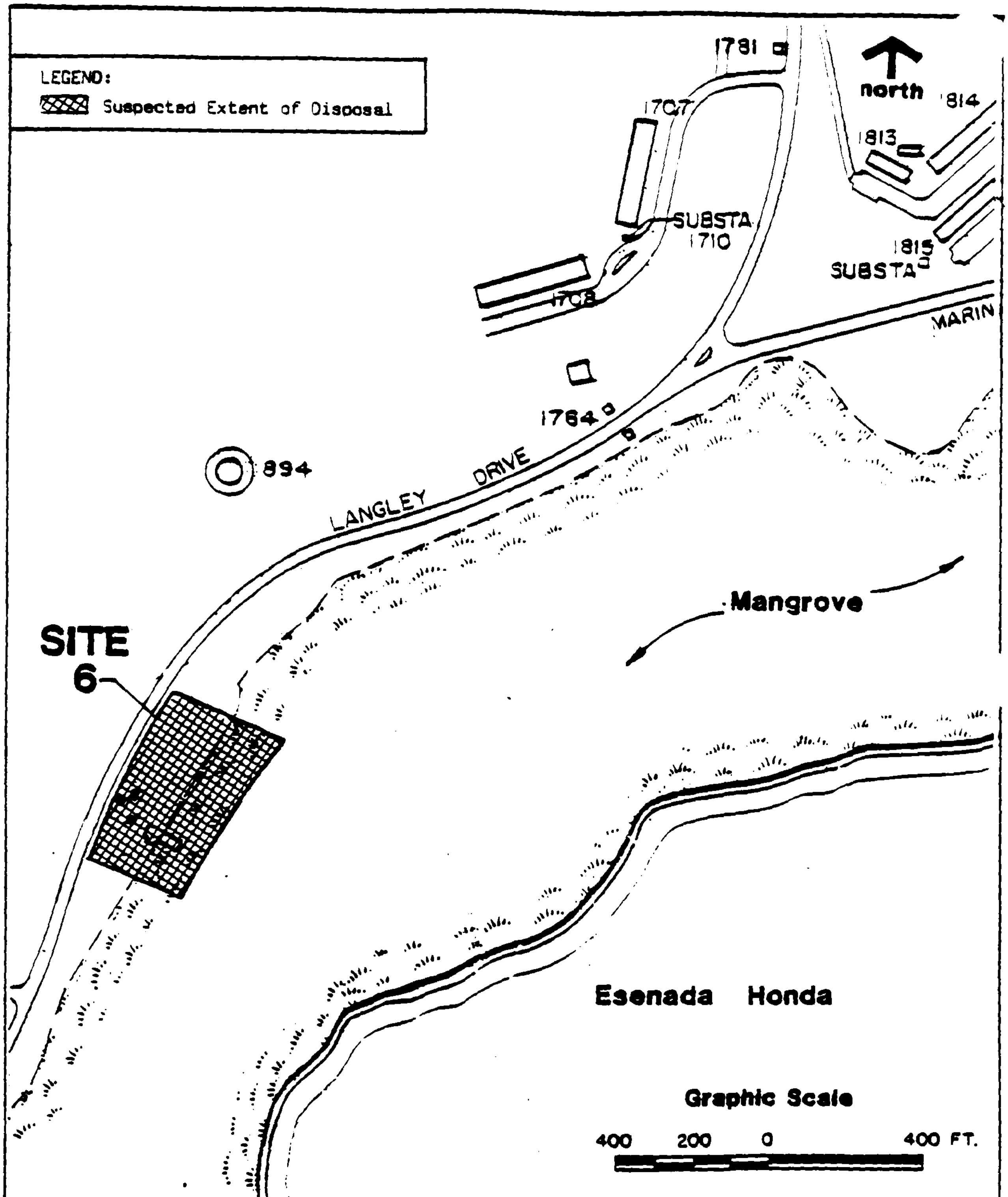

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FIGURE 8-4
SITE 6, LANGLEY DRIVE SITE

be potentially hazardous, so that as much as 800 pounds (20 drums x 50 gallons x 8 pounds/gallon) of hazardous material may be present.

8.7 SITE 7, STATION LANDFILL. This site has been used as the activity landfill since the early 1960s, when the Army Cremator disposal site (Site 5) was abandoned. The disposal of hazardous material at this site was halted in 1978. A map of the area is shown on Figure 3-5. The landfill site encompasses 85 acres of land, most of which has been used for waste disposal (see Figure 8-5). Prior to 1970 the Public Works Transportation Division was responsible for the collection of refuse and operation of the landfill. From 1970 through the present a private contractor has been contracted for refuse collection. From 1980 to the present a private contractor has operated the landfill.

Disposal methods used at the site consisted of excavating a trench to the water table, filling the trench in with waste materials, spreading and compacting this material with a bulldozer, and then covering the area with soil. Estimates of quantities of waste disposed of in the past range from 40 to 60 tons per day. Materials known to have been disposed of at the site include residential wastes, foreign cooked garbage, scrap metal, cables, paint waste, solvents, PCBs, OTTO Fuel II, Agentine, pesticides, lubricating oil, dead animals, digested sludge, construction debris, and possibly Super Tropical Bleach (STB), a decontaminating agent.

From the early 1960s through the mid-1970s, the Weapons Support Detachment of AFWTF disposed of contaminated OTTO Fuel II and Agentine at the landfill at the maximum rate of 10 55-gallon drums per month. The Power Distribution Shop disposed of 55-gallon drums of Askarel, a PCB fluid, which had been drained from transformers, as well as a one-time (1968) disposal of approximately 40 five-gallon cans of Askarel. The five-gallon cans of Askarel, which had been stored in Building 31, were never opened, and were in a rusted condition at the time of disposal. Old pole-mounted transformers, possibly containing 30 to 75 gallons of contaminated PCB oils each, were disposed of at a rate of eight per year for approximately 12 years.

There are several disposal areas within the landfill. The "scrap metal area" was originally designed as a storage area for scrap metal recycling. It covers an acre, and in addition to hundreds of car bodies and other scrap metal objects, contains solvents, lubricants, and aqueous film-forming foam (AFFF) containers which have leaked to the soil. South of the metals area in the landfill, a ditch containing approximately 10 leaking 55-gallon drums of what appears to be an oily substance has been recently discovered. The ditch was dug to the water level, and the oil is mixed with the ground water. Just to the north of the drum ditch is an area that has been used for asbestos disposal. The area is approximately 10 yards in diameter, as estimated from the presence of stressed vegetation. This area lies next to a main access road and is marked with only one faded sign. The asbestos disposal area is not segregated from the rest of the landfill, nor is direct human contact precluded. The cover over the area is disturbed, and totally lacking in vegetation.

To the south of the drum ditch, and generally lying between the active portion of the landfill and Ensenda Honda, are a number of disposal areas overgrown with vegetation which are undetectable from the ground. These areas appear to contain primarily metal items that have been placed on the ground, rather than

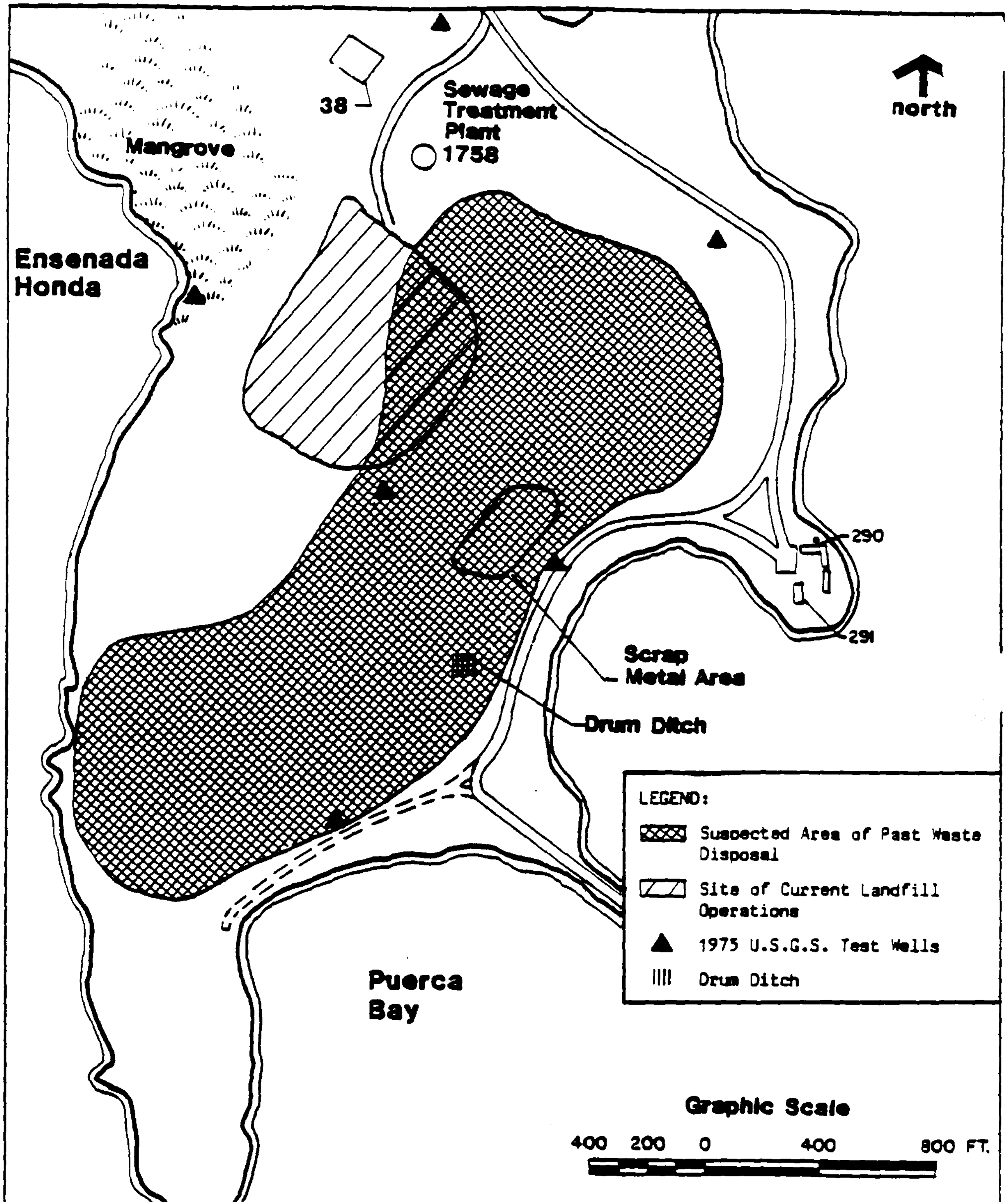

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FIGURE 8-5
SITE 7, STATION LANDFILL

buried. These materials vary from isolated metal items to piles of drums, approximately five yards in diameter and six to eight feet in height. There are an estimated 50 intact 55-gallon drums. Based on material found in drums elsewhere on the base, it is probable that the drums contain hazardous material.

One area of the landfill, south of the scrap metal area and east of the drum ditch, has been used for sand borrowing. This has uncovered old garbage, and has resulted in the water table appearing at the land surface. Inert ordnance items have been found in this area.

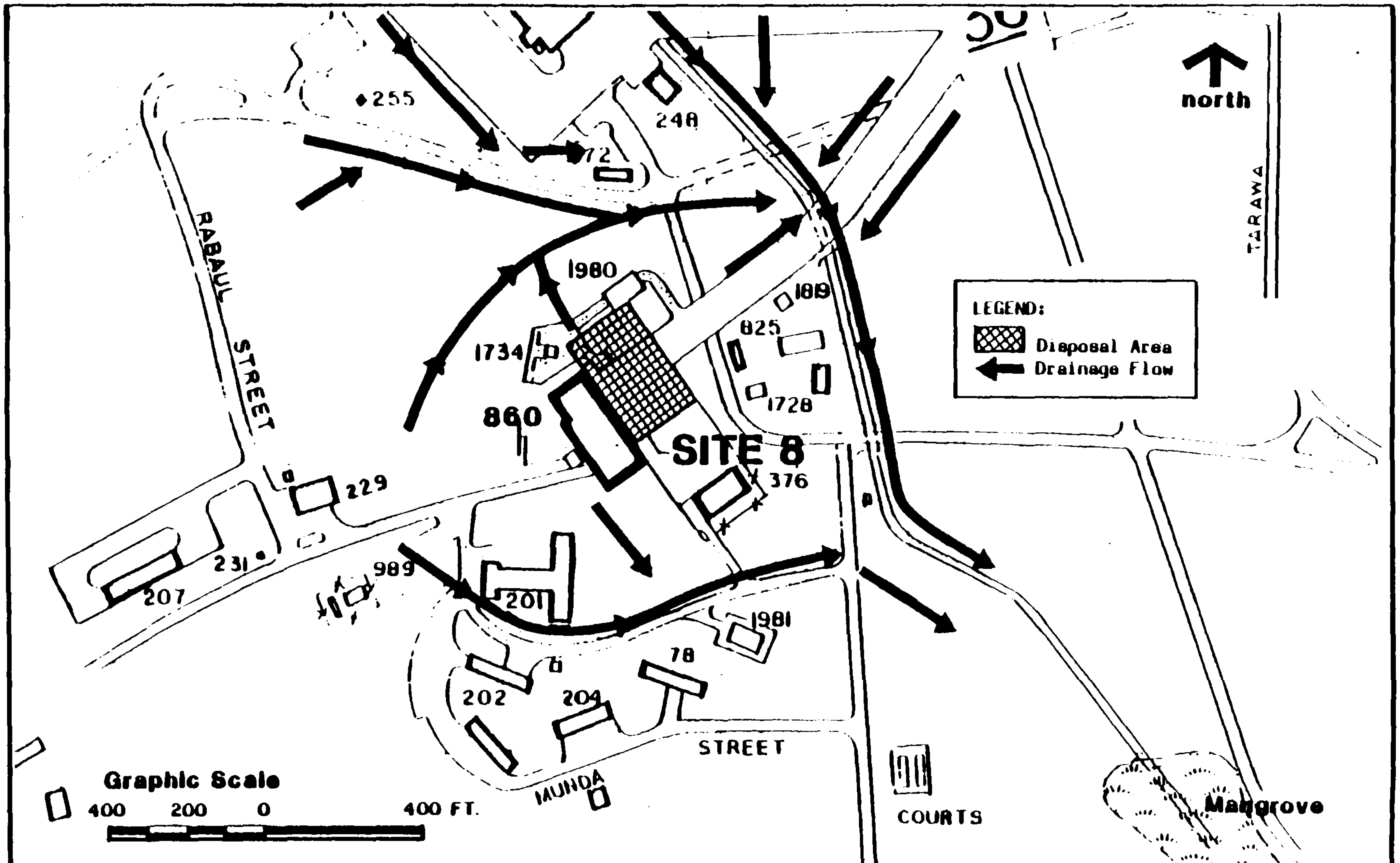
Areas of stressed vegetation are apparent throughout the landfill. In some areas it is probable that the vegetation is stressed due to the nature of the fill originally used to create the landfill; other areas are probably stressed due to the nature of the materials disposed of there.

8.8 SITE 8, DRONE WASHDOWN. The drone washdown area (see Figure 8-6) is located at Building 860 (Aerial Target Systems Department). The drones are launched from Cabras Island at the eastern entrance to Roosevelt Roads Harbor. Drones that are not destroyed during the presentation are recovered by helicopter in the Pasaje de Vieques for reuse and returned to Building 860. This operation has been active there since about 1961. Between 1961 and 1969 the Aerial Target Systems Activity averaged 125 presentations per year, totaling about 1,000 presentations. Since Radio Corporation of America, Inc., (RCA) received the contract in 1969, approximately 4,000 presentations have been conducted, bringing the total to approximately 5,000 presentations over a 20-year period.

After each presentation the outside of the drone is washed with freshwater to remove the saltwater and marker dye, and any remaining fuel is removed from the fuel tank. In the past this was done outside Building 860, where the fuel and wastewater were disposed of in a drainage ditch which flows into a mangrove swamp and eventually into the harbor. From about 1960 to the mid-1970s all contaminated fuels (JP-4 and JP-5) and oil were disposed of in this ditch. During this estimated 15-year period, about 2,500 presentations occurred. Estimating one to two gallons of unused fuel per drone, about 2,500 to 5,000 gallons of JP-4 and JP-5 fuel were disposed of in the unlined earthen drainage ditch. An undetermined amount of oil was also routinely disposed of in this ditch.

In the mid-1970s an underground oil separator was constructed outside Building 860 to prevent any oil or fuel from the drone washdown procedure from entering the drainage ditch and storm sewer system. A tank truck (1,500-gallon capacity) is used to siphon the fuel from the oil separator. Any oil or fuel removed from the drones is also disposed of in this tank truck. Until about 1982 the tank truck was emptied by the Public Works Department and disposed of by DPDO on a monthly basis; since this time it has normally been emptied every three or four months.

Until about 1983, the oil separator would overflow into the adjacent storm sewer system during periods of heavy rainfall. This problem was corrected by the installation of a valve on the pipe between the separator and storm sewer which, if closed, can stop the flow of oil into the storm sewer.



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NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 8-6
SITE 8, DRONE WASHDOWN

8.9 SITE 9, PCB DISPOSAL, DRY DOCK AREA. In approximately 1968 the Power Distribution Shop made a one-time dumping of excess PCB fluid into the ocean at the dry dock wharf (see Figure 8-7). Twenty-five five-gallon cans of Askarel were disposed of into the ocean on the southern side of the wharf between the second and third berths. Some of the cans, which had been stored in Building 31 (Public Works) for some time, were in a rusted condition at the time of the dumping.

8.10 SITE 10, BUILDING 25 STORAGE AREA. Building 25 was used from 1951 until the structure collapsed in 1979 by the Public Works-Supply Department for temporary storage of materials to be turned over to DPDO (see Figure 8-8). The entire area around the building was used for open storage of drummed material from at least 1957, according to aerial photographs.

The entire area in and around the collapsed building is overgrown with vegetation, although historical aerial photographs show the area to be relatively free of vegetation other than ground cover through 1977.

Materials found in and around Building 25 include 20 to 25 apparently empty to partially filled 55-gallon drums; 10 to 15 five-gallon pails; office furniture; mechanical devices; construction rubble; industrial gas cylinders; asbestos sheeting; fiberglass buoys; and transformers.

Of particular interest are the five-gallon pails, the drums, and a large transformer found at the collapsed building. The five-gallon pails have become corroded, exposing a substance similar to that found at the Langley Drive site (Site 6, see Section 8.6). The compound has a green-colored crust about 1/2-inch thick, encasing a white material with the consistency of semi-dry plaster. A large transformer is lying on its side at the east corner of the building. No evidence of oil leakage was apparent.

Material was also found along the various access roads and consisted of drums, office furniture, asbestos, rubber, and a pole-mounted transformer from which oil has leaked. Some of these areas exhibited stressed vegetation. There are several other areas of disposed material (about five acres) between the access routes. A 1957 photograph taken by a tenant activity shows that the area around Building 145 was used as a general storage area for several hundred drums. During the IAS team's overflight, CONEX containers were also found in a clearing in this area.

Near Building 31 evidence of a similar type of storage operation was found. Approximately 50 drums were found within the vegetation bordering the north side of the Building 31 transportation lot. Most of the drums are full to partially full of unknown contents. The Public Works Department attempted to remove some of these drums; however, the condition of the drums resulted in massive leakage. The spill contaminated a flatbed truck before running onto the ground, staining an approximately 10-foot-diameter circle of soil. An extremely strong creosote or solvent odor was present. These drums and the spill can be easily accessed by base personnel. The spilled material was identified by the Navy as asphalt, and will be sent to DPDO for sale or reuse. Three drums were not identified and are being held.

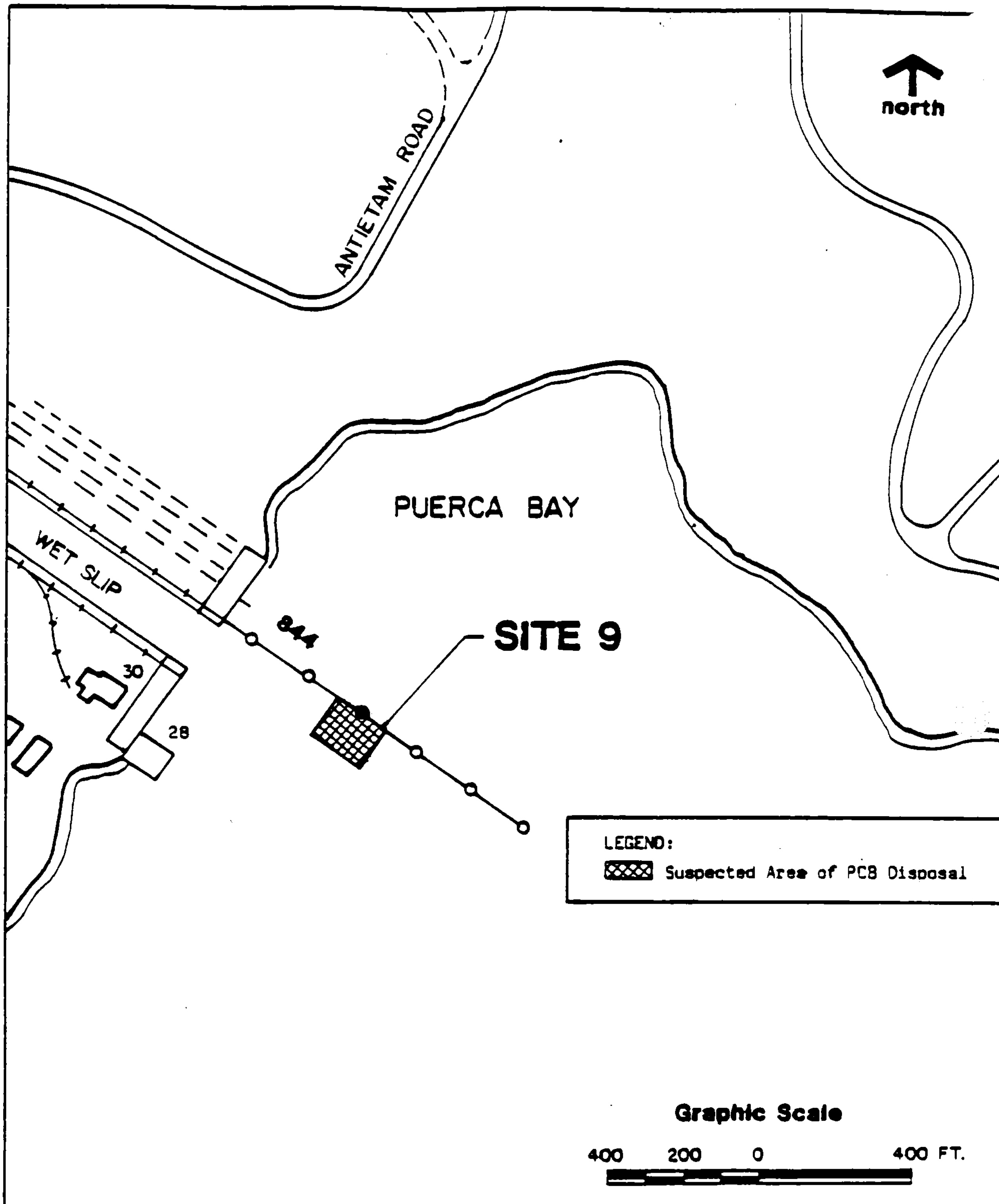

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FIGURE 8-7
SITE 9, PCB DISPOSAL
DRY DOCK AREA

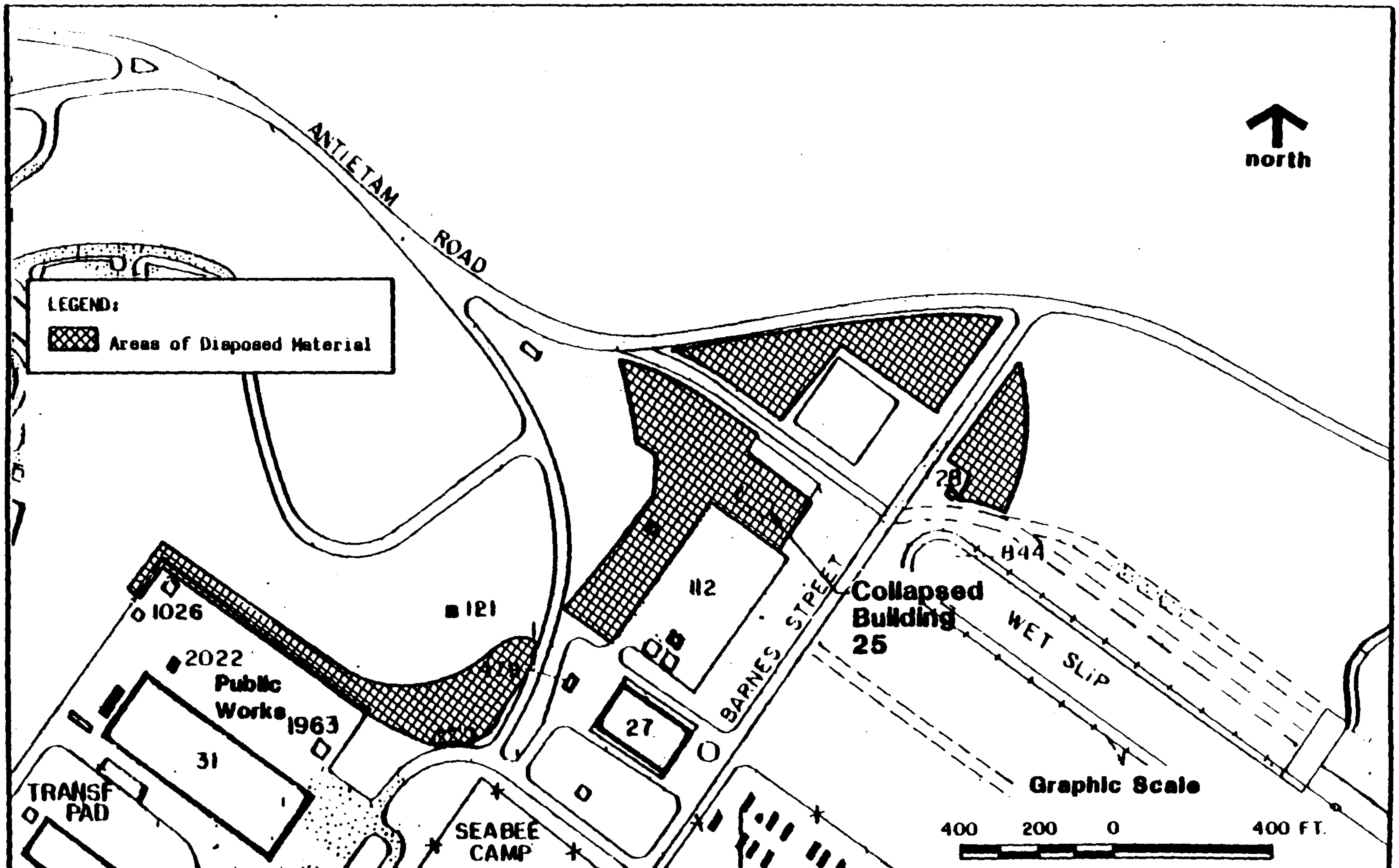

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FIGURE 8-8

SITE 10, Building 25 Storage Area

The IAS team estimates that about 50 to 75 drums of hazardous material present at the site, along with some small (less than 25 gallons) amounts of fluids possibly containing PCBs in the transformers.

8.11 SITE 11, BUILDING 145. Building 145 (see Figure 8-9) contains an estimated 60 55-gallon drums, about 100 five-gallon pails, and a number of other small containers. The building is a concrete bunker about 60 yards long, about seven feet high, and eight feet wide. There are three openings to the surface through the roof that are covered with dilapidated wood structures, and one entrance at ground level. The walls and roof are made of reinforced concrete over a foot thick.

Various suggestions have been made as to the probable intended use of the structure. The building is not shown or listed on the earlier maps of the station. The first reference found to the building by the IAS team is on a map dated 1959; no function for the building is ever listed. The only other structures that are not shown on early (1939-1959) maps are those associated with the alleged planned evacuation of the British Royal Fleet, such as the Pineros Island bunker system. It is most probable that the structure was to be used in conjunction with the dry dock.

The building has been used for the storage of materials for at least 25 years based on interviews with base personnel. This is supported by the shipping dates found on the containers.

The containers are in three distinct areas within the tunnel. At the ver rear, about 20 or 25 drums have been randomly placed (not dropped through t roof opening directly above, however). The drums are rusted; some have the bungs removed, and some have obviously leaked. Most seem empty or only partially full. Just past the midpoint of the tunnel, toward the rear, are approximately 100 five-gallon pails. The pails are tumbled about and prevent access to the rear of the tunnel. The pails seem to be filled.

Some old office furniture and other metal objects are in the center of the tunnel, which is a low point caused by the floor sloping in both directions toward the center. One of the three roof openings occurs here, and water has collected in a pool about 10 yards long, up to six inches deep, stretching between the walls. Roots from trees at ground level, about eight feet above the tunnel floor, have entered the roof opening and have grown into the pool of water.

Between the pool and the entrance are a number of 55-gallon drums, several five-gallon pails, and some smaller containers. All of these containers are neatly organized and stacked, and some are stored on metal pallets. Most of the containers were full. Some spills of material are also present.

Samples were taken by the IAS team from 21 55-gallon drums, eight five-gallon pails, and three other areas of spills or other materials. The containers sampled by the IAS team ranged from drums with fairly discernible markings and intact bung seals, to drums and pails that had obviously been opened, emptied of the original contents, and used for disposal of waste material. Material identified by sight by the IAS team included Navy gray paint, olive drab paint, black boot polish, and some adhesives. The materials sampled underwent anal

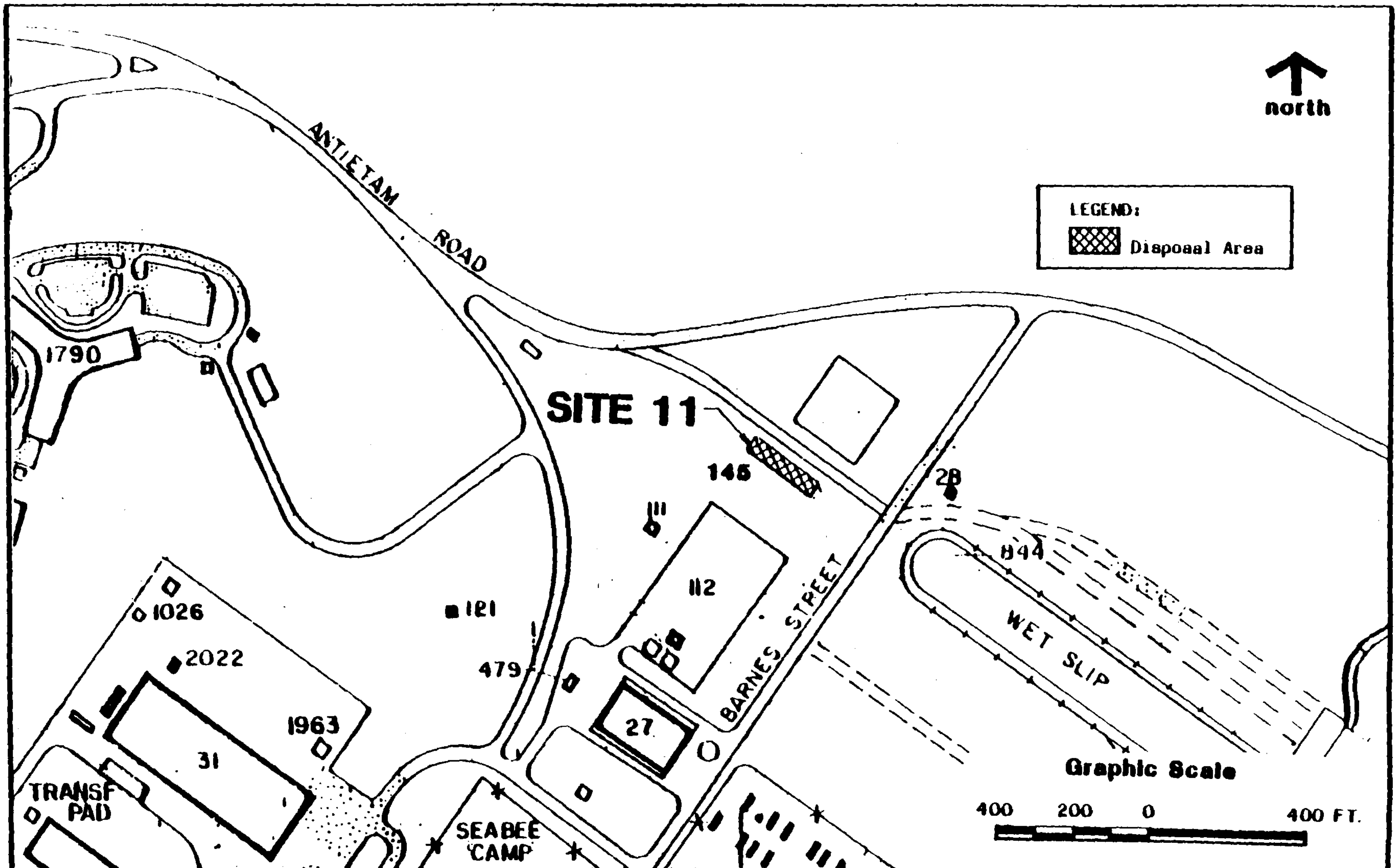

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FIGURE 8-9

SITE 11, BUILDING 145

ysis by contract laboratories under hire to Atlantic Division, Naval Faciliti[illegible] Engineering Command (LANTNAVFACENGCOM).

Markings on the containers included such items as "C-610/Corrosion Preventative, Aircraft"; "From Supply Officer, Newport News Ship Yard, Portsmouth, Virginia to Supply Officer, Roosevelt Roads"; "Paint, semi-gloss, rapid drying, olive drab, March 1959"; "Dupont-GRX Methanol"; "195_, Cheatam Annex"; and "Sherwin Williams Boot Topping."

All of the containers can be assumed to contain hazardous materials. Other material in and around the building includes ships tackle and various bolts, nuts, and other fastening devices.

8.12 SITE 12, TWO WAY ROAD FUELS FARM. The fuels farm (see Figure 8-10) is located northeast of Two Way Road on a hill overlooking Ensenada Honda and consists of a number of different tanks. Tank 1080 has a capacity of 1,134,000 gallons and was used to store diesel fuel. In 1978 a leak occurred at Tank 1080, resulting in the release of approximately 65,000 gallons of diesel fuel from the tank. The fuel flowed downhill, south of Tanks 82 and 83 and north of Tanks 1083 and 84, into the storm drain at the base of the hill and across Two Way Road into Ensenada Honda (north of the fuel pier). The fuel entered the harbor, reaching the Ensenada Honda mangrove area on the southwest side of the harbor, due in part to very windy weather conditions that day.

Cleanup procedures included the use of cloth absorbent diapers to remove t[illegible] fuel, digging a leaching trench with a backhoe, placing booms across th[illegible] harbor, and using an oil skimmer with an oil-water separator to recover the fuel. It is estimated that about 10,000 gallons were recovered during cleanup operations. The reclaimed fuel and absorbent pads were taken to the Public Works Department for disposal. A private contractor also assisted in the disposal effort. This included the disposal of several 55-gallon drums of absorbent pads in the Fajardo Landfill, as well as the delivery of approximately 60 drums of pads to the Crash Crew for burning during training operations.

Along the path of the fuel spill (approximately 1,000 feet long and 200 feet wide) vegetation remains stressed in several locations, and absent in others. A permanent leaching trench has been dug at the base of the hill to contain the fuel that still leaches from the hillside. After every heavy rainfall at least two barrels of cloth absorbent pads are collected from the area. A dense oil film was present in the trench at the time of the IAS team visit. To minimize fuel from entering the harbor, three booms have been placed northwest of the Fuel Pier.

In 1957 or 1958 a fuel line to Tank 82 (2,100,000-gallon capacity) burst when a hydraulic jack was removed, resulting in a major spill of Bunker C fuel. The oil spill (termed "a river" by interviewees) followed a path downhill toward the harbor in a southwesterly direction across Two Way Road to Ensenada Honda, extending to the shoreline and the Ensenada Honda mangrove swamp across the harbor. The spill occurred during the night and lasted several hours before it was stopped. It is estimated by base personnel in the Fuels Division and Surface Operations Department that at least 420,000 gallons of Bunker C fuel leaked from the storage tank.

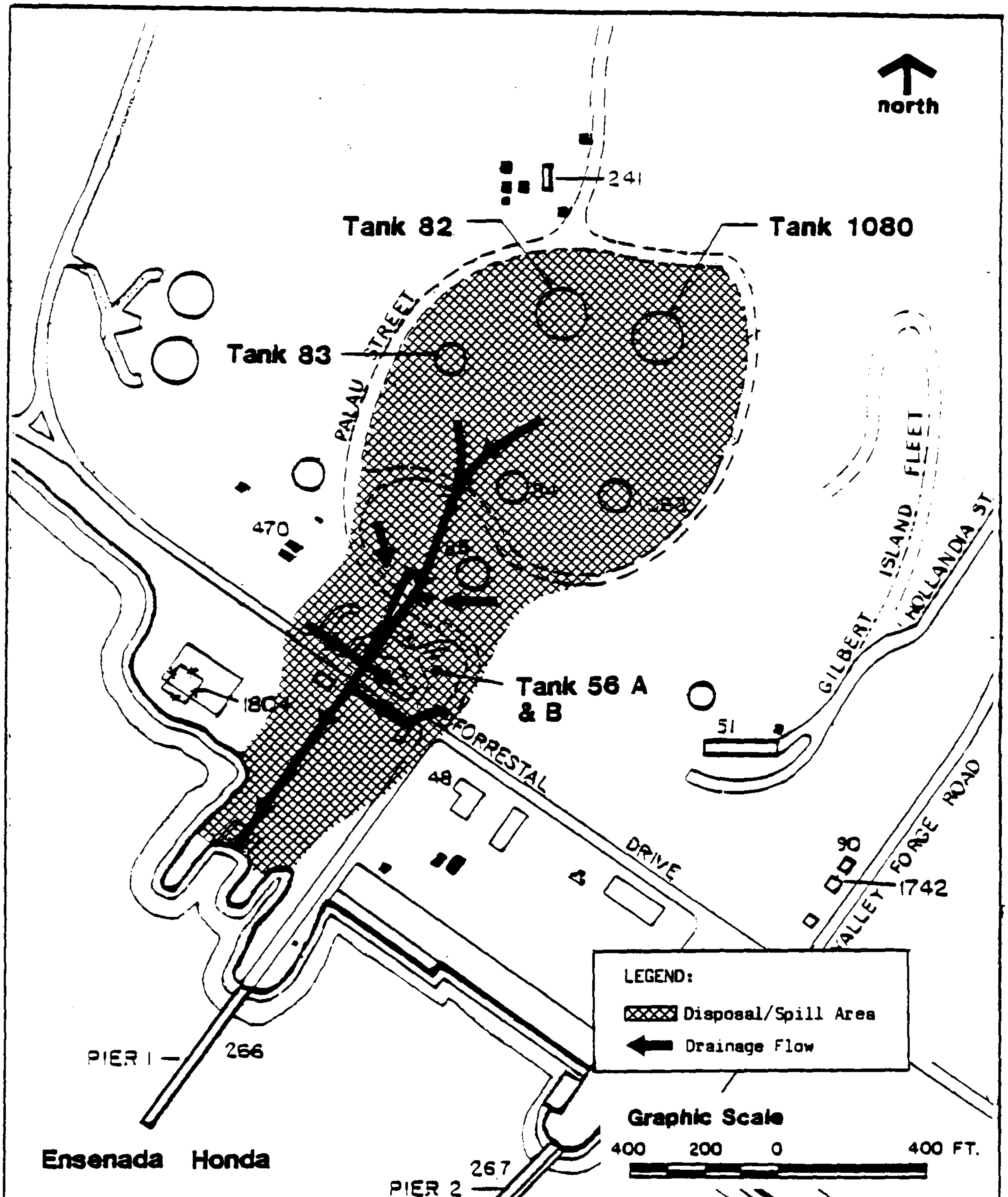

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FIGURE 8-10
SITE MAP
SITE 12, TWO WAY ROAD
FUELS FARM

Between 1971 and 1972 Tanks 83 (2,100,000-gallon capacity) and 1080 (1,34,(gallon capacity) were cleaned in order to change over from Bunker C fuel to diesel fuel storage. The Bunker C fuel and sludge from the tanks were disposed of in pits dug within 100 feet of each tank. A pit approximately 100 feet in circumference and 10 to 20 feet deep was dug 50 to 75 feet west of Tank 83 (about 25 to 50 feet from the tunnel) for the disposal of the fuel and sludge from the tank. It is estimated that about 3,000 to 6,000 cubic yards of materials were disposed of at this site, which remained open for seven years.

A smaller pit, with a 50-foot circumference and 10- to 20-foot depth, was dug in proximity to Tank 1080. Oil and sludge from Tank 1080 were disposed of in this pit, which remained open for six or seven years. It is estimated that 900 to 1,500 cubic yards of oil and sludge were disposed of at this site. After the materials solidified in both pits (a process estimated to take six to seven years) a two- to three-foot layer of soil was placed over the pits.

Two underground diesel storage tanks (56A and 56B) have a capacity of 10,500 gallons each and were used to store diesel fuel, just north of Building 54. The tanks were used for 20 to 25 years.

In the late 1960s leaks began in these tanks. It is estimated by interviewees that 420,000 gallons spilled over a 15- to 20-year period onto the surrounding soil. In February 1984 the tanks were removed and replaced. A dark black fuel-stained soil was present around the old tanks, as well as isolated pools of oil. The spilled fuel was floating on top of the groundwater.

8.13 SITE 13, TANKS 210 TO 217. Tanks 212 to 215 are located along Manila B Road, north of Forrestal Drive. Tanks 216 and 217 are on a hilltop about 4,000 feet southeast of Tanks 212 to 215, north of Forrestal Drive. Tanks 210 and 211 have not been used since 1950 (see Figure 8-11).

The capacity of Tanks 212 and 213 is 50,000 gallons, while the capacity of Tanks 214 through 217 is 252,000 gallons each. Tanks 212 to 217 are located on hilltops which are surrounded by mangrove swamps to the northwest, north, and northeast. The tanks, which were installed in 1940, were used for the storage of AVGAS and were cleaned every five years thereafter until 1978. The tank cleaning procedure consisted of mucking out 20 to 30 drums (800 to 1,250 gallons) of leaded fuel sludge from the tanks into a pit in the vicinity of each tank. These pits, or trenches, were dug by a backhoe within 300 feet of each tank. On the average, the pits were dug to a depth of eight feet with a length and width of eight feet. The sludge and fuel were disposed of in the pit and remained uncovered until solidified. Three to four feet of soil were then placed over the sludge to fill in the hole.

Six of the tanks were cleaned at least seven times each during a 40-year period. An estimated 32,400 to 50,500 gallons of leaded sludge were discharged and buried in the vicinity of Tanks 212 to 217. An additional 1,600 to 2,500 gallons were buried at Tanks 210 and 211, totaling approximately 34,000 to 53,000 gallons of highly leaded sludge for the entire site.

8.14 SITE 14, ENSENADA HONDA SHORELINE AND MANGROVES. In August 1981, the Arco Prestige, a civilian tanker ship chartered by the U.S. Navy, developed a

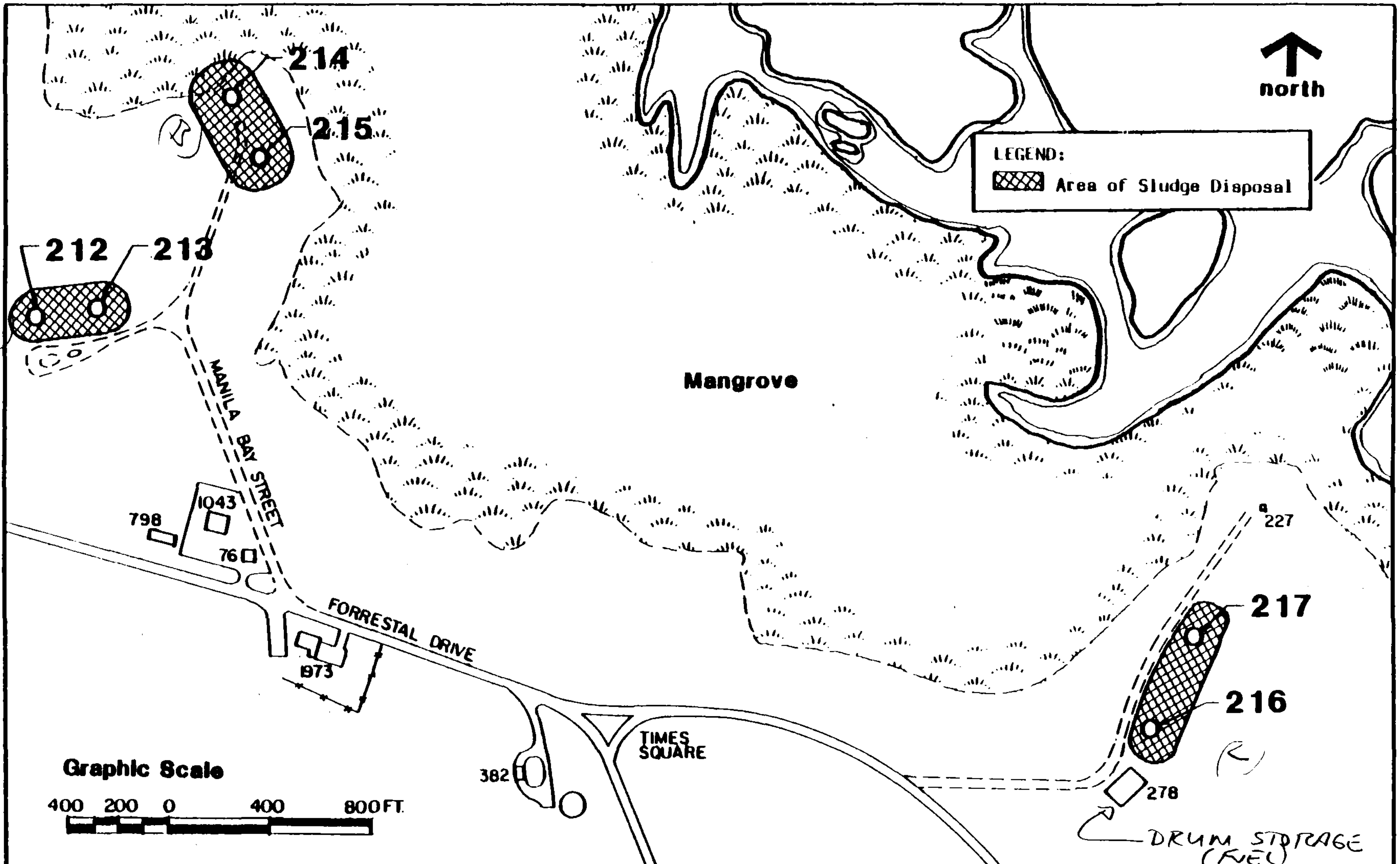

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FIGURE 8-11
SITE 13, TANKS 212-217

problem with the piping system while anchored in the vicinity of Berthing Pi No. 3 and leaked an estimated 210,000 gallons of diesel fuel into Ensenada Honda (see Figure 8-12). The fuel spread in a northwesterly direction across the harbor to Community Beach, the Ensenada Honda mangrove swamp north of Community Beach, and the area south to about Punta Cascajo.

Crowely Environmental Company was contracted to assist the Navy in cleanup operations. A boom was placed in the harbor and a skimmer on a flat bottom boat was used to remove the fuel floating on the surface of the water. The fuel was pumped into a Ships Waste Offload Barge (SWOB) with an oil-water separator. A large percentage of the spilled fuel was recovered from the harbor by this method. About 50 Navy personnel assisted Crowely Environmental Company in conducting cleanup operations along the shoreline using absorbent pads to remove fuel from Community Beach and the mangrove swamp. A total of 60 to 100 55-gallon drums of oil-soaked pads were collected and given to the Crash Crew for use in training. Approximately two to three five-ton truckloads of oil-stained sand also were removed from the beach front area. The remainder of the fuel (estimated at 100,000 gallons) was blown into the Ensenada Honda mangroves, or sank to the bottom.

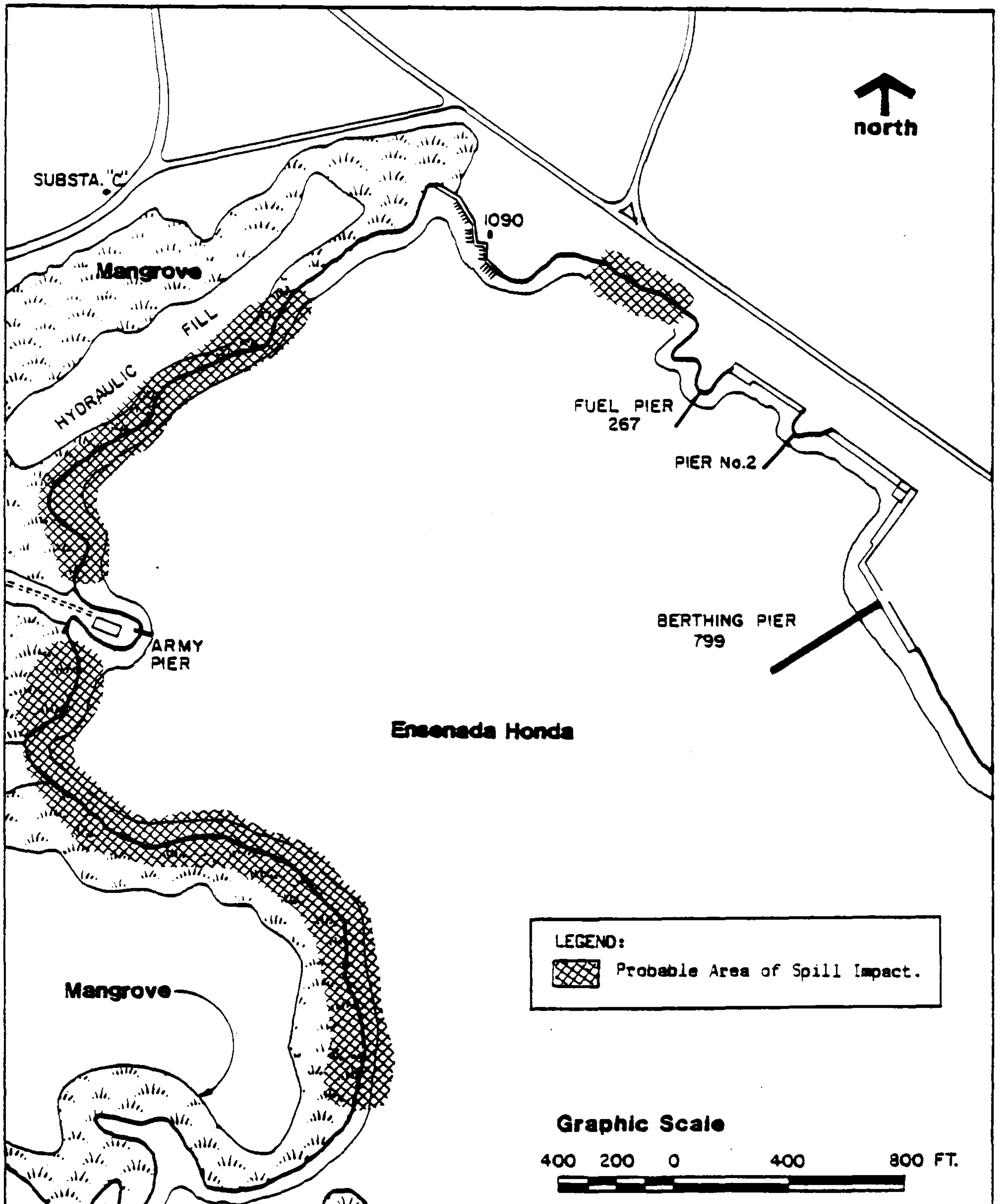
8.15 SITE 15, SUBSTATION 2. Substation 2, Building 90 (see Figure 8-13) has been used by the Public Works Department-Power Distribution Shop as a transformer repair shop since 1964. As part of the maintenance of pole-mounted distribution transformers, the transformer oil was drained to facilitate repair of the inner core and coils. From 1964 to 1979 used oil drained from the transformers was poured onto the ground in the vicinity of Building 90. Personnel interviewed remembered using PCB-based dielectric fluids (by the trade names of Askarel, Inerteen, and Pyranol) for servicing the transformers. Approximately 200 gallons of replacement transformer fluid were ordered per year by the Power Distribution Shop.

Assuming that the total 200 gallons of transformer fluid were used per year, it is possible that over the 15 years of this practice, a maximum of 3,000 gallons of transformer oil were drained to the soil in the vicinity of the building. This oil could have been either "pure" PCBs or oil containing PCBs in the 300-ppm range, as was common at the time.

The only exception to this standard operating procedure was with Askarel transformers. Due to incidents in the past whereby Power Distribution Shop personnel developed skin rashes from direct contact with Askarel, the transformers containing this fluid were drained directly to 55-gallon drums, which were then disposed of at the station landfill. The exact quantity of Askarel disposed of in this manner is unknown. Replacement five-gallon cans of Askarel were disposed of in the station landfill (Site 7) or the ocean (Site 9).

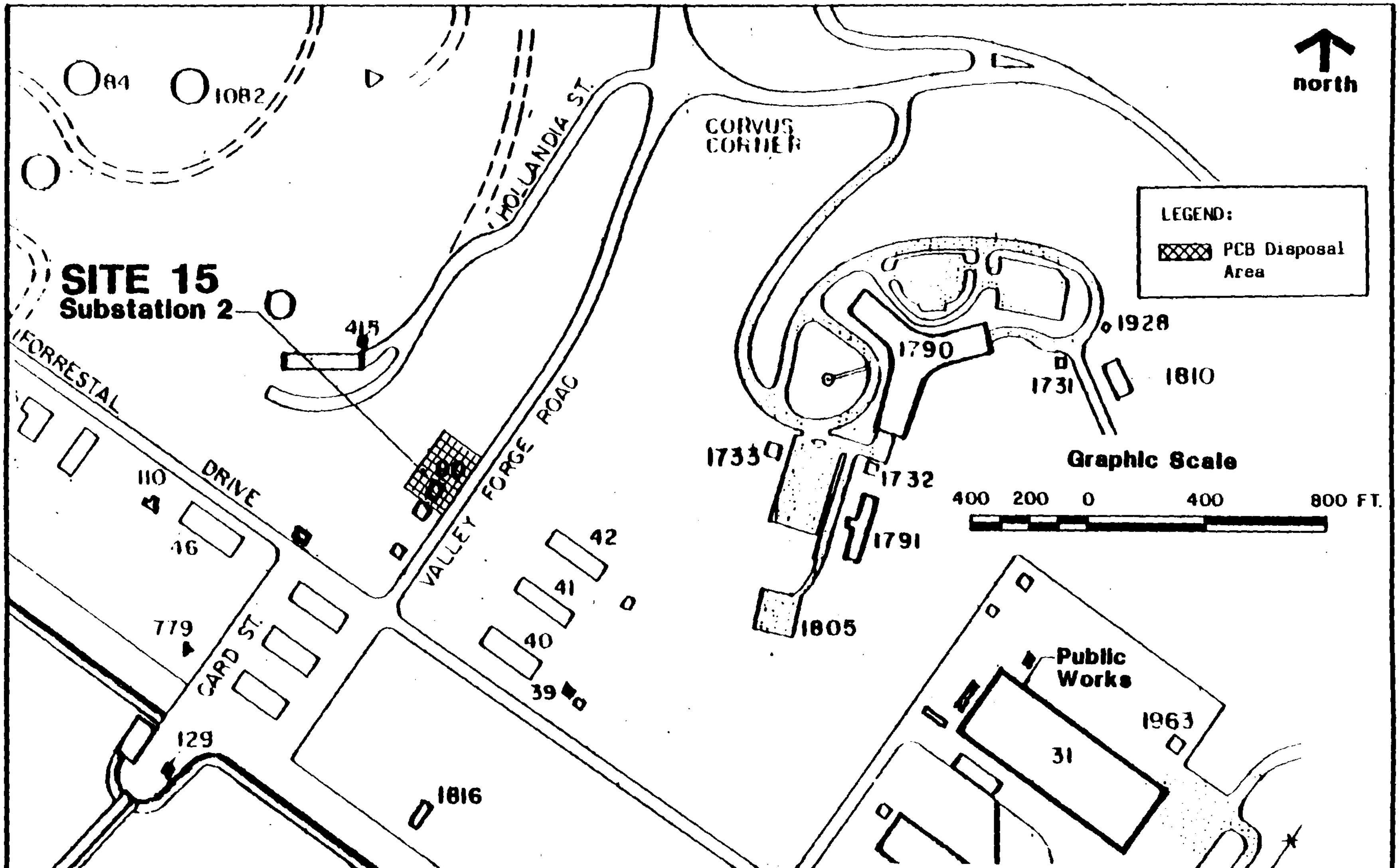
There is visible evidence of past oil spills around Building 90 today.

8.16 SITE 16, OLD POWER PLANT, BUILDING 38. Building 38 was a 60-megawatt steam turbine facility that generated power from the early 1940s through 1949 (see Figure 8-14). The plant used Bunker "C" fuel, which was stored in two 50,000-gallon reinforced concrete tanks located directly northwest of the building. During heavy rainfalls in the 1970s, Bunker C fuel was observed in the manholes near the building and was also discharged to the Enlisted Beach



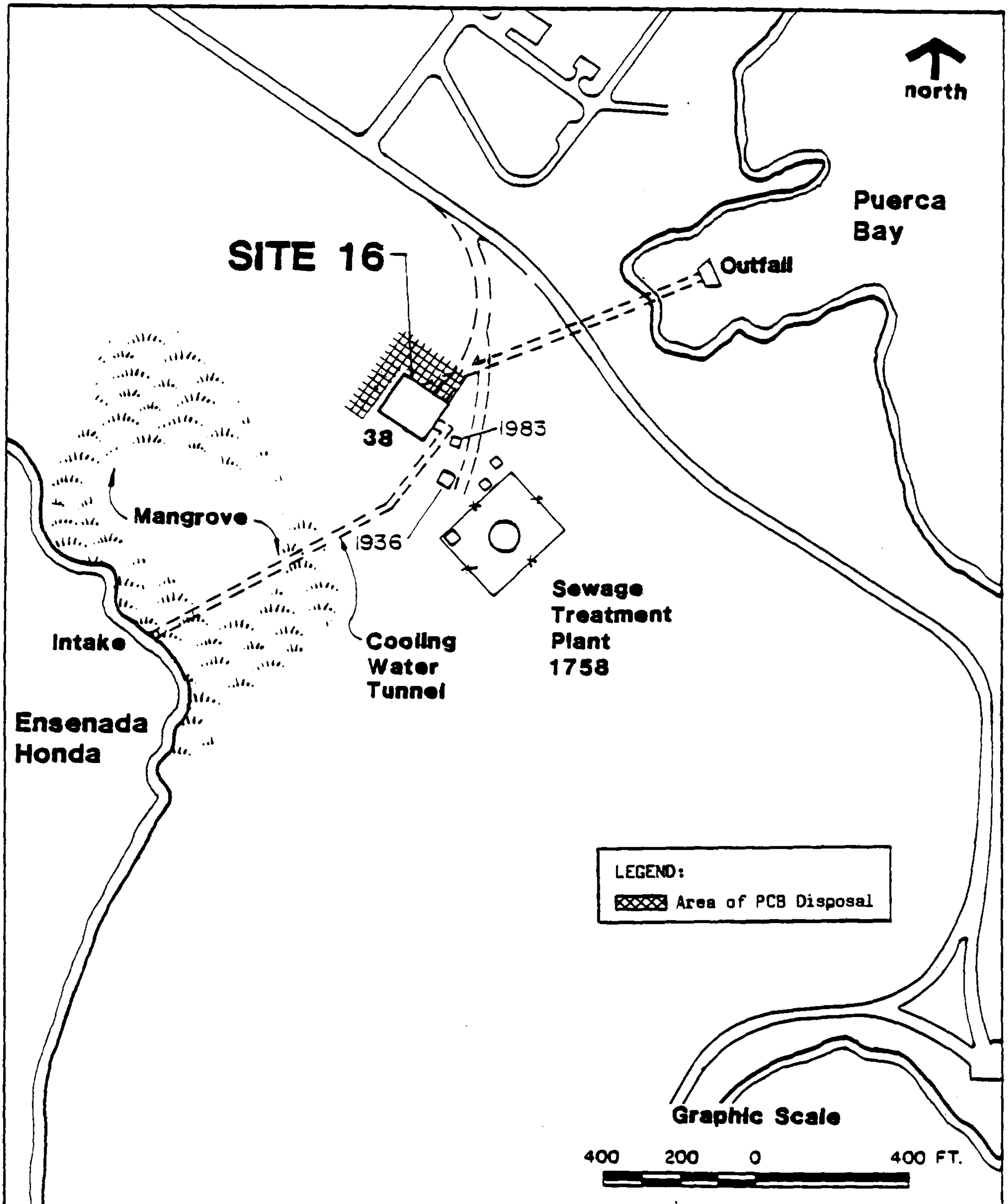
INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 8-12
SITE 14, ENSENADA HONDA
SHORELINE AND MANGROVES



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 8-13
SITE 15, SUBSTATION 2



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 8-14
SITE 16, OLD POWER PLANT,
BUILDING 38

via the old cooling water outlet for the Power Plant. A cleanup contractor hired twice to drain the underground fuel tanks and cleanup the spill.

From 1956 to 1964 transformer maintenance was performed at Building 38 by the Public Works Power Distribution Shop. The majority of transformer repair work was conducted just outside of the building at its northeast corner. As part of the maintenance of the transformers, the transformer oil was drained to facilitate repair of the inner cores and coils. Interviewees reported draining the transformers to the soil in the immediate vicinity of the building. The only exception to this practice was with Askarel (a type of PCB) transformers. Power Distribution Shop employees drained transformers containing Askarel directly to 55-gallon drums which were disposed of at the station landfill. The exact quantity of Askarel disposed of in this manner is unknown. The Power Distribution Shop ordered 200 gallons of replacement transformer fluid per year. Assuming the total 200 gallons were used each year, it is possible that over the eight years during which Building 38 was used, approximately 1,600 gallons of transformer oil were drained to the soil in the vicinity of the building, with some portion going to the landfill. The transformer oil commonly used in this time frame was either "pure" PCBs or oil containing PCBs at a 300-ppm concentration.

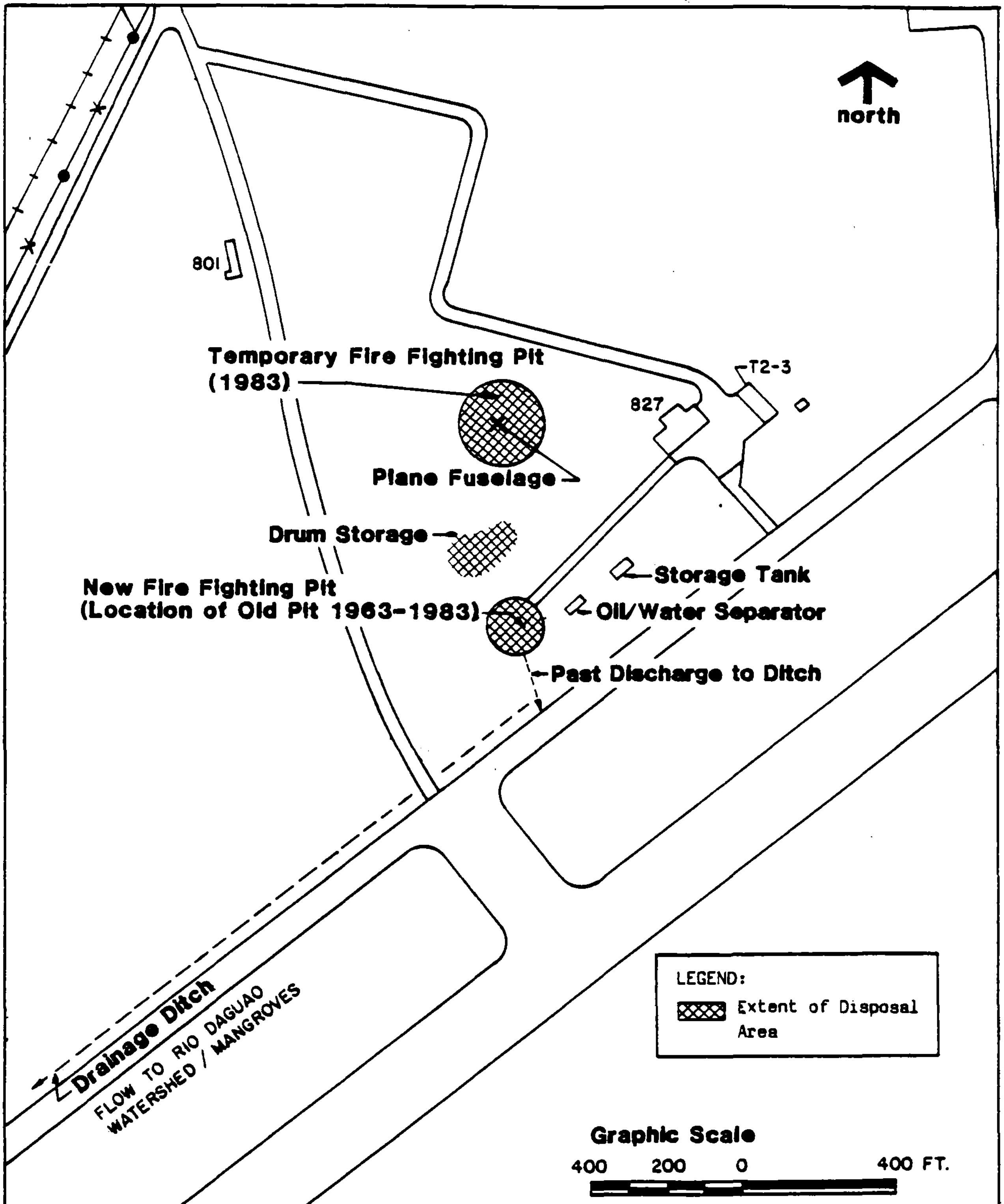
Vegetation once located at the northeast corner of the building has since died. Interviewees suggested that the cause of this may have been the disposal of transformer fluids in this area, or the leakage of Bunker C fuel from the two 50,000-gallon underground storage tanks. The vegetation to the northwest and southwest of the building was also stressed.

8.17 SITE 17, CRASH CREW TRAINING AREA. The Crash Crew training area (see Figure 8-15) was operated by the Air Operations Department from the early 1960s through 1983.

Two unlined pits were used in the past for fire fighting training. The first pit, which was approximately 40 feet in diameter, was used from the early 1960s through the beginning of 1983 (20 years). Assuming 20 years of operation, about 120,000 gallons of waste solvents, fuels, and oils were placed in the pits and set on fire for fire fighting training. Also burned were wood, trash, plastic, fuel filter elements, oily rags, and other debris. The fires were extinguished using aqueous film-forming foam (AFFF) and potassium bicarbonate (Purple K). Past aerial photographs show drainage from this pit to the ditch along the runway shoulder. The new fire training pit was built at the same location as the old pit. When the new pit was built, all of the oil-stained, contaminated soil was excavated and most likely disposed of in the base landfill.

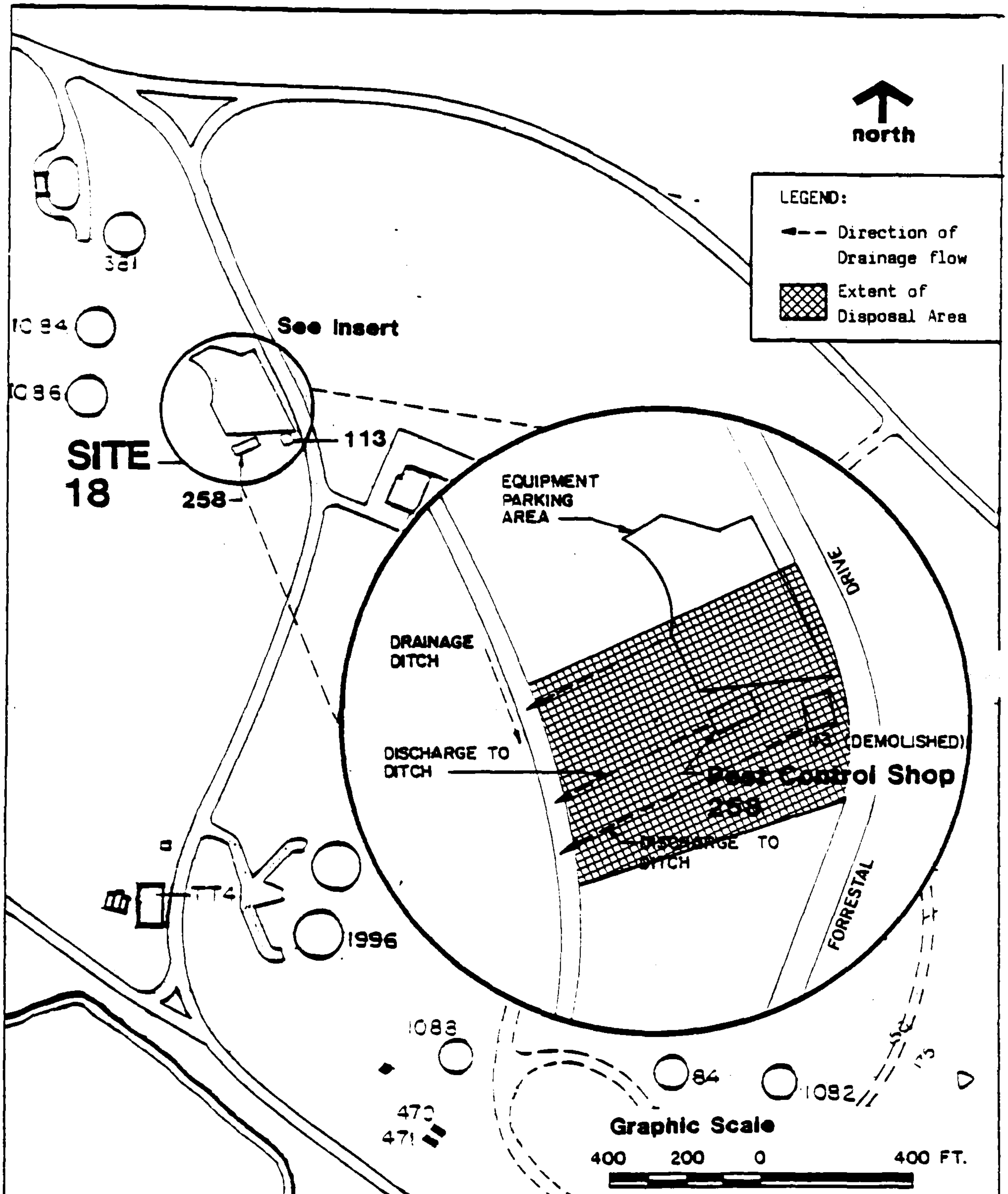
The second pit was used temporarily during the construction of the new fire training pit in 1983. This unlined gravel pit has a diameter of 200 feet and was used approximately six times. Approximately 3,000 gallons of waste fuel, oil, and solvents were burned in this area. Only small amounts of fuel were allowed to soak into the ground.

8.18 SITE 18, PEST CONTROL SHOP. The Pest Control Shop (see Figure 8-16) was located at Building 258 from the late 1950s through 1983. Pesticides were stored in Building 258 and also on the parking apron. Former Pest Control Shop



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 8-15
SITE 17, CRASH CREW TRAINING AREA



INITIAL ASSESSMENT STUDY
NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

FIGURE 8-16
SITE 18, PEST CONTROL SHOP

employees remember incidental spillage of pesticides in and around the building. In 1976 a 55-gallon drum of malathion, which was stored outside the building, ruptured and the contents spilled onto the ground, eventually washing into the drainage ditch in back of the building. This same ditch received rinse waters from the cleaning of pesticide equipment over a storm drain which discharged to the ditch. Excess pesticides were also poured into this ditch. Past environmental engineering surveys cite numerous aquatic kills due to pesticides entering the ditch. The area surrounding the building is devoid of vegetation, although the drainage ditch does not show any signs of stressed vegetation.

Pesticides used in the past include DDT, Paris Green, maldane, malathion, and chlordane. Table 8-1 gives toxicological information for each of these pesticides. There is no information available, either from records or interviewees, regarding the amounts or concentrations of the pesticides used. Table 8-1 contains information on amounts gathered from the 1980 Pest Management Plan.

8.19 SITE 19, WEST EXPLOSIVE ORDNANCE DISPOSAL (EOD) RANGE, VIEQUES. The West EOD Range, located within a one-half-mile radius of the old bridge at Punta Boca Quebrada (see Figure 8-1), was used from 1969 to about 1979. Interviewees stated the range may have been used since the 1940s. This is supported by the fact that no EOD blows have ever occurred on Roosevelt Roads itself, but no records exist. The range was closed after an accident in 1976 involving an undetonated photoflash cartridge. Between 1976 and 1979, the range was swept at least three times by EOD personnel. Inert items can still be seen scattered throughout the area, and unexploded munitions may still be present underground or in areas of extremely dense thorn shrub.

8.20 SITE 20, CAMP GARCIA DISPOSAL SITE, VIEQUES. The Camp García disposal site (see Figure 8-2) is located on high ground approximately 3,000 to 4,000 feet north-northwest of Bahía de la Chiva (Blue Beach) and 1.5 to 2 miles east of Camp García. The landfill was in operation from approximately 1954 to 1978, and serviced an average population of 150 individuals. This number was significantly increased during maneuvers and other military exercises. A five-ton dump truck was used to dispose of waste at the site. At least one trip per day was made to the site five days a week. The Camp García maintenance staff estimated that, on the average, 2.5 tons of waste were disposed of per week at the site over a 24-year period. Navy personnel estimated that 75 tons per year were deposited per week. It is estimated that between 1,800 and 3,120 tons of materials total have been disposed over the 100- to 200-acre area. This includes waste from the activity at Camp García over the 24-year period, as well as the EM Club, Staff Club, and Officers Club between 1965 and 1978.

Only Type I waste including paper, corrugated containers, rags, wood, scrap metal, cans and food packaging materials, and yard waste generated from the activities were taken to this site. Food garbage from Camp García and NAF, Vieques, was collected by civilians and used as livestock feed by the local farmers. Bulky wastes and junk vehicles were transported to Roosevelt Roads for disposal or to recheck survey yards or scrap steel stock sites. Junk vehicles were occasionally used on the range as targets; when destroyed, they were transported to Roosevelt Roads for disposal. Waste oil was also

Table 8-1

TOXICITY OF PESTICIDES HISTORICALLY USED AT ROOSEVELT ROADS

Pesticide	LD_{50} - Rat (mg/kg)*	Toxicity Rating	Annual Usage, 1980
Chlordane	283	High via oral and intraperitoneal routes	120 gallons, 72%**
DDT	113	High via oral and dermal routes	N/A
Diazinon	76	High via oral and dermal routes	10 gallons, 48%
Malathion	1,401	Moderate via oral and dermal routes	22 gallons, 95%
Paris Green (copper acetate)	710	Moderate via oral and inhalation routes	N/A
Dursban	145	High via oral and dermal routes	10 gallons, 41%

*The LD_{50} is the statistical estimate of dosage necessary to kill 50% of an infinite population of test animals.
**Percent active ingredient.

Source: Pesticide information taken from Dangerous Properties of Industrial Materials, Fifth Edition, N. Irving Sax, ed.; 1980 Pest Management Plan, NAVSTA Roosevelt Roads.

transported to Roosevelt Roads for disposal. Since 1978, all waste from the Vieques Naval Reservation has been disposed of in the municipal landfill.

The trench method of disposal was employed and land clearing was kept to a minimum to avoid erosion problems at the site. With the use of a bulldozer a trench was dug into which materials were disposed. The trench was then covered with six inches of soil to control blowing of litter. A final soil cover of two feet was placed over the trench.

No hazardous materials were ever disposed of at this landfill.

Other disposal areas on Camp García include a construction rubble disposal area, a scrap metal disposal area, and an aboveground disposal area for general trash. These areas do not constitute a potential pollution threat.

BIBLIOGRAPHY

BIBLIOGRAPHY

Atlantic Division, Naval Facilities Engineering Command, updated (c. 1981), U.S. Naval Complex Master Plan, Roosevelt Roads, Puerto Rico.

Bartelli, Linda J., December 1968, Classification and Correlation of the Soils of Humacao Area, Puerto Rico, Fort Worth, Texas, USDA, Soil Conservation Service, South Regional Technical Service Area.

Bentley, Craig B., James L. Cook, et al., July 1981, Water Resources Data for Puerto Rico, U.S.G.S. Water Data Report PR-78-1, Water Year 1978, prepared in cooperation with Commonwealth of Puerto Rico and other agencies.

Bonnet Benítez, Juan Amédée, 1976, Vieques en la Historia de Puerto Rico, San Juan, Puerto Rico, F. Ortiz Nieves.

Cunanan, P., 1976, Sanitary/Environmental Facilities Survey Report for U.S. Naval Ammunition Depot, Vieques, Puerto Rico.

Curtis, Russell, etal., March 1983, Water Resources Data, Puerto Rico, Water Years 1981 to 1982, U.S.G.S. Water Data Report PR-81-82-1, prepared in cooperation with the Commonwealth of Puerto Rico and other agencies.

Environmental Quality Board (EQB), March 1982, Regulations for the Control of Hazardous and Non-Hazardous Solid Wastes, Office of the Governor, Commonwealth of Puerto Rico.

Feliciano, Claro C., 1981, Apuntes y Comentarios de la Colonización y Liberación de la Isla de Culebra, Puerto Rico, Art Printing, Inc.

Fettke, Charles R., 1924, "The Geology of the Humacao District, Porto Rico," in Scientific Survey of Porto Rico and the Virgin Islands, Academy of Sciences, Volume II, Part 2, New York, New York.

Gierbolini, Roberto E., et al., December 1975, Soil Survey of Mayagüez Area of Western Puerto Rico, USDA Soil Conservation Service, College of Agricultural Sciences.

Goméz-Goméz, Fernando, and Senén Guzmán-Rios, 1982, Reconnaissance of Ground-water Quality throughout Puerto Rico, September-October 1981, U.S.G.S. Water Resources Division, Open File Report 82-332, prepared in cooperation with the Environmental Quality Board of Puerto Rico.

Goodwin, David, P.E., 1977, Environmental Engineering Survey, April 1977, Marine Corps Training Facility, Camp García, Utilities Division, Atlantic Division, Naval Facilities Engineering Command.

_________, 1978, Environmental Engineering Survey, Naval Ammunition Facility, Vieques (UIC 00389).

Hazardous Waste Annual Report, 1982, Weapons Department, Naval Station Roosevelt Roads (UIC 00389).

_________, 1982, Report 14, AFWTF Torpedo Shop (UIC N0017A).

Johnson, Karl G., Ramón A. Carrasquillo, and Ralph González, December 1982, Flood of October 8, 1977, in St. Croix, U.S. Virgin Islands, U.S.G.S. Water Resources Investigations 82-262, Open File Report, in cooperation with the Government of the U.S. Virgin Islands, Department of Public Works, San Juan, Puerto Rico.

Jordon, D.G., and B.D. Gilbert, September 1976, Water Supply and Waste Disposal, Culebra, Puerto Rico, U.S.G.S., Water Resources Investigations 3-76, Washington D.C., Department of the Interior.

Junta de Cualidad Ambiental, 1971, An Island in Transition - Culebra 1970, San Juan, Puerto Rico, Office of the Governor, Environmental Quality Board (Document No. 100-CAM-mp).

López, Miguel A., and Fred K. Fields, August 1970, A Proposed Streamflow Data Program for Puerto Rico, USDOT, Geological Survey, Caribbean District Open File Report, prepared in cooperation with Commonwealth of Puerto Rico.

Multer, H. Gray, and Lee C. Gerhard, 1974, Guidebook to the Geology and Ecology of Some Marine and Terrestral Environments, St. Croix, U.S. Virgin Islands, Special Publication No. 5, Christian, St. Croix, West Indies Laboratory, Fairleigh Dickenson University.

Naval Sea Systems Command, December 15, 1980, Technical Manual Otto Fuel I Safety, Storage, and Handling Instructions.

Philibosian, Richard, and John A. Yatema, 1977, Annotated Checklist of the Birds, Mammals, Reptiles, and Amphibians of the Virgin Islands and Puerto Rico, Frederiksted, St. Croix, Information Services.

Pico, Rafael, 1974, The Geography of Puerto Rico, Chicago, Aldine Publishing Company.

Samailoff, Louise Cripps, 1984, Portrait of Puerto Rico, New York, Cornwall Books.

Sullivan, Gregory F., 1978, Environmental Engineering Survey, U.S. Naval Station, Roosevelt Roads, Puerto Rico, Utilities Division, Atlantic Division, Naval Facilities Engineering Command, Norfolk, Virginia.

Tippetts-Abbett-McCarthy-Stratton (TAMS), March 30, 1973, DEIS, Atlantic Fleet Integrated, Weapons Training Ranges (Culebra Study), Prepared for Commander-in-Chief U.S. Atlantic Fleet, New York, New York, TAMS.

_________, and Ecology and Environment, Inc., 1979, Draft Environmental Impact Statement, Continued Use of the Atlantic Fleet Weapons Training Facility, Inner Range (Vieques), Department of the Navy, Volumes I and II.

_________, 1980, Final Environmental Impact Statement, Continued Use of the Atlantic Fleet Weapons Training Facility, Inner Range (Vieques), Departme of the Navy

United States Department of Agriculture (USDA), August 1970, Soil Survey of the Virgin Islands of the United States, Washington D.C., USDA Soil Conservation Service.

United States Department of the Army, October 1969, Ammunition, General, Technical Manual No. 9-1300-200, Washington, D.C., Department of the Army.

United States Department of the Interior (USDOI), March 19, 1971, Impact of Four Configurations of the Natural and Physical Envirmnment of Culebra and Adjoining Cays and Their Recreational Values, Atlanta, Georgia, USDOI, Bureau of Sport Fisheries and Wildlife.

_________, September 1981, Final Environmental Impact Statement, Proposed Disposition and Administration of Land Declared Excess By the U.S. Navy on the Island of Culebra and Culebrita in Puerto Rico, Atlanta, Georgia, USDOI, Fish and Wildlife Service.

United States Navy, 1983, Manual for the Use of the Atlantic Fleet Weapons Training Facility, Naval Station Roosevelt Roads, Puerto Rico,

LANTFLTWPNTRAFAC INST. 3120.1F.

Aerial Photographs

1951, Roosevelt Roads, Ceiba, Puerto Rico, 33/36; 84/88; 137/153.

1962, North Tip, Roosevelt Roads, Puerto Rico, 1962, 8-10/8-11.

1964, Culebra, Puerto Rico, 34/66.

1964, Roosevelt Roads, Ceiba, Puerto Rico, 61/65; 82/87; 90/96.

1964, Vieques, 137/142; 149/159.

1967, Vieques, 186/202; 163/168.

1972, Culebra, Puerto Rico, 004/014; 019/029; 033.

1972, Roosevelt Roads, Ceiba, Puerto Rico, 001/007; 049/055.

1972, Vieques, 15/59.

APPENDIX A
LIST OF OFFICES VISITED AND RECORDS REVIEWED

APPENDIX B
FLORA AND FAUNA OF ST. CROIX

APPENDIX C
GLOSSARY

APPENDIX A

List of Offices Visited and Records Reviewed

APPENDIX A. LIST OF OFFICES VISITED AND RECORDS REVIEWED

Atlantic Fleet Weapons Training Facility, File Titles:

- MILCON Projects
- Oil Spill Records File

Department of Defense (DOD) Explosives Safety Board, Alexandria, Virginia.

National Archives, Washington, DC:

- Cartographic Branch (Alexandria, Virginia)
- Still Picture Branch, Audio Visual (Washington, DC)
- Navy and Old Army Branch (Washington, DC):
    - Record Group 38, Records of Office of Chief of Naval Operations
    - Record Group 71, Records of Bureau of Yards and Docks
    - Record Group 72, Records of Bureau of Aeronautics
    - Record Group 74, Records of Bureau of Ordnance
    - Record Group 80, General Records of the Navy
    - Record Group 181, Records of Naval Districts and Shore Establishments

Naval Communication Station, Roosevelt Roads, File Titles:

- Pollution Control
- Forestal Regulations for Special Permits No. 1
- National Pollutant Discharge Elimination System (NPDES) for Fort Allen
- Engineering Service Request
- Class V Underground Injection
- Sewage Treatment EPA Report (LANTDIV)
- Air Pollution Control Permit No. 2 for Building 386, Roosevelt Roads
- Air Pollution Control Permits, Fiscal Year 1982

Naval Energy and Environmental Support Activity, Port Hueneme, California:

- NACIP Files
- Hazardous Materials Files
- Activity Files
- NPDES Permits and Reported Data
- Pollution Control Reports
- Potable Water System Files

Naval Facilities Engineering Command, Atlantic Division, Caribbean, File Titles:

- Inventory of American Islands
- U.S. Navy Atlantic Fleet Weapons Range
- Environmental Pollution General Folders Nos. 1-4, 7 (Nos. 6240/1, 6240/2)
- EXXON Research and Engineering Company Report
- NAVSTAINST 6240.6, Code 181F
- EPA Solid Waste Guidelines, Compliance Survey of Federal Jurisdiction (Code 00389)
- Abandoned PCB Transformers at Naval Station (NAVSTA) San Juan
- EPA Generator Annual Hazardous Waste Report, Files:
    - Culebra Environmental
    - Culebra Water General
    - Culebra General

- NAVSTA San Juan Permits for Water Discharges
- St. Thomas Electric
- LST Mole, Vieques
- Virgin Islands Power Contract
- St. Thomas Water (Folder 3)
- St. Thomas Water (December 1971)
- St. Thomas Water (January 1972 to February 1979)
- Aruba Water
- St. Thomas Water Caper
- Vieques Environmental (General)
- Solid Waste: Garbage and Scrap
- Vieques Air Quality Permits
- Camp Garcia Sewage Plant
- Ocean Dumping and Permits
- Vieques Air Quality
- Unmarked (Vieques Operations)
- Economic Assistance Situation
- NAVSTA Roosevelt Roads
- Miscellaneous Vieques Environmental
- Vieques Environmental
- Camp Garcia Water
- Vieques Water
- Vieques Office of Economic Adjustment
- Initial Report, Defense Access Roads, Island of Vieques Naval Facilities
- Vieques Supplement to "Plano Regulador Junta de Planificacion"
- Coastal Zone Management Program
- Ocean Dumping Permits; Army Permits for Construction
- TAMS Supplement to DEIS, Phase 1 Interim Report
- EIA, LST Mole Dredging, Vieques, Puerto Rico (31 August 1972)
- Vieques Naval Maneuver
- Correspondence Folder for:
  - COMANTDEFCOM
  - COMNAVFORCARIB
  - COMFAIRCARIB
  - COMNAVBASE
  - Roosevelt Roads, Puerto Rico
- USMC, DEIS, Vieques Military Range Complex, Vieques, Puerto Rico 29 February 1972)

Naval Facilities Engineering Command, Engineering Field Division:

- Atlantic Division (LANTNAVFACENGCOM), Norfolk, Virginia
- Environmental Branch
  - Activity Environmental Files
- Facilities Planning
  - Environmental Impact Statements
  - Environmental Impact Assessments
  - Activity Master Plans
  - Cadastrial Records
  - Aerial Photos
- Real Estate
  - Natural Resources Records
  - Operational Real Estate Records

- Military Readiness
  - Records of Storage of Military Readiness Chemicals
- Design Division
  - Geotechical Records
- Utilities
  - Utility Maps and Applied Biology

Naval Facilities Engineering Command Headquarters, Alexandria, Virginia
- Real Estate Branch

Naval Facilities Engineering Command Historian, NCBC Port Hueneme, California
- Photographs
- Activity Historical Files; with the Following Titles:
  - Camp Moscrip, Puerto Rico, Roosevelt Roads
  - Puerto Rico General (Roosevelt Roads)
  - Puerto Rico General: Fort Allen 941AC, Salinas 1360, Ramey Command Annex
  - Martin Pena, Puerto Rico (Culebra)
  - Isabela, Puerto Rico
  - Martin Pena, Puerto Rico
  - Sabana Seca, Puerto Rico
  - San Juan, Puerto Rico, Naval Station on Isla Grande
  - San Juan, Puerto Rico, Naval Command Station, Salinas, Fort Allen
  - San Juan, Puerto Rico, Naval Station
  - Roosevelt Roads, Puerto Rico, Guided Missile OPNS
  - San Juan Fuel Depots, Catano and San Antonia
  - San Juan, Puerto Rico, General Area
  - Geological File, Puerto Rico
  - OSJ, Puerto Rico
  - Dry Dock and Repair Facility
  - Roosevelt Roads After Fall 1962
  - San Patricio, Puerto Rico
  - Vieques Island, Puerto Rico

Naval Historical Center, Operational Archives, Washington Navy Yard, Washington, DC:
- War Diaries of World War II
- Annual Command Histories

Naval Sea Systems Command, Crystal City, Alexandria, Virginia

Naval Station Roosevelt Roads

Ordnance Environmental Support Office (OESO), Indian Head, Maryland

Regional Federal Archives and Records Centers:
- Federal Archives and Records Center (Bayonne, New Jersey) Record Group 181 - Records of Naval Districts and Shore Establishments

- Washington National Records Center, Archives Branch (Suitland, Maryland) Record Group 74 - Records of Bureau of Ordnance

United States Geological Survey (USGS), Field Offices, San Juan, Puerto Rico and Reston, Virginia

APPENDIX B

FLORA AND FAUNA OF ST. CROIX

APPENDIX B. FLORA AND FAUNA OF ST. CROIX

B.1 FLORA OF ST. CROIX. Most island floras have at least some species of plants that are found nowhere else. These species, called "endemics," make up as much as 97% of the indigenous floras of some very high, very isolated islands, such as the Hawaiian group. Islands closer to other large islands or continents usually have a much lower percentage of endemics. The Virgin Islands have only a few endemic vascular plant species. Out of a total indigenous flora recorded by N. L Britton in 1918 for the U.S. Virgin Islands (the last list published) of 890 native seed plant species, 27 were considered endemic to the island group, and only four of the 27 were restricted to St. Croix. These figures have changed slightly since then, but not significantly.

Due to the activities of the Navy, extensive habitats have developed for xerophytic (dry-tolerant) species, and plants once confined to small dry rain shadow areas and steep, over-drained, rocky slopes have prospered and greatly extended their ranges, and now dominate much of the island. Thorny acacias, rigid spiny Randia, and several cacti are among the most obvious members of the flora.

The widespread strand and mangrove floras have been more successful than most other components of the total flora. Although their habitats have been much reduced, there are still many parts of the coastline where salt-tolerant species can find a home and where they may be seen to advantage. Inhospitable wind and spray-swept bluffs have not been much modified, and plants evolved for these conditions, such as Suriana, Lithophila, Sporobolus argutus, and Jacquemontia cumanensis, grow here. Likewise, on sand ridges and beach flats, Tournefortia gnaphalodes, Scaevola plumieri, Ipomoes pes-caprae, Sporobolus virginicus, Ernodea littoralis, and many other species still form a rather diverse shrubby or low vegetation, liberally parasitized by orange-colored stringy Cassytha. Here also the poisonous Hippomane, with Pisonia, Thespesia, Coccoloba, and other trees, form patches of beach forest. In saline swamps the several diverse trees termed mangroves, each with its own peculiar pneumatophores or "breathing" apparatus--Rhizophora, Laguncularia, Conocarpus, and Avicennia--form a characteristic vegetation. In open saline places Batis maritima and Sesuvium portulacastrum form conspicuous succulent mats.

Likewise, the Caribbean dry lowland flora shows considerable diversity. As noted above, its habitat on St. Croix was expanded as a result of human influence. Such widespread Caribbean genera as Acacia, Bursera, Bromelia, Cordia, Bourreria, Cephalocereus, Croton, Tabebuia, Piscidia, Melicoccus, Opuntia, Melocactus, Crescentia, and Pithecellobium are frequently seen. In slightly moister sites further upland other Caribbean genera such as Ficus, Eugenia (represented by a diversity of species), Clusia, Coccoloba, Amyris, Zanthoxylum, Lasiacis, the handsome but poisonous Comocladia, Andira, Enallagma, and Bucida (which also occurs at lower elevations) are found. Piper and Peperomia are common beneath the trees. Ferns are present in these higher, slightly moister areas, but are few, both in species and in numbers of individuals. This slightly more mesophytic flora is well represented in the higher mountains and in deep shaded gulches. Psychotria, an enoromous pantropical genus, is present in several species, prominent in the undergrowth. The epiphytic flora, even in the wettest areas, is very limited. Most of the few ferns and even some of the even fewer orchids are terrestrial.

The vast tropical American rain forest flora is almost totally unrepresented in St. Croix, as might be expected from the dryness of its climate.

While the native flora has been diminishing, the exotic flora has increased enormously. Economic plants, ornamentals, and weeds continue to be brought in, either intentionally or accidentally, and many of them have now become established.

Sugarcane and a number of forage grasses, such as Guinea grass (Panicum maximum), came in early. Sugar was the dominant crop for many years under Danish rule. The picturesque ruins of old windmills dot the landscape, indicating the sites of old sugarcane plantations. Although there are no plantations now, sugarcane (Saccharum officinarum) persists here and there, a tall coarse grass with pale silvery-lavender tassels.

Fruit trees such as mango (Mangifera indica), sour sop (Annona muricata), and sugar apple (Annona squamosa) are both cultivated and freely naturalized in the more moist areas. The papaya (Carica papaya) and the banana (Musa sapientum), which appear to be trees but are really gigantic herbs, are frequent, both planted around dwellings and, especially the papaya, naturalized.

Cotton (Gossphium barbadense and G. hirsutum) persists around settled areas as a reminder of former cultivation. Sisal (Agave sisalana) forms small stands, relicts of earlier attempts to establish a fiber industry on the island.

Coconut palms (Cocos nucifera) provide both food and drink, as well as characterize the tropical landscape.

Among the widespread tropical weeds to be seen in St. Croix gardens, fields, and along roadsides, are nut-grass (Cyperus rotundus), goose-grass (Eleusine indica), finger-grass (Chloris barbata), spurges (several species of Euphorbia), sand-bur (Cenchrus echinatus), false mallow (Malvastrum coromandelianum and a number of species of Sida and Abutilon), purslane (Portulaca oleracea), beggar's ticks (Bidens pilosa), beggar's lice (various species of Desmodium), and others. At least one native plant, Boerhavia coccinea, is a very successful weed.

The plants that give the tropics their reputation for floral magnificence are almost all exotics on St. Croix. Splashy, gaudy Bougainvillea, flamboyant (Delonix regia), golden shower (Cassia fistula), coral tree (several species of Erythrina), Mexican creeper (Antigonon leptopus), Ixora, African tulip (Spathodea campanulata), and ginger Thomas (Tecoma stans, possibly native), are present.

Foliage plants contribute greatly to this pantropical ornamental flora. Crotons (Codiaeum variegatum) and panax (several species of Polyscias), Rhaphidophora aurea, Buttonwood (Conocarpus erecta, probably native), bowstring hemp (several species of Sansevieria), asparagus fern (Asparagus sprengeri), and many others are seen. Breadfruit trees (Artocarpus altilis) from the South Seas provide excellent food.

The Tamarind (Tamarindus indicus) is, next to mahogany, perhaps the most common tree on the island. It comes from Asia, where the acid pulp of the pods is used to form the base of a pleasant soft drink. The mango (Mangifera indica), a tall tree with a full, seasonally varicolored crown, is present thoroughout the island.

Ornamental trees that yield valuable woods are the monkey pod (Samanea saman), mahogany, woman's tongue (Albizia lebbeck), the wood of which is widely used for charcoal, and many others.

The tropical almond (Terminalia catappa) has an elegant pagoda-like, horizontal branching pattern, a scattering of large bright red leaves, and a fruit containing an edible nut.

Palmettoes (Sabal), California fan plams (Washingtonia), native fan palms (Coccothrinax), date palms and Canary Island palms (Phoenix), and a few fis-tail palms (Caryota), as well as ornamental Pritchardia, are to be seen in many places.

Aroids (Araceae) are present locally on St. Croix in the wetter parts of the island and in gardens that are watered. Elephant ear (Alocasia), Monstera deliciosa, Rhaphidophora aurea, Anthurium, and various philodendrons are examples.

The mulberry family (Moraceae), though named for a temperate tree, is an enormously developed tropical family. Figs (Ficus) including various banyans and stranglers, breadfruit (Artocarpus), and the Cecropia, uncommon on St. Croix, but present, are members of this family.

Perhaps the most ubiquitous of all tropical families is the pea or bean family (Leguminosae). It is represented literally everywhere, and includes trees, lianas, shrubs, creepers, and herbs (smooth, fuzzy, or spiny). The spiny acacias which dominate the thorn forests also are legumes, as are the tamarine, the gorgeous pride-of-Barbados (Caesalpinia pulcherrima), chick peas (Cicer arietinus) and beans (Phaseolus vulgaris) which are items in the local diet, and the local fish-poison tree (Piscidia piscipula).

The orchid family (Orchidaceae), the largest of plant families and one of the most typical, is poorly represented on St. Croix. A number of species of Epidendrum are found in the mountain forests, but are rare and localized. Another grows in the scrub on the sand flats of Sandy Point.

The spurge family (Euphorbiaceae) is well represented. Its most notable local member, the deadly manchineel (Hippomane mancinella), with caustic sap and poisonous fleshy fruit, is commonly seen on beaches and the edges of mangrove swamps. A number of species of Croton, gray fuzzy-leafed shrubs, dominate large areas of scrub on dry slopes. An interesting shrubby Euphorbia is common in coastal scrub. A number of small weedy spurges (Euphorbia species) are abundant in cultivated and disturbed ground. The fleshy-stemmed shrub, Pedilanthus padifolius, is found on one or two high ridges, such as Lang Peak or Jakobsberg. Several cactus-like African species of Euphorbia, such as Euphorbia antiquorum and E. milii, are cultivated, as is rarely the Otaheite gooseberry, Phyllanthus acidus. The castor oil bean (Ricinus communis) and several similar species of Jatropha grow as weeds and are occasionally planted. Of these, Jatropha gossypifolia may be native.

The dogbane family (Apocynacear) is not well represented on St. Croix, but contains several fine ornaméntals, such as the grangipani (Plumeria rubra), Allamanda hendersonii, the oleander (Nerium oleander), the false gardenia (Tabernaemontana divaricata), and the curious Adenium with showy pink flowers and a swollen stem base.

The trumpet-vine family (Bignoniaceae) provides some of the finest flowering trees, shrubs, and vines, such as the famed Ginger Thomas (Tecoma stans), official island flower of St. Croix; the African tulip (Spathodea); the jacaranda (Jacaranda mimosifolia); several handsome Tabebuia species; the red Tecomaria capensis; and the curious sausage-tree. In addition, the calabash tree has long leafy wand-like branches and cannonball-like fruits from which utensils are made.

Finally, the coffee family (Rubiaceae) is frequently seen. The most ornamental in St. Croix are several kinds of Ixora, with scarlet flowers. Coffee itself (Coffea arabica and another species) persists in a few places from former cultivation. Psychotria, a green-stemmed shrub which bears red fruit, is common in undergrowth in all moist forests. The pain-killer Morinda citrifolia is a commonly seen shrub or small tree with a reputation in folk medicine. Several inconspicuous tree species of Guettarda are found in the forests. Portlandia grandiflora has been brought from Jamaica to be planted in gardens. The littoral shrubs Ernodea littoralis, Strumpfia maritima, and Erithalis fruticosa, are common enough locally in their proper habitats.

B.2 AVIFAUNA OF ST. CROIX. Off the northeast coast of St. Croix lies Buck Island National Monument. Birds recorded here are typical of the arid scrub, and include the brown pelican, magnificent frigatebird, red-tailled hawk, laughing gull, Zenaida dove, ground dove, green-throated carib, gray kingbird, Caribbean elaenia, yellow warbler, and the bananaquit.

Recorded on St. Croix itself are the brown pelican, magnificent frigatebird, great blue heron, American egret, snowy egret, little blue heron, cattle egret, red-tailed hawk, sparrow hawk, spotted sandpiper, least tern, royal tern, Zenaida dove, ground dove, mangrove cuckoo, smooth-billed ani, green-throated carib, Antillean crested hummingbird, gray kingbird, Caribbean elaenia, northern mockingbird, black-whiskered vireo, yellow warbler, bananaquit, and the black-faced grassquit.

Birds found at ponds on the island include the pied-billed grebe, green heron, common gallinule, pectoral sandpiper, and the Louisiana waterthrush.

Salt ponds or lagoons are found on the southern coast of the island, with Great Pond in the east and Westend Saltpond on the far side of the southern coast. Birds recorded at the salt ponds include the great blue heron, American egret, snowy egret, little blue heron, green heron, Bahama duck, osprey, semi-palmated plover, Wilson's plover, black-bellied plover, black-necked stilt, greater yellowlegs, lesser yellowlegs, solitary sandpiper, spotted sandpiper, willet, short-billed dowitcher, semi-palmated sandpiper, western sandpiper, white-rumped sandpiper, least sandpiper, stilt sandpiper, laughing gull, gull-billed tern, royal tern, and the sandwich tern.

Forested areas are found in the northwest, between Frederiksted and Mt. Eagle. Here can be found the red-tailed hawk, red-necked pigeon, green-throated carib, pearly-eyed thrasher, bananaquit, and the black-faced grassquit.

Brown boobies, bobwhite, guinea fowl, cattle egrets, and smooth-billed ani ar also found on St. Croix.

B.3 MAMMALS, REPTILES, AND AMPHIBIANS. The mammalian fauna of St. Croix is depauperate in native species because of the difficulties inherent in colonizing an island so far removed from centers of species origin in North and South America. The species listed in Table B-1 are known to have occurred on St. Croix in recent times.

B.4 OTHER FAUNA. Invertebrates are diverse. The molluscan fauna of St. Croix is excellent in diversity and ecological types. Many coelenterate species, echinoderms, crustaceans, foraminifera, and sponges are present. In deep water, sclerosponges are common, and two species of crinoids have been collected.

The fish population, especially at Buck Island, is varied. West Indian fish traps have seriously cut fish populations in many other shallow water areas. Large gamefish are well-known from the shelf edges; sharks can be observed. Porpoises, turtles, and whales are frequently sighted.

Table B-1

MAMMALS, REPTILES, AND AMPHIBIANS OF ST. CROIX

Mammals

Order Chiroptera (bats)

Family Phyllostomatidae

Brachyphylla cavernarum - West Indian fruit-eating bat
Artibeus jamaicensis - Jamaican fruit-eating bat

Family Noctilionidae

Noctilio leporinus - Fish-eating bat

Family Moloasidae

Molossus major - Velvety free-tailed bat

Reptiles

Order Squamata (lizards and snakes)

Family Amphisbaenidae

Amphisbaena fenestrata - Ground worm

Family Gekkonidae

Hemidactylus mabouia - Small wood slave
Thecadactylus rapicaudus - Large wood slave
Sphaerodactylus macrolepis - Tiny gecko "cotton ginner"
Sphaerodactylus beattyi - Tiny gecko

Family Iguanidae

Iguana iguana - Iguana
Anolis acutus - Tree lizard
Anolis cristatellus - Doctor lizard
Anolis pulchellus - Snake lizard

Family Teidae

Ameiva exul - Ground lizard
Ameiva polops - Ground lizard

Family Typhlopidae

Typhlops richardii - Blind snake

Family Scincidae*

Mabuya sloanii - Slippery back

Family Colubridae*

Alsophis santi-crusis- Snake

Table B-1 (Cont.)

<u>Amphibians</u>
Order Anura (toads and frogs)
Family Bufonidae
<u>Bufo turpis</u> - Crapaud toad
<u>Bufo marinus</u> - Marine toad
Family Leptodactylidae
<u>Leptodactylus albilabrus</u> - Water frog
<u>Eleutherodactylua lentus</u> - Tree frog
<u>Eleutherodactylus portoricensis</u> - Tree frog
<u>Eleutherodactylus antillenis</u> - Tree frog

*Of doubtful occurrence on St. Croix.

APPENDIX C

GLOSSARY

APPENDIX C. GLOSSARY

AFFF	aqueous film-forming foam, used to extinguish fires
AFWTF	Atlantic Fleet Weapons Training Facility
Agentine	dry cleaning solvent
AIMD	Aircraft Intermediate Maintenance Division
alluvium	clay, silt, sand, or gravel deposited by running water
amphipods	any of large group of small crustaceans such as the sand flea
andesite	extrusive usually dark grayish rock consisting essentially of oligoclase or feldspar
annelides	any of a phylum of coelomate and usually elongated segmented invertebrates such as marine worms
aquifer	water-bearing stratum of permeable rock, sand, or gravel
ATG	air to ground
AUW	Advanced Underwater Weapons
AVGAS	leaded aviation gasoline
breccia	rock consisting of sharp fragments embedded in fine-grained sand or clay
bryozoans	any of a phylum or class of aquatic mostly marine invertebrate animals that reproduce by budding and usually form permanently attached branched or mossy colonies
calcareous	consisting of or containing calcium carbonate
CCCS	Central Command and Control System
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CNO	Chief of Naval Operations
COMNAVFACENGOM	Commander, Naval Facilities Engineering Command
CSRS	Confirmation Study Ranking System
DFM	diesel fuel marine

DGPS	data gathering and processing system
dinoflagellate	any of an order of chiefly marine plankton usually solitary plantlike flagellates that include luminescent forms
diorite	granular crystalline igneous rock
DOD	Department of Defense
DPDO	Defense Property Disposal Office
DSS	Donut Servicing System
DS-2	Decontaminating Solution Two
drone	pilotless airplane controlled by radio signals
EFD	Engineering Field Division
EIS	Environmental Impact Statement
EMA	Eastern Maneuver Area
EOD	Explosive Ordnance Detachment
EPA	United States Environmental Protection Agency
epiphyte	plant that derives its moisture and nutrients from the air and rain and usually grows on another plant
evapotranspiration	loss of water from the soil by evaporation and by transpiration from plants
EWR	Electronic Warfare Range
FAA	Federal Aviation Administration
floodplain	level land that may be submerged by floodwaters
FLTAUDVISCEN	Fleet Audio Visual Center, Caribbean
FMFLANT	Fleet Marine Force, Atlantic
FORAC	Fleet Operational Readiness Check
gabbro	granular igneous rock
GMOCU	Guided-Missile Operations Control Unit
graben	depression of the earth's crust bounded on at least two sides by faults

granodiorite	granular intrusive quartzose igneous rock intermediate between granite and quartz diorite
GSA	General Services Agency
herptiles	reptiles and amphibians
IAS	Initial Assessment Study
indurated	hardened
IRFNA	inhibited red fuming nitric acid
ISA	ignition separator assembly
ITCS	Integrated Target Control System
JP fuel	jet propulsion fuel
KW	kilowatt
LANTNAVFACENGCOM	Atlantic Division, Naval Facilities Engineering Command
LAW	light antitank weapon
LBL	Long Baseline
limestone	rock formed chiefly by accumulation of organic remains (shells, corals) consisting mainly of calcium carbonate
littoral	of, relating to, or situated or growing on or near a shore, especially of the sea
mafic	of or relating to a group of usually dark-colored minerals rich in magnesium and iron
MAF-4	mixed amine fuel
marl	loose or crumbling earthy deposit containing a substantial amount of calcium carbonate
MASWT	Mobile Anti-Submarine Warfare Target
MEK	methyl ethyl ketone
mesic	characterized by, relating to, or requiring a moderate amount of water
MG	megawatt
mgd	million gallons per day

mg/l	milligrams per liter
microphyllous	characterized by a leaf that has single unbranched veins and no demonstratable leaf gap
MOGAS	motor gasoline, regular or unleaded
MPC	maximum permissible concentration
NACIP	Navy Assessment and Control of Installation Pollutants
NAF	Naval Ammunition Facility
NARU	Naval Air Reserve Unit
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAVCOMSTA	Naval Communication Station
NAVENENVSA	Naval Energy and Environmental Support Activity
NAVSECGRUACT	Navy Security Group Activity
NBC	nuclear, biological, chemical
NEPSS	Naval Environmental Protection Support Service
NGFS	Naval gunfire support
NJS	Noise Jammer System
NMCB	Navy Marine Construction Battalion
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NTDS	Naval Tactical Data System
OP	Observation Post
PCB	polychlorinated biphenyl
petroglyph	aboriginal rock carving
plutonic	formed by solidification of molten magma within the earth
POL	petroleum, oil, lubricants

ppm	parts per million
PREPA	Puerto Rico Electric Power Authority
psi	pounds per square inch
Purple K	potassium bicarbonate, used to extinguish fires
quebrada	intermittent drainage area
RCA	Radio Corporation of America, Inc.
RDDCS	Remote Data and Drone Control System
ROC	Range Operations Center
SAM	surface-to-air missile
saprolite	disintegrated rock lying in its original place
SBL	Short Baseline
sedimentary rock	rock formed by deposits of sediment through biological, mechanical, and organic processes
SHPO	State Historic Preservation Office
SIA	Surface Impact Area
SPECWARGRUTWO	Special Warfare Group, Detachment 2, Caribbean
STB	Super Tropical Bleach (decontamination agent)
SWOB	Ships Waste Offload Barge
TOC	total organic carbon
TORPEX	torpedo exercises
TOX	total organic halogens
TPS	Threat Platform Simulator
tuff	rock composed of the finer kinds of volcanic detritus, usually fused together by heat
UEPH	Unaccompanied Personnel Housing
UTR	Underwater Tracking Range
VC-8	Fleet Composite Squadron Eight
VIWPA	Virgin Islands Water and Power Authority

WAAS	Wide Area Active Surveillance System
WASP	Water Security Patrol
WSAT	Weapons Systems Accuracy Trials
xeria	characterized by, relating to, or requiring only a small amount of moisture

APPENDIX J-2

RCRA FACILITY ASSESSMENT (RFA)

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Management
Consultants

JAN 2

November 17, 1988

ATKEARNEY

Mr. Ben R. Singh
Regional Project Officer
U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, NY 10278

RFA report

Reference: EPA Contract No. 68-01-7038; Work Assignment No. R02-01-46; U.S. Naval Station Roosevelt Roads Facility, Roosevelt Roads, Puerto Rico, EPA ID No. PR2170027203; Final Phase II RCRA Facility Assessment Report

Dear Mr. Singh:

Enclosed is the final Phase II RCRA Facility Assessment (RFA) report for the U.S. Naval Station Roosevelt Roads Facility at Roosevelt Roads, Puerto Rico. The RFA resulted in the identification of 47 solid waste management units (SWMUs) and four areas of concern (AOCs).

The Roosevelt Roads Facility is located on the eastern end of Puerto Rico. It functions primarily as the major support facility for weapons training and associated activities of the Atlantic Fleet. Numerous tenant activities take place at the facility. Wastes generated or stored by the facility include waste oils and fuels, PCBs, and pesticides.

Sampling has been suggested for the following units which were determined to have a high potential for release to the environment:

SWMU #1	Army Cremator Disposal Site
SWMU #2	Lanley Drive Disposal Site
SWMU #3	Station Landfill
SWMU #7	Tow Way Road Fuels Farm
SWMU #8	Tow Way Road Disposal Pits
SWMU #9	Leaded Sludge Pits
SWMU #13	Old Pest Control Shop
SWMU #47	Local Disposal Areas
AOC D	Naval Station Outfalls

Integrity testing has been suggested as a further action for the following units:

SWMU #4	Drone Fuel Drain Oil/Water Separator
SWMU #21	Donuts
SWMU #22	Ships Waste Offload Barges (SWOBs)
SWMU #24	Oil Spill Oil/Water Separator
SWMU #27	Capehart Area Wastewater Plant
SWMU #28	Bundy Area Wastewater Plant
SWMU #29	Industrial Area Wastewater Plant
SWMU #35	Aircraft Wash Rack Oil/Water Separator
SWMU #36	Vehicle Wash Rack Oil/Water Separator
SWMU #38	Sewer Drainage System

There are documented releases of PCBs at the Transformer Maintenance Area (SWMU #10) and PCB Spill Area (SWMU #45). This RFA suggests that the regulatory status of both SWMUs be reviewed and that either or both be referred to TSCA (if not already TSCA regulated.)

Additional information was requested from the facility during the VSI, but was not received until October 21, 1988. As directed by EPA, this information has been included as an attachment only and has not been incorporated into the report at this time. Additional information was requested from the U.S. Coast Guard through the Freedom of Information Act concerning possible release information (e.g., spills). This information arrived on November 3, 1988 and is enclosed as Attachment C.

If you have any questions, please call me or Marvin Unger, the Work Assignment Manager, who can be reached at 409/690-9280.

Sincerely,

Gayle Kline

Gayle Kline
Technical Director

Enclosure

cc: J. Gorman, EPA Region II
J. Levin
D. Bean
C. Saunders
M. Unger, KWB

5201E-AM

PHASE II
RCRA FACILITY ASSESSMENT

OF THE

U.S. NAVAL STATION ROOSEVELT ROADS FACILITY
ROOSEVELT ROADS, PUERTO RICO

EPA ID No. PR2170027203

prepared for

U.S. Environmental Protection Agency
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College Station, Texas 77840

EPA Contract No. 68-01-7038
Work Assignment No. R02-01-46

November, 1988

PHASE II

RCRA FACILITY ASSESSMENT REPORT

of the

U.S. NAVAL STATION ROOSEVELT ROADS FACILITY
ROOSEVELT ROADS, PUERTO RICO

EPA ID No. PR2170027203

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1.0 INTRODUCTION

The 1984 Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) authorize the U.S. EPA to require corrective action for releases of hazardous waste or hazardous constituents from solid waste management units (SWMUs) and other areas of concern (AOCs) at all operating, closed, or closing RCRA facilities. The intent of this authority is to address previously unregulated releases to air, surface water, soil, and groundwater, and from the generation of subsurface gas. The first phase of the corrective action program, as established by the EPA, is a RCRA Facility Assessment (RFA). The RFA includes a Preliminary Review (PR) of all available relevant documents, a Visual Site Inspection (VSI), and, if warranted, a Sampling Visit (SV).

This report summarizes the results from the PR and VSI phases of the RFA at the U.S. Naval Station Roosevelt Roads Facility at Roosevelt Roads, Puerto Rico. The findings of the assessment are based upon a review of files from EPA Region II in New York and the Environmental Quality Board of Puerto Rico, and a VSI conducted August 15 through 22, 1988.

The preliminary review of file material resulted in the identification of 30 SWMUs and 5 additional AOCs. Following the VSI, a total of 47 SWMUs and 4 additional AOCs were identified (Table 1). The final identification of units as SWMUs and AOCs is based upon the PR, observations made during the VSI, and conclusions made concerning the types of wastes managed and the potential for a release from the units. The locations of these units are illustrated in Figure 1.

Roosevelt Roads covers an area of more than 8000 acres and provides general support for numerous tenant activities. Those SWMUs and AOCs identified in this report are concluded to be representative of waste management activities at the Naval Station Roosevelt Roads. Areas not identified as waste management units (including process areas, product storage facilities, etc.) that were not observed during the VSI are those areas that were situated indoors. The nature of these areas (i.e., fully enclosed) makes it unlikely that there would be releases to environmental pathways; in addition, these areas are not identified with any associated documented releases to the environment.

Prior to the VSI and as a result of review of the PR file material and conversations with both EPA and Roosevelt Roads representations, the VSI team did not expect difficulty with gaining access to any of the Roosevelt Roads areas or units. However, at the time of the VSI and unbeknownst to the VSI team, the VSI team was informed by Mr. Nestor Paradis, Director of the Atlantic Fleet Weapons Training Facility (AFWTF), that the Waste Explosive Storage (SWMU #16) and the Torpedo Shop (AOC A) are both unique military operations. These areas were not observed during the VSI due to associated, unanticipated security restrictions.

This report is organized under eight chapter headings and contains three attachments. Chapter 2.0 describes facility activities and operational areas, history of site ownership, regulatory history, manufacturing operations and processes, wastes managed at the facility, waste management practices and history of releases. Chapter 3.0 discusses the facility's

Table 1. SWMUs and AOCs at the U.S. Naval Station, Roosevelt Roads, PR.

SWMU Name	Unit Status*
1. Army Cremator Disposal Site	Inactive, NACIP
2. Langley Drive Disposal Site	Inactive, NACIP
3. Station Landfill	Active, NACIP
4. Drone Fuel Drain Oil/Water Separator	Active
5. Dumpsters	Active
6. Former Paint Storage (Building 145)	Inactive, NACIP
7. Tow Way Road Fuels Farm	Active, NACIP
8. Tow Way Road Disposal Pits	Active, NACIP
9. Leaded Sludge Pits	Active, NACIP
10. Transformer Maintenance Area (Building 90)	Active, NACIP
11. PCB Storage Compound (Building 38)	Active, NACIP
12. Fire Training Pit Oil/Water Separator	Active
13. Old Pest Control Shop (Building 258 and Surrounding Area)	Inactive, NACIP
14. Fire Training Pit	Active, NACIP
15. Hospital Incinerator (Building 1928)	Active
16. Waste Explosive Storage (Building 1666)	Active
17. DRMO Hazardous Waste Storage Facility (Building 1973)	RCRA, Interim Status
18. Ignitable Storage Facility (Building 2009)	RCRA, Interim Status
19. Pesticide Waste Storage (Building 121)	Active, Waiting Closure Plan
20. Waste Oil Tank Truck (near Building 860)	Active
21. Donuts	Active
22. Ships Waste Offload Barges (SWOBs)	Active
23. Oil Spill Separator Tanks	Active
24. Oil Spill Oil/Water Separator	Active
25. Past DRMO Hazardous Waste Storage	Active, Waiting Closure Plan
26. Abandoned Engine Oil Drums (behind Building 544)	Active
27. Capehart Area Wastewater Plant	Active, NPDES
28. Bundy Area Wastewater Plant	Active, NPDES
29. Industrial Area Wastewater Plant	Active, NPDES
30. Former Incinerator Site (adjacent to landfill entrance)	Inactive
31. Waste Oil Collection Area (PWD Storage Yard)	Active
32. Battery Collection Area (PWD Storage Yard)	Active
33. AIMD Hazardous Waste Storage Pad	Active
34. VC-8 Waste Storage Pad	Active
35. Aircraft Wash Rack Oil/Water Separator (VC-8 yard)	Active
36. Vehicle Wash Rack Oil/Water Separator	Active
37. Waste Oil Drum Storage Area (near Hangar 200)	Active
38. Sewer Drainage System	Active
39. Spent Battery Storage Building (Building 3158)	Active
40. Seabee Oil Collection Area	Active

-- Continued --

Table 1. Continued.

SWMU Name	Unit Status*
41. Rinse Rack Near Sea Bee Pesticide Storage (Building 3152)	Active
42. Water Treatment Plant Sludge Lagoons	Active
43. Drone Washdown Area	Active, NACIP
44. Aerial Target Systems Department Drainage Ditch	Active
45. PCB Spill Area (Building 38)	Active, NACIP
46. Pole Storage Yard	Active, NACIP
47. Local Disposal Areas	Active
<u>AOC Name</u>	
A. Torpedo Shop	Active
B. Former PWD Storage Area (Building 25)	Active, NACIP
C. Transformer Storage Area (near Building 2042)	Active
D. Naval Station Outfalls	Active

* Active - Indicates the unit continues to actively manage wastes
Inactive - Indicates the unit no longer actively manages wastes
RCRA - The unit is either permitted under RCRA or operates under RCRA interim status, as noted.
NACIP - The unit or area was a subject in the Initial Assessment Study conducted under the Navy Assessment and Control of Installation Pollutants (NACIP) program.

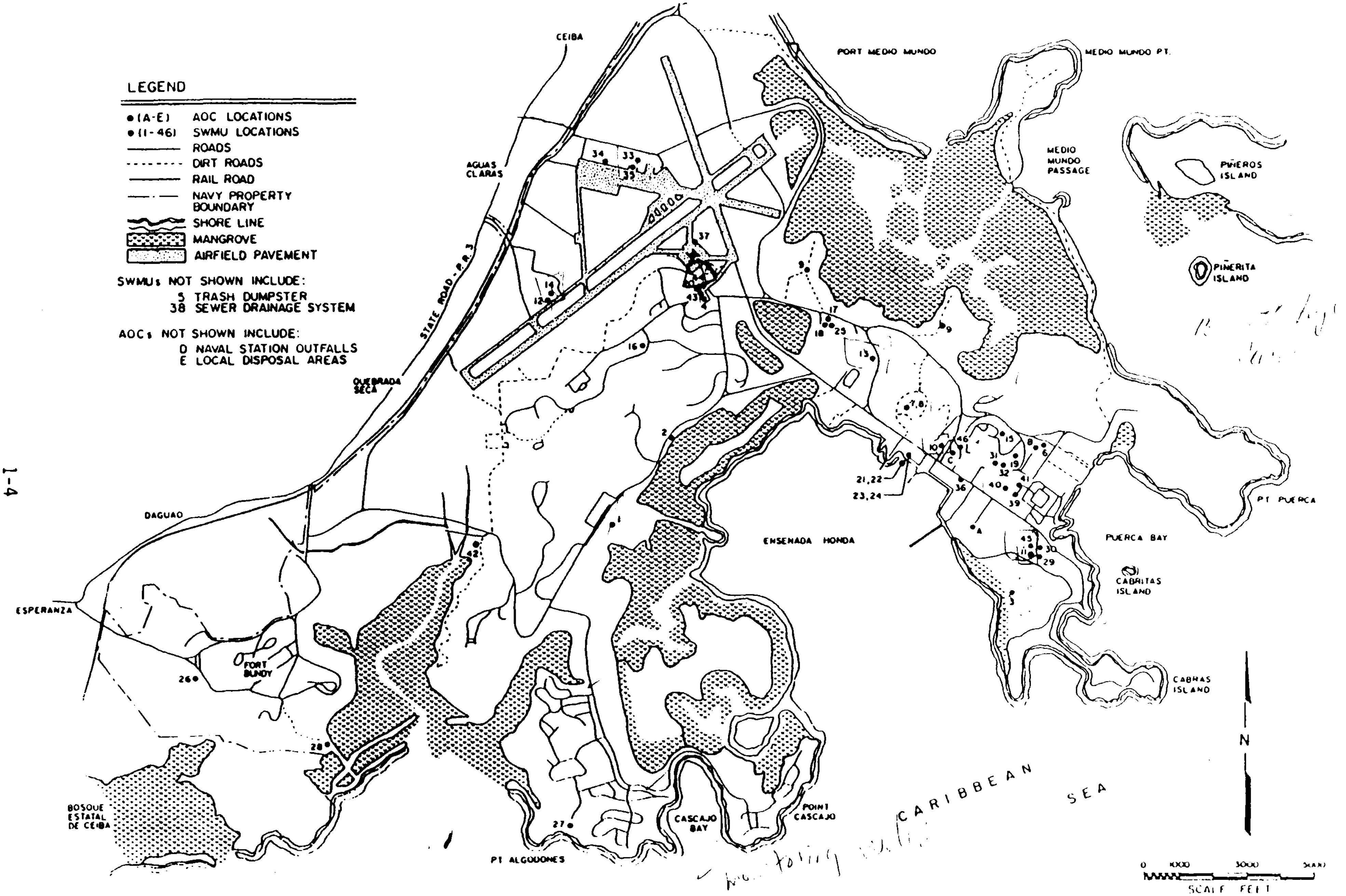

FIGURE 1. LOCATION OF SWMUs AND AOCs AT U.S. NAVAL STATION, ROOSEVELT ROADS (REF. 53).

location, climate, topography, geology, soils and surrounding surface waters. A description of SWMUs and AOCs identified by the assessment are presented in Chapter 4.0. An executive summary of the report is presented in Chapter 5.0 and release pathways are discussed in Chapter 6.0. Conclusions regarding the potential for release and suggested further actions for each area are summarized in Chapter 7.0. References used in preparation of this report are given in Section 8.0. A photographic log, showing facility conditions at the time of the VSI, is included as Attachment A.

Information requested from facility officials arrived on October 21, 1988, too late to be included in this report. It is provided as Attachment B. Furthermore, additional information was requested from the U.S. Coast Guard through the Freedom of Information Act concerning possible release information (e.g., spills) not contained in the documents collected during the PR file search. Information requested from the U.S. Coast Guard arrived on November 3, 1988 and is enclosed as Attachment C. As directed by EPA Region II, the information provided in these documents has not been reviewed, and is not reflected in the text of this RFA report.

2.0 FACILITY DESCRIPTION

General Facility Description

Naval Station (NAVSTA) Roosevelt Roads is located on the eastern tip, or Caribbean side, of Puerto Rico (Figure 2). The capital city of San Juan is approximately 33 miles northwest of Roosevelt Roads, or "Roosey Roads" as the base is commonly referred to by naval personnel. To the southwest is agricultural land and the mangrove forest, Bosque Estatal de Cieba. Adjacent residential villages include Esperanza, Daguao, Quebrada Seca, Aguas Claras, and Cieba (Ref. 48), whose border flanks the road to Gate 1 (Figure 1).

The primary mission of the Roosevelt Roads Naval Complex is to provide full support for Atlantic Fleet weapons training and development activities. NAVSTA Roosevelt Roads provides a refueling station for NATO ships, services aircraft and drones, and provides support for numerous tenant activities. Much of the actual weapons training and ordnance activities take place on the Island of Vieques where the Atlantic Fleet Weapons Training Facility (AFWTF) and Naval Ammunition Facility (NAF) are located. NAF and AFWTF each have their own EPA identification number and are not addressed in this RFA report.

History of Ownership

Plans for a naval base in the Caribbean region were first considered in 1919; however, it was not until 1940, when U.S. involvement in World War II seemed inevitable, that the U.S. Navy established the need for a naval base in this area (Figure 3). Roosevelt Roads was initially targeted to be the base of the Caribbean Defense System with its fully protected anchorage, major air station, and sophisticated industrial complex. The NACIP IAS report (Ref. 48) states that, in the event Great Britain was overwhelmed by the Axis Powers, Roosevelt Roads was to become the new operating port for the British Fleet.

However, by the time Roosevelt Roads was commissioned in 1943, it was clear to Allied leaders that, due to the location of most Allied operations, a base of the intended size would not be necessary in the Caribbean. Perhaps for that reason, Roosevelt Roads was placed in caretaker status the next year. The following year, it was placed in maintenance status and remained so until 1957. That year it was chosen as the primary center for Fleet Guided-Missile Training Operations in the Atlantic because of its location and existing facilities. During the interim, from 1943 to 1957, Roosevelt Roads was an important refueling station and training site for portions of the Atlantic Fleet. One of the first changes made upon the recommissioning of Roosevelt Roads was the acquisition of the U.S. Army's Fort Bundy which now comprises the southern part of the station. Established in 1940, Fort Bundy's purpose was to defend against enemy attack during Naval base construction.

By 1959, Roosevelt Roads had one of the world's largest dry docks, a machine shop to service and repair any ship that might arrive, an 11,000 foot long runway capable of receiving any existing jet aircraft, fuel and ammunition storage facilities, and its own water supply system. In 1963, AFWTF was commissioned as a separate activity, and several years later

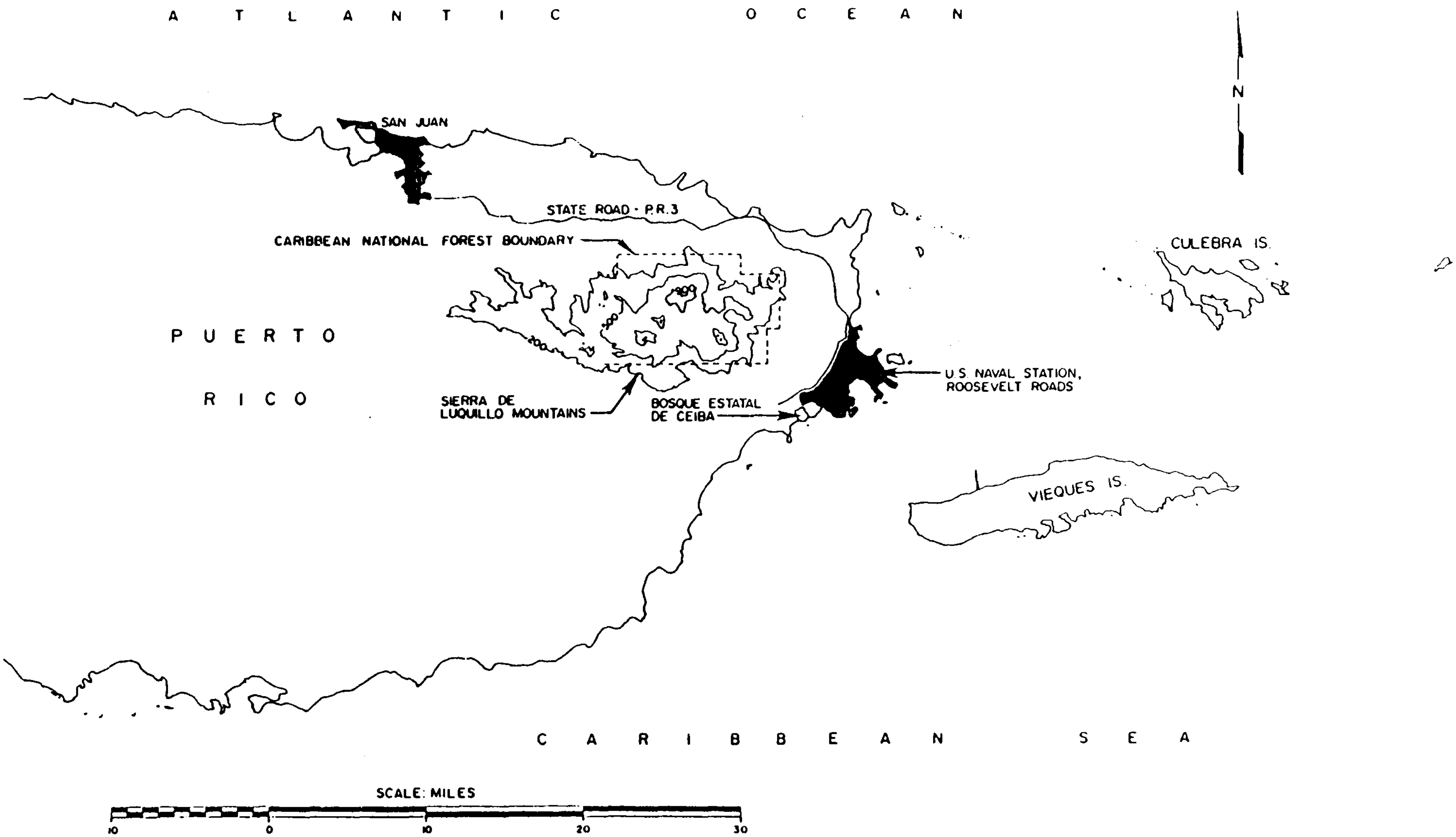

FIGURE 2. VICINITY MAP OF U. S. NAVAL STATION, ROOSEVELT ROADS (REF. 54).

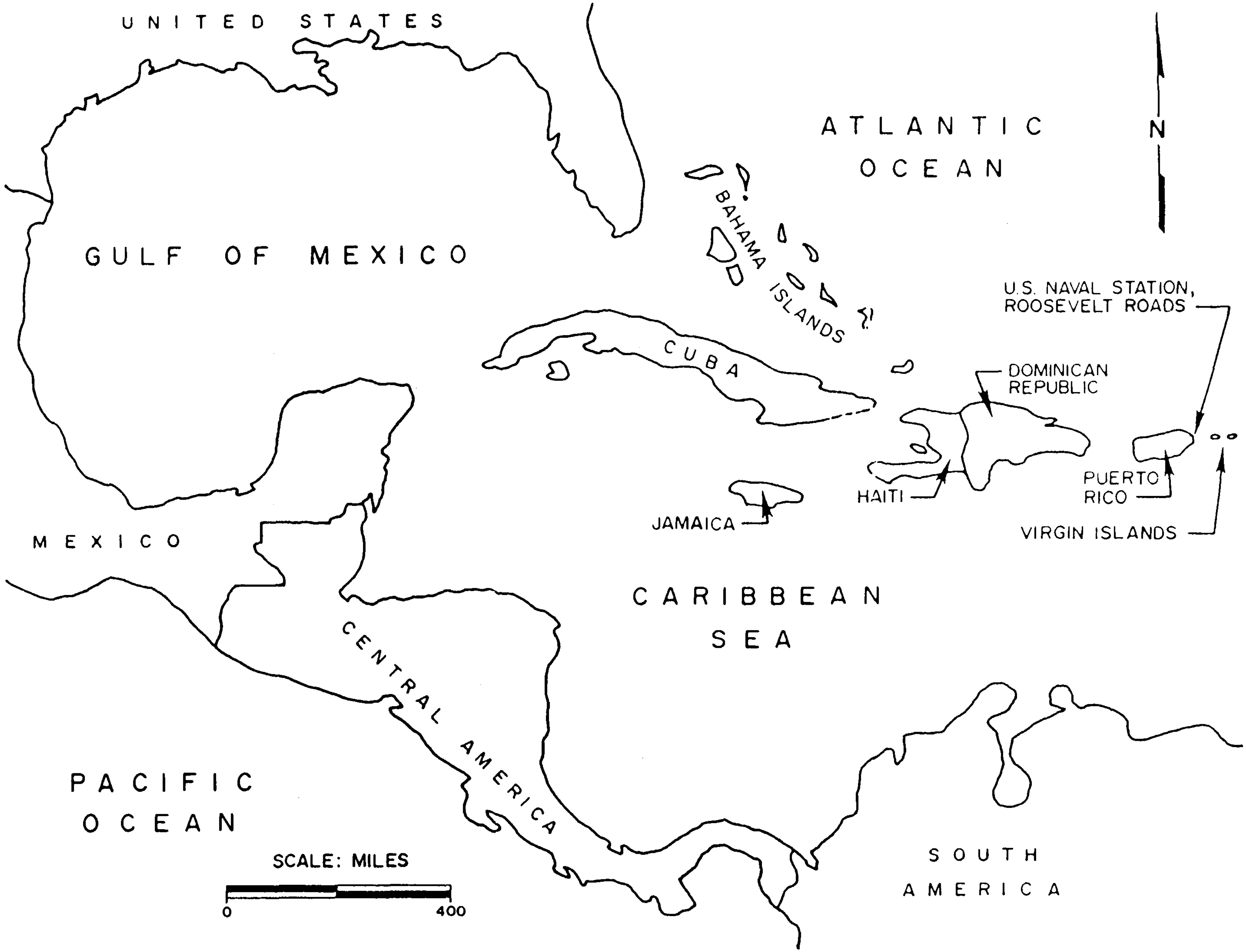

FIGURE 3. PROXIMITY MAP OF U.S. NAVAL STATION, ROOSEVELT ROADS (REF. 55).

activated its computerized Central Command and Control System (CCCS), allowing the rapid exchange of information between ships and aircraft operating many miles apart. Soon after, a Remote Data and Drone Control System (RDDCS) was added to the CCCS which provided for the control of drones from the Range Operations Center (ROC) on Vieques, instead of the three separate drone control sites located at the Naval Station and on St. Thomas and St. Croix. By the early 1960s, the Roosevelt Roads Complex became known as one of the world's largest and most technologically advanced training complexes in the world, and has provided support for various special and joint exercises held annually in Caribbean waters (Operation Springboard, CARIBEX, etc.) (Ref. 48).

Regulatory History

This section provides an overview of the regulatory history of Naval Station Roosevelt Roads. In November 1980, NAVSTA Roosevelt Roads submitted Part A of its hazardous waste permit application. The Part B permit application was submitted in April 1988. DRMO Hazardous Waste Storage Facility (Building 1973) (SWMU #17) and the Ignitable Storage Facility (Building (2009) (SWMU #18) have been operating under interim status since November 1980. Building 38, PCB Storage Compound (SWMU #11), is the only TSCA regulated unit at this facility, although two other areas have been identified with release of PCBs to the environment. These areas are addressed in Suggested Further Actions, Section 7.

The Defense Reutilization and Marketing Office (DRMO) and Roosevelt Roads, Main Base have the same EPA ID number and are therefore considered in the same report. In the brief summary of noteworthy regulatory events provided below, Class I violations are included since they apply to situations where there is direct potential for release to the environment or where there exists a potential hazard to human health or the environment.

September 29, 1981	Request for Part B permit application by EPA Region II (Ref. 14)
September 29, 1981	RCRA Interim Status Inspection by Puerto Rico Environmental Board; Notice of compliance with all required documents (Ref. 25a)
July 18, 1985	Inspection by EPA Region II; unspecified Class I violation found (Ref. 25b)
September, 1985	Preliminary report of EPA Federal Facility Inspection; Recommendation to send U.S. Naval Station Roosevelt Roads a letter requiring information through Section 114 of Title I of the CAA (as amended) (24a).
November 13, 1985	EPA request for information to determine source compliance status with the Puerto Rico Air Pollution Control Regulations (Ref. 24b)
June 6, 1986	Inspection by EPA Region II; unspecified Class 1 violation found (Ref. 25b)

December 6, 1986	USNSRR submits spill status report and message report to Puerto Rico Environmental Quality Board concerning JP-5 leak from Tank 85 (Ref. 20)
April 29, 1987	Interim Status Compliance Inspection; Notice of Violation/Compliance Demand issued for deficiencies at drum storage area and in waste analysis (Ref. 18)
September 28, 1987	PCB inspection by EPA Region II Toxic Substances Compliance Section; Report provides summary of inspection and request for additional information (Ref. 23)
October 23, 1987	Request for Part B permit application by EPA Region II (Ref. 14)
December 22, 1987	Part B Call-In Inspection by Puerto Rico Environmental Quality Board; unspecified Class 1 violation found (Ref. 25b)
February 29, 1988	Inspection by Puerto Rico Environmental Quality Board; unspecified Class 1 violation found (Ref. 25b)

Other units at the Roosevelt Roads facility are operated under various permit and regulatory conditions. These are listed in Table 2.

Table 2. Naval Station Roosevelt Roads Existing Environmental Permits (Ref. 49).

Permit Type	Permit Number	Permit Description
NPDES	PR0020010	Sewage Treatment Plants (SWMUs #27, #28, and #29)
TSCA		Building 38 (SWMU #1)
RCRA	PR2170027203	NAVSTA Roosevelt Roads - Part A
Air*	PFE-19-0984-0691-I-II-0	BOQ Boiler - Building 729
Air	PFE-19-0883-0601-I-0	Bulk Fuel Storage Tanks
Air	PFE-19-0981-0794-I-C	Contaminated Fuel Storage Tank
Air	PFE-19-0883-0604-II-0	NAVSTA Emergency Generator
Air	PFE-480-0359-I-II-0	Naval Hospital (SWMU #15)
Air	PFE-19-0283-0056-II-0	NAVSTA Boilers
Air	PFE-1080-1001-I-0	NAVSTA Quarry
Air	PFE-19-0585-0383-1-0	Surface Operations Sandblasting
Solid Waste*	PFE-19-0789-0475-I-0	NAVSTA Building Demolition
Solid Waste	CR6-82W & MRP-76-83	Construction Projects
Solid Waste	C-680-675-JCA	NAVSTA Sanitary Landfill (SWMU #3)
Misc.	II-PR-154	EPA Emergency Ocean Dumping

* Air Emission and Solid Waste Permits are issued by the Environmental Quality Board (EQB).

Operations/Process Description

Ongoing operations at Naval Station Roosevelt Roads reflect this facility's purpose; to provide full support for Atlantic Fleet weapons training and development activities. These activities include machining, degreasing and solvent cleaning, battery maintenance, electrical maintenance, calibration, painting and paint stripping, pest control, power generation, air conditioning and refrigeration, medical and dental care, water treatment, specialized installation operations, and some ordnance operations.

Many operations at Roosevelt Roads are run by private contractors. According to a facility representative during the VSI, contractors are responsible for offsite disposal of those wastes generated during the operations they perform. The Torpedo Shop (AOC A) is one of a few exceptions. Although it is run by a contractor, wastes generated by the Torpedo Shop are disposed of through DRMO. Wastes generated by military run operations are disposed of through DRMO. However, DRMO also contracts the transportation and offsite disposal of all hazardous waste stored in the DRMO yard. Where known, distinctions are made between contractor operated and military operated processes in the following section.

A. Industrial (Non-Ordnance) Operations

1. Machining. The Public Works Machine Shop is located in Building 31. Machine Shop operations include all sheet metal work, welding, and tool making. Daily activities involve the repair and maintenance of pumps and other dynamic equipment. Metal pieces, welding material, small grease and oil containers, and small equipment parts are wastes disposed of at the Station Landfill (SWMU #3) (Ref. 48). Located in the Aircraft Intermediate Maintenance Department (AIMD), Building 379 is another small machine shop. During the VSI, a facility representative reported that in recent years there has been very little activity in this shop because aircraft parts are usually ordered from more technologically advanced manufacturers.

2. Degreasing and Solvent Cleaning. Degreasing and solvent cleaning are a necessary part of maintenance and corrosion control. These facility-wide operations are carried out at many locations on base; however, the most extensive operations are located at the Public Works Department (PWD), Aircraft Intermediate Maintenance Department (AIMD), Fleet Composite Squadron Eight (VC-8), and the Torpedo Shop (AOC A) (Ref. 48).

a. Public Works Department. The Transportation Division of the Public Works Department performs maintenance and corrosion control on equipment and machinery. An estimated 2,500 gallons of waste solvent, cleaning solutions, oil, brake fluids, and other oil derivatives were disposed of annually at the Station Landfill (SWMU #3) from 1960 until 1973 (Ref. 48). General Electric Services, a private contractor, runs the Transportation Division. A Transportation Division temporary waste oil accumulation area, noted in this report as Waste Oil Collection Area (SWMU #31), was observed to be a curbed concrete pad in poor condition. Waste oil, solvents, and degreasers are stored in 55-gallon drums on the pad until a private contractor picks up the waste and disposes of it offsite.

b. Aircraft Intermediate Maintenance Department (AIMD). Degreasing and solvent cleaning occurs in all AIMD shops, which are located in Buildings 379 and 826. The degreasing chemical PD-680 (a mineral oil solvent) is used in both the Power Plant Shop (two small baths for dipping engine parts) and the Tire Shop (small tanks for cleaning wheel housings, bearings, and associated hydraulic mechanisms). The Ordnance Shop uses methyl ethyl ketone (MEK), PD-680, Freon, and corrosion inhibiting compounds to clean tow wheels, racks, holders, and release mechanisms (Ref. 48). There was almost no activity in the AIMD shops at the time of the VSI. Building 379 was observed to be a large hangar that had been subdivided into a number of small shops that appeared very clean and well organized. Building 826 appeared to be vehicle storage. A facility representative stated that waste solvents are sent to the Ignitable Storage Facility at DRMO (SWMU #18). The NACIP study (Ref. 48) reported that some wastes are washed into the Sewage Drainage System (SWMU #38) through the floor and hangar drains.

c. Fleet Squadron Eight (VC-8). VC-8's cleaning activities, conducted in Building 1625, are similar to those at AIMD shops, but on a considerably smaller scale. Collectively, less than 10 gallons of dry cleaning solvent, alcohol, aliphatic naptha, technical xylene, and methyl ethyl ketone (MEK) are generated monthly. During the VSI, the VC-8 hangar was observed to be an area where routine aircraft cleaning and maintenance operations were being implemented. Wastes from VC-8 activities are disposed of by a DRMO contractor.

d. Torpedo Shop. The Torpedo Shop (AOC A) assembles MK 30, MK 46, and MK 48 torpedoes for the Atlantic Fleet Weapons Training Facility (AFWTF) and the Weapons Department. Contractors have run the shop since 1964. After a practice run by target or practice torpedoes, the torpedoes are recovered and remaining fuel is removed; finally, the torpedoes are washed with Agentine, a dry cleaning solvent. Wastes generated by this operation include: OTTO Fuel II, clothing contaminated during assembly/maintenance, detergent, Agentine, alcohol (Neosol), sodium sulfide, denatured ethyl alcohol, acetone, oil, and silver cell batteries (MK 30, Torpedo Shop only). OTTO Fuel II consists of propylene-glycol dinitrate (76%), dibutyl sebacate (22.5%), and nitrodiphenylamine (1.5%) (Ref. 48). The VSI team was unable to gain access to the Torpedo Shop because of unanticipated security clearance restrictions.

e. Naval Mobile Construction Battalion (NMCB). The NMCB is located adjacent to the Public Works Department and dry dock area, where its approximately 370 pieces of heavy construction equipment are maintained. During the VSI, Seabee Oil Collection Area (SWMU #40) was observed to be a mobile tank with a capacity of approximately 300 gallons, according to a facility representative. Because the Naval Mobile Construction Battalion is Navy owned and operated, their mobile waste oil tank is emptied by a DRMO contractor who disposes of the waste offsite.

3. Painting. According to facility representatives, all large scale painting is done by contractors. At the time of the VSI, private contractors were painting the interior and exterior of AIMD Building 379. Painting by AIMD and VC-8 is generally restricted to aircraft components. Spray cans are used until empty. Unused paint is sent to the Ignitable Storage Facility (SWMU #18) located at DRMO (Ref. 48). The Carpentry Shop, Public Works Department, does small, isolated painting jobs. According to the NACIP report (Ref. 48), wastes (e.g. scrap wood pieces, and empty paint cans) are sent to the Station Landfill (SWMU #3) (Ref. 48).

4. Paint Stripping. Paint stripping is carried out by the Public Works Department, AIMD, and VC-8 in an attempt to prolong the life expectancy of equipment and aircraft (Ref. 48).

a. Public Works Department. Whether done by hand or using machinery, paint stripping at the Public Works Department involves scraping paint from pumps, motors, vehicle parts, and other mechanical equipment. This results in small amounts of paint scrapings getting mixed in with the rest of the trash (Ref. 48). A facility representative stated that the Public Works Department also has a sandblaster.

b. Aircraft Intermediate Maintenance Department (AIMD). Paint stripping here usually involves only vehicle components. The paint stripping process is done by scraping manually or by dissolving with removing compounds and then rinsing the component with water. According to the NACIP report, rinse water carrying paint skins and removing compound is flushed to the Sewer Drainage System (SWMU #38) (Ref. 48). After stripping and before repainting, corrosion prevention and metal conversion coatings are applied. Like paints, they are completely used up during application and overage materials are sent to the Ignitable Storage Facility (SWMU #18) at DRMO (Ref. 48).

c. Fleet Composite Squadron Eight. Paint stripping activities here are very minor, limited to touch-ups or corrosion/metal conditioning. All waste paint stripping and coating compounds are sent to the Ignitable Storage Facility (SWMU #18) located at DRMO. Wastes generated here include epoxy paint remover and phosphoric acid metal conversion solution (Ref. 48).

5. Printing. Main printing operations are housed in Building 583. Before the early 1970s, the use of oil-based ink made it necessary to wipe down the presses every night with Blankrola solvent, which contains perchloroethylene and petroleum naptha. The current practice of using rubber-based ink reduces the need for cleaning to usually once a week. All materials used at this facility are consumed in the process, with the exception of cleaning rags, which are sent to the Station Landfill (SWMU #3), and the approximately 8 gallons of lubricating oil used annually (Ref. 48). According to facility representatives, this is either sent to DRMO or picked up directly by a private contractor.

6. Photograph Developing. The purpose of the photograph developing center, according to the NACIP study, is to provide official photography and coordination of photographic activities for the Naval establishment in the Caribbean area. The Center developed 2,575 rolls of 36-shot film and slides in 1983. All film has been recycled for silver recovery through DRMO since about 1978. Prior to this, all wastes were disposed of in the Station Landfill (SWMU #3) (Ref. 48).

7. Calibration. The purpose of calibration shops is to simulate field use by fine tuning electronic components against signal generators and frequency standards, or by testing the accuracy of various pressure and vacuum gauges. These shops are located at the Aircraft Intermediate Maintenance Department (AIMD), Fleet Composite Squadron Eight (VC-8), and Naval Electronics Engineering Office (Ref. 48).

a. Aircraft Intermediate Maintenance Department (AIMD). The NACIP study states that no wastes are generated in the calibration of avionic components. The testing of gauges and hydraulic components involves instruments containing small amounts of oil which are changed periodically and recycled. Occasionally a component of the test unit will fail and hydraulic fluid will flow into the floor drain (less than 100 gallons total over the years) to be released into the Sewer Drainage System (SWMU #38) (Ref. 48).

b. Fleet Composite Squadron Eight (VC-8). VC-8 shops are located in Building 1625, performing very much like the AIMD shops, but on a smaller scale. According to the NACIP, negligible amounts of waste oil are generated (Ref. 48). The little waste that is generated goes to the Oil Spill Oil/Water Separator (SWMU #24) which is pumped out by a DRMO contractor, according to facility representatives.

c. Naval Electronics Engineering Office. Moved from San Juan to Building 377 in 1975, the Naval Electronics Engineering Office calibrates equipment for the entire Caribbean fleet, the local U.S. Coast Guard and U.S. Army units. Equipment is calibrated against signal generators and frequency standards which do not generate any appreciable amount of waste. Interviewees have stated that calibration sources are low-level isotopes, possibly of cesium and plutonium (Ref. 48). The NACIP report states that the Department of Energy maintains this operation (Ref. 48).

8. Electrical and Electronic Equipment Repair. The Public Works Department; AIMD; VC-8; and Air Operations Department, Ground Electronics Division all have electrical and electronics shops whose activities include repair and maintenance of electrical motors, generators, switching units, etc., as well as navigational, communications, and avionics equipment, etc. (Ref. 48).

a. Public Works Department. The Public Works Department Electric Shop maintains and repairs intercommunication cables, electrical motors and appliances, and repairs, installs, and replaces electrical systems of up to 600 volts according to the NACIP report. Wastes include cables, wires, conduits, receptacles, ballasts, bulbs, and small amounts of grease and oil containers which are disposed of at the Station Landfill (SWMU #3). Waste production averages 10 tons annually (Ref. 48). The Power Distribution Shop maintains and repairs the electrical distribution system which includes 13 main transformers in eight substations located at the Airfield, Industrial Area, Bundy Area and the Capehart Housing Area (Ref. 48). From 1956 through 1964, transformer maintenance was performed at the PCB Spill Area (SWMU #45). From 1964 to the present, all transformer maintenance was performed at the Transformer Maintenance Area (SWMU #10). To facilitate inner core repair, transformer oil was commonly drained on the ground until the dangerous properties of PCBs were recognized in 1978 (Ref. 48). Since that time, drained transformer fluid has been contained in 55-gallon drums inside the PCB Storage Compound (SMWU #11) and is disposed of by a DRMO contractor.

b. Aircraft Intermediate Maintenance Department (AIMD). Located in Building 379, the AIMD Electronics/Avionics Shop provides avionics maintenance and repair services. Its services range from minor calibration and gauge cleaning and repair to the complete overhaul of avionic components. According to the NACIP study, luminescent dials are sent stateside for servicing. Most materials used are consumed in the process, although small amounts of solder and lead are discarded daily. All waste fluids are recycled through a private contractor (Ref. 48).

c. Fleet Composite Squadron Eight (VC-8). The VC-8 Electronic/ Avionics Shop, located in Building 1625, performs a service similar to AIMD, but on a smaller scale, because its sole responsibility is squadron aircraft (Ref. 48).

d. Air Operations Department, Ground Electronic Division. According to the NACIP report, Ground Electronics Shops are housed in Buildings 377 and 426 where they perform maintenance on airfield electronics and ground communications for base operations and security. Wastes generated are similar to that of AIMD and VC-8s (minor amounts of solder, lead, and spent cleaning fluids). Additionally, small electronic transformers (no PCBs), low voltage batteries, and power tubes containing beryllium insulators (total of 12 per month) are disposed of in the Station Landfill (SWMU #3). At one time, mercury switches and vacuum tubes possibly containing radium were also disposed of in the Station Landfill (SWMU #3) (Ref. 48).

9. Pest Control. Under the direction of the Public Works Department, the Pest Control Shop is responsible for insect and rodent control in station buildings and on station property, as well as weed control along streets, sidewalks, and buildings. Replacing the Old Pest Control Shop (SWMU #13) in 1983, this facility has separate storage areas for pesticides, equipment, and pesticide mixing, in addition to a concrete-bermed equipment wash pad which drains to the Sewer Drainage System (SWMU #38) (Ref. 48). According to facility representatives, pesticide containers are triple rinsed and the rinsate is saved for later use. Empty

containers do not go into the dumpster. They are taken to the Station Landfill (SWMU #3) by Pest Control Shop Employees. The NMCB pesticide storage building, which is immediately adjacent to the Rinse Rack near Sea Bee Pesticide Storage (SWMU #41), appeared clean and well maintained at the time of the VSI. Sea Bee personnel reported that pesticides had not been applied for several months, since no one in their battalion had a pesticide applicators license.

10. Steam Supply. The Utility Shop operates and maintains the 16 boilers scattered throughout the base according to the NACIP report. Used for making steam and hot water, most of the boilers are fueled by No. 2 diesel fuel which is stored in underground tanks adjacent to the boilers. No acid cleaning is required to clean the soft boiler sludge and soot because of the soft characteristics of the water supply. Between 1962 and 1972, loose asbestos chipping from pipe insulation was removed and disposed of at the Station Landfill (SWMU #3) as a part of regular maintenance (Ref. 48). According to a facility representative during the VSI, this is an ongoing practice.

11. Power Supply. Puerto Rico Water Resources Authority supplies the base with electric power, but 42 fixed standby and 18 portable generators, ranging from 3.5 kilowatts (kw) to 850 kw, are available in case of emergency. All units operate on diesel fuel. Between 1960 and 1972, an estimated 1,000 gallons of waste oil and 1 ton of other waste (wires, meters, gauges, windings, etc.) from generator maintenance were disposed of at the Station Landfill (SWMU #3) yearly. It is suspected that the non-electric temperature gauges contained a small amount of mercury (Ref. 48). The current practice is to sell the waste oil to a private contractor who recycles it, according to facility representatives.

12. Air Conditioning and Refrigeration. Located in Building 1788, the Refrigeration and Air Conditioning Shop does repair and preventative maintenance for air conditioning units, in addition to household, commercial, and industrial refrigeration equipment. Waste sent to the Station Landfill (SWMU #3) averages 2.5 tons annually and consists of small parts, air conditioners, and empty 5-gallon cans of cleaning solution (Ref. 48) in addition to empty freon containers.

13. Battery Maintenance. The Public Works Department, AIMD, Weapons Department, and NMCB have battery shops whose primary purpose is the disassembly, reassembly, drainage, rinsing, recharging, and cleaning of batteries (Ref. 48).

a. Public Works Department. The Transportation Division of the Public Works Department is responsible for maintenance and replacement of batteries in all Naval Station vehicles. Approximately 2,300 batteries were disposed of at the Station Landfill (SWMU #3) from 1960 to 1973. Since then, all discarded batteries (approximately 20 per month) are drained of acid and sent to the DRMO Hazardous Waste Storage Facility (SWMU #17). The drained acid is neutralized in special acid-resistant containers (Ref. 48). In the Public Works Department yard the VSI team discovered a Battery Collection Area (SWMU #32). Several dozen old batteries, most of them undrained, were stacked outside in the bed of a truck and on a pallet.

b. Aircraft Intermediate Maintenance Department (AIMD). Two battery shops are operated by AIMD in Building 379. One handles small nickel-cadmium (NICAD) rechargeable batteries, but only to the extent of cleaning and charging. Batteries that will not hold a charge are returned to the manufacturer. The second shop cleans, drains, rinses, and recharges lead/acid batteries. Wastes, including concentrated sulfuric acid, acid-contaminated rinse waters and potassium hydroxide electrolyte, are discharged to the sewer system (SWMU #38) after the acids are neutralized with baking soda (Ref. 48).

c. Weapons Department. Located in Building 378, the mission of the Weapons Department is to provide logistical support to the tenant activities and those units assigned to Roosevelt Roads for training. According to the NACIP report, silver cell batteries from torpedoes are returned to Kingsport, Washington for reworking or disposal (Ref. 48).

d. Naval Mobile Construction Battalion. According to the NACIP report, approximately 30 to 40 batteries are sent to the DRMO Hazardous Waste Storage Facility (SWMU #17) every six months from the Naval Mobile Construction Battalion. During the VSI, the Spent Battery Storage Building (SWMU #39) was observed. On a covered concrete pad, next to the building, spent batteries are drained by pouring the contents into an oversized funnel and collecting the battery acid below. The spent battery acid is stored inside the Spent Battery Storage Building (SWMU #39). At the time of the VSI, battery shells were stacked next to the building. The batteries and battery acid go to the DRMO Hazardous Waste Storage Facility (SWMU #17) for disposal.

14. Fire Fighting Training. The Fire Division of the Air Operations Department provides fire protection and crash rescue response at Roosevelt Roads. The structural fire station, built in the early 1960s, is Building 798 on Forrestal Drive. Building 827, located on the north side of Runway 6 between the 3,000 and 4,000-foot runway markers, is the aircraft crash rescue station, and has been used since the early 1960s for fire fighting training (Ref. 48). Waste oil is burned at the Fire Training Pit (SWMU #14) in the course of fire fighting training.

15. Medical and Dental Care. Medical and dental health care facilities are located in Buildings 1790 and 593 (Ref. 48). Wastes from these two facilities are disposed of in several ways.

a. U.S. Naval Hospital. Located in Building 1790, the U.S. Navy Hospital provides general clinical and hospitalization services for active duty Navy and Marine Corps personnel and their eligible dependents. Acute and long-term cases are sent off-base to better equipped hospitals. Solid wastes produced at the hospital are sealed in plastic bags and sent to the Station Landfill (SWMU #3). Pathological and biohazardous wastes are burned at the permitted Hospital Incinerator (SWMU #15). Laboratory wastes go to the DRMO

Hazardous Waste Storage Facility (SWMU #17), with the exception of small amounts, which are washed into the Sewer Drainage System (SWMU #38). X-ray solutions are processed for silver recovery and then flushed into the Sewer Drainage System (SWMU #38) (Ref. 48).

b. Dental Facilities. According to the NACIP report, dental facilities are located at both the Naval Hospital and at the U.S. Regional Dental Center. Both facilities produce similar wastes in comparable quantities. Developing solution is poured down the drain to the Sewer Drainage System (SWMU #38), while spent fixing solution and scrap amalgam are sent to the DRMO Hazardous Waste Storage Facility (SWMU #17) for metals recovery (Ref. 48).

16. Water Treatment. The Naval base water treatment plant (Building 88) has been in operation for over 30 years according to the NACIP report (Ref. 48). It has the capacity to treat 4 million gallons a day using pre-chlorination, coagulation, sedimentation, filtration, and final chlorination. The amount and type of waste, mainly water from filter backwash and sludge from the sedimentation tanks, has been fairly consistent over the lifespan of this plant. Adjacent to the plant are two specially constructed lagoons (SWMU #42) which receive daily backwash from the filters, as well as sludge from the treatment system sedimentation basins. By plant design, decanted backwash is returned to the front of the plant which enables the recovery of wash water. Sludge (river mud containing aluminum sulfide and lime) is discharged into the adjacent lagoons (SWMU #42) at a rate of 150 tons per year of dry sludge (Ref. 48). The Water Treatment Plant operator stated during the VSI that the source water is piped in from the mountains to the west. Although owned by the Navy, the Water Treatment Plant is operated by a contractor.

17. Wastewater Treatment. Domestic sewage and some stormwater flow is processed through one of three wastewater treatment plants on base. The Capehart Area Wastewater Plant (SWMU #27), Bundy Area Wastewater Plant (SWMU #28), and Industrial Area Wastewater Plant (SWMU #29) comprise this NPDES permitted wastewater treatment system. The Bundy Area and Industrial Area Wastewater Plants (SWMUs #28 and #29) use a trickling filter system with final chlorination before effluent discharge to surface water. Both units are designed to maximize gravitational pull of wastewater through the system. It is likely that the Capehart Area Wastewater Plant (SWMU #27) is similar in design. Influent reaches the wastewater treatment system through the Sewer Drainage System (SWMU #38) and is discharged through Naval Station Outfalls (AOC D) as treated effluent. All three wastewater treatment plants are in violation of Puerto Rico Environmental Quality Board regulations (Ref. 50). Because Reference 50 is undated and reports no specific violations, it is not possible to determine how long these units have been in violation and the reasons for violation. However, the VSI team was informed by a plant operator that all three had been in violation for an extended period of time.

18. Specialized Installation Operations. Several specialized operations are conducted by various organizations at the facility including veterinary services, garage and gas station facilities, Water Security Patrol, Army Reserves, and the Navy Courier Service Detachment. A description of the services and any wastes generated follows.

a. Veterinary Services. According to the NACIP study, the Veterinary Services Section offers small and large animal veterinary services in addition to conducting meat and food inspections at the Navy Exchange and the commissary. Approximately 25 small animals are buried at the Station Landfill (SWMU #3) per month (Ref. 48).

b. Navy Exchange Garage and Gas Station Facilities. The Navy Exchange operates two service areas: a garage and gas station facility in the Bundy Area, and a gas station near the base fire department, north of the Industrial Area. Each facility has three underground fuel tanks of approximately 10,000 gallon capacity. At the Bundy facility a private contractor removes waste oil, spent batteries, and tires. The remaining tires, empty quart oil cans, and waste cardboard are disposed of at the Station Landfill (SWMU #3). Machinery or resellable parts are stored in the DRMO yard until resale (Ref. 48). Specific information regarding the Industrial Area gas station was not available in the PR file material; nor did facility representatives provide additional specific information during the VSI.

c. Water Security Patrol (WASP). Established in 1983, the Water Security Patrol is under the command of Surface Operations and is responsible for waterfront security. Fueling is done at the fuel pier loading facility. Waste generated from routine maintenance of boats and outboard motors is considered minimal, consisting of small amounts of oil, solvents, soaps, etc., all of which is disposed at the Station Landfill (SWMU #3) (Ref. 48).

d. U.S. Army Reserves - 390 Terminal Transfer Company. The mission of the 390 Terminal Transfer Company is to train reserves on weekends in material handling and transport, and for qualification for various motor vehicle class licenses. Although training in cargo handling is conducted, no cargo is actually handled. However, about one 55-gallon drum of waste oil from vehicle maintenance is picked up by a DRMO contractor every three months (Ref. 48).

e. U.S. Army Reserves - 699 Engineering Company. The mission of the 699 Reserves Engineering Company is to provide port construction training. Four landing craft-type units, as well as land vehicles, are available to the reserves. Maintenance of the watercraft is handled by Surface Operations. Land vehicle maintenance generates about five gallons of waste oil per month, which is picked up by a DRMO contractor (Ref. 48).

f. U.S. Navy Courier Service Detachment. The mission of the detachment is to provide transportation and handling of special classified documents in a manner similar to a private service such as Federal Express. Wastes generated from this service are considered by the Navy to be minimal, consisting of general office waste and shredded paper which is picked up and disposed of by a private contractor (Ref. 48).

B. Ordnance Operations

1. Torpedo Shop. All ordnance for disposal from the Torpedo Shop (AOC A) is taken offsite by the Explosive Ordnance Disposal (EOD) detachment to the Vieques Naval Ammunition Facility (NAF) for proper disposal. Ordnance items include propellants, igniters, carbon dioxide bottles with squibs, explosive bolts, rocket motors, ignition separator assemblies (ISAs), and piston motors. Formerly, ISAs were burned off in the office ashtrays. Before 1968, explosives from this activity were disposed of in the Station Landfill (SWMU #3) or in the ocean. None of the torpedoes prepared by this activity are armed with warheads (Ref. 48). The Torpedo Shop is considered a "unique military operation" by the Navy. At the time of the VSI, the VSI team was informed of unanticipated security clearance regulations associated with this operation and, therefore, was not able to proceed with the visual inspection of the Torpedo Shop.

2. Weapons Department, Naval Station Roosevelt Roads. The Weapons Department, located in Building 378, is responsible for receipt, storage, maintenance, transport, and disposal of ordnance as well as providing logistical and administrative support regarding ordnance activities. Ordnance disposal is through Explosives Ordnance Disposal (EOD) which takes place on Vieques Island (Ref. 48).

3. Radiological Operations. According to the NACIP report, the Naval Electronics Engineering Center uses low-level isotopes to calibrate fleet electronic instruments twice a year. The Department of Energy monitors these activities. Electron-generator type X-ray machines, which produce no radiological waste, are used by the Naval Hospital and the Naval Regional Dental Center. The hospital laboratory uses small amounts of low-level radioisotopes, such as iodine (Ref. 48). Facility representatives could not determine if wastes were being generated by these facilities.

Wastes Handled and Waste Management Practices

Waste management operations at the Roosevelt Roads facility include activities involving the Defense Reutilization and Marketing Office (DRMO), operation of storage lots and scrap yards, and management of PCBs, pesticides, petroleum, oil, lubricants (POL), and various other hazardous wastes. A discussion of the wastes generated and waste management practices follows. Table 3 provides a composite of wastes generated and specific disposal practices.

1. Waste Management. Waste management practices at Roosevelt Roads are discussed in the following section. The primary waste management units or practices include the Defense Reutilization and Marketing Office and the numerous temporary accumulation areas at the facility.

a. Defense Reutilization and Marketing Office (DRMO). The DRMO at Roosevelt Roads transports, stores, and disposes of both materials and wastes from all base operations from the Naval Ammunition Facility (NAF) and Atlantic Fleet Weapons Training Facility (AFWTF) on Vieques, from other Department of Defense facilities on Puerto Rico and from Puerto Rico National Guard units. Materials stored in the open include office furniture, clothing, vehicles, salvage drums, and hazardous material. Materials are stored in

Table 3. Waste Management Practices at U.S. Naval Station Roosevelt Roads, PR.

Process	Disposition	Wastes Generated
Painting	• Station Landfill (SWMU #3)	Scrap wood pieces, empty paint cans
	• Ignitable Storage Facility (SWMU #18)	Waste paint
Paint Stripping*	• Station Landfill (SWMU #3)	Paint scrapings
	• Ignitable Storage Facility (SWMU #18)	Paint stripping compounds, corrosion prevention compounds, metal conversion compounds
Degreasing and Solvent Cleaning*	• Offsite disposal by private contractor	Waste oil, solvents, degreaser
	• Ignitable Storage Facility (SWMU #18)	Corrosion inhibiting compounds, PD-680 (mineral oil solvent), methyl ethyl ketone (MEK)
	• Offsite disposal by DRMO contractor	Dry cleaning solvent, alcohol, aliphatic naptha, technical xylene, methyl ethyl ketone (MEK), OTTO Fuel II, Agentine, alcohol (Neosol), sodium sulfide, acetone, denatured ethyl alcohol, silver cell batteries, waste oil, contaminated clothing, detergent
Machining	• Station Landfill (SWMU #3)	Metal pieces, welding material, small grease and oil containers
Printing	• Station Landfill (SWMU #3)	Cleaning rags (soiled with rubber-based ink)
	• Offsite disposal by private contractor	Minor amounts of lubricating oil
Photograph Developing*	• Offsite recycling by DRMO contractor	Film (recycled for silver recovery)
Electrical & Electronic Equipment Repair	• Offsite disposal by DRMO contractor	Transformer oil (PCB)
	• Station Landfill (SWMU #3)	Cables, wires, conduits, receptacles, ballasts, bulbs, grease and oil containers, minor amounts of solder and lead, small electronic transformers (no PCBs), low voltage batteries, power tubes containing beryllium insulators (approximately 12 per month)
	• Recycled through a private contractor	Spent cleaning fluids
Calibration	• Deposited in Oil Spill/Oil Water Separator (SWMU #24) which is pumped out by a DRMO contractor	Small amounts of oil and hydraulic fluid
	• Washed into Sewer Drainage System (SWMU #38) and eventually discharged from Naval Station Outfalls (AOC D)	Small amounts of oil and hydraulic fluid
Power Generation	• Station Landfill (SWMU #3)	Wires, meters, gauges, windings, etc.
	• Recycled through a private contractor	Waste oil
Navy Exchange Garage & Gas Station Facilities	• Offsite disposal by private contractor	Waste oil, spent batteries, tires
	• Station Landfill (SWMU #3)	Empty quart oil cans, tires, waste cardboard

-- continued --

Table 3. Continued.

Process	Disposition	Wastes Generated
Battery Maintenance	• Hazardous Waste Storage Facility (SWMU #17)	Battery acid, drained batteries
	• Returned to manufacturer for reworking or disposal	Rechargeable and silver cell batteries
	• Released to Sewer Drainage System (SWMU #38) and eventually discharged from Naval Station Outfalls (AOC D)	Acid contaminated rinse waters (neutralized with baking soda), potassium hydroxide electrolyte
Medical & Dental Care	• Hazardous Waste Storage Facility (SWMU #17)	Laboratory wastes
	• Station Landfill (SWMU #3)	Solid wastes sealed in plastic bags
	• Hospital Incinerator (SWMU #15)	Biological and pathological wastes
	• Released to Sewer Drainage System (SWMU #38) and eventually discharged from Naval Station Outfalls (AOC D)	Small amounts of laboratory waste
Pest Control*	• Station Landfill (SWMU #3) (after triple rinse)	Empty pesticide containers
Steam Supply	• Station Landfill (SWMU #3)	Asbestos from pipe insulation
Veterinary Services	• Station Landfill (SWMU #3)	Approximately 25 small animal corpses monthly
	• Buried on stable property	Approximately two horses per year
Air Conditioning & Refrigeration	• Station Landfill (SWMU #3)	Small parts, air conditioners, empty containers of cleaning solution and freon
Fire Fighting Training*	• Burned at Fire Training Pit (SWMU #14) then washed into Fire Training Pit Oil/Water Separator (SWMU #12)	Waste oil
Water Treatment	• Water Treatment Plant Sludge Lagoons (SWMU #42)	River mud containing aluminum sulfide and lime
Wastewater Treatment	• Processed through Naval Station Wastewater Plants (SWMUs #27, #28, #29) and eventually discharged from Naval Station Outfalls (AOC D)	Domestic sewage
Ordnance Activities	• Explosive Ordnance Disposal (EOD) on Vieques Island	Propellants, igniters, CO_2 bottles with squibs, explosive bolts, rocket motors, ignition separator assemblies (ISAs), piston motors
Water Security Patrol (WASP)	• Station Landfill (SWMU #3)	Small amounts of oil, solvents, soaps
U.S. Army Reserves	• Offsite disposal by DRMO contractor	Approximately 280 gal. waste oil/year
U.S. Navy Courier	• Offsite disposal by private contractor	General office waste and shredded paper

* Some wastes may be released to the Sewer Drainage System (SWMU #38) and eventually discharged from Naval Station Outfalls (AOC D).

designated areas, and numbered and moved according to a manifest system (Ref. 48). Disposal depends upon the nature of the material and entails auctioning, sending materials to other government agencies, or removal by a contractor. Housing two RCRA-permitted units (SWMUs #17 and #18), the DRMO yard is located on Forrestal Drive, south of the intersection of Forrestal Drive and Tow Way Road. The DRMO Hazardous Waste Storage Facility (SWMU #17) is contained inside Building 1973 and is used to store all nonflammable hazardous waste. The Ignitable Storage facility, Building 2009 (SWMU #18), is a small metal building inside the fenced DRMO yard, which stores all flammable hazardous waste. Immediately adjacent to Building 2009 is an open area, Past DRMO Hazardous Waste Storage (SWMU #25), that is presently used to store hazardous materials. Approximately 1,000 gallons of acid, bases, paints, thinners, and sealing compounds, as well as 10 to 15 55-gallon drums of waste oils, are received at DRMO monthly (Ref. 48). According to facility representatives, DRMO contracts the services of transportation and offsite disposal for all hazardous wastes.

b. Storage Lots and Scrap Yards. Storage lots and scrap yards are primarily associated with the Public Works Department, Supply Department, DRMO, Naval Mobile Construction Battalion (NMCB) and the dry dock area. The Transportation Division of the Public Works Department maintains a storage yard adjacent to the Public Works Department Building (Building 31) where the Waste Oil Collection Area (SWMU #31) and Battery Collection Area (SWMU #32) were observed at the time of the VSI. Items stored at the Public Works Transportation Division and Supply Department storage yards are generally vehicles and construction equipment. The Pole Storage Yard (SWMU #46) located behind Building 2042 is a Public Works storage yard that was noted during the VSI to be a telephone pole and insulator storage area. Adjacent to the Pole Storage Yard is the Transformer Storage Area (AOC C) in the former location of Navy Exchange Warehouses 40, 41, and 42. The Former Paint Storage Building (SWMU #6), now empty, and Former PWD Storage Area (AOC B), a collapsed building, are located in an unfenced yard in the vicinity of the dry dock. Naval Mobile Construction Battalion (NMCB) yards store fuels, oils, construction equipment and chemicals (Ref. 48), and some waste, as in the case of the Spent Battery Storage Building (SWMU #39) and the Seabee Oil Collection Area (SWMU #40).

2. Wastes Generated. The primary wastes generated at the facility include hazardous wastes, PCBs, petroleum products (e.g., lubricants, oils) and pesticides. The generation of these wastes is discussed as follows.

a. PCBs. The process of testing and, if necessary, replacing all transformers on base started in 1981 and should be completed during 1988-1989 (Ref. 23). For this reason there is a PCB Storage Compound (SWMU #11) where PCB-contaminated and possible PCB-contaminated items are stored indoors on a curbed concrete pad in an area surrounded by a cyclone fence. Past release to the ground outside this unit has been documented (Ref. 48) and is noted in this report as PCB Spill Area (SWMU #45). Another possible PCB storage area is the Transformer Storage Area (AOC C). Release of transformer oil to the ground was observed at this unit during the VSI. Approximately 150 feet north of the Transformer Storage Area (AOC C) is the Pole Storage Yard (SWMU #46), which was used to store transformers and drums containing PCB-contaminated materials, according to the NACIP report (Ref. 48). No transformers or drums were observed during the VSI. Substation 2, noted in this report as Transformer Maintenance Area (SWMU #10), was observed to have release to the soil. According to the NACIP study, PCB-contaminated items have been disposed of at the Station Landfill (SWMU #3).

b. Pesticides. Past and present pesticide waste storage areas include the Old Pest Control Shop (SWMU #13) and Pesticide Waste Storage (SWMU #19). According to facility representatives, closure plans are forthcoming for Pesticide Waste Storage (SWMU #19) which is used to store outdated pesticides. The New Pest Control Shop was not observed during the VSI but, according to the NACIP study, it houses insecticides, herbicides, and rat poisons and has separate areas for pesticide storage and mixing. According to facility representatives, pesticide containers are triple-rinsed before being taken to the Station Landfill by shop employees. The rinsate is treated as a material and is added to the next batch when that particular pesticide is needed. The Old Pest Control Shop (SWMU #13) no longer stores pesticides and, according to the president of the Navy Scuba Diving Club, was "decontaminated" before being used as their headquarters.

c. Petroleum, Oil, Lubricants (POL). Because petroleum, oil, and lubricants are essential to equipment function, maintenance and repair, POL storage, transportation, and disposal goes on throughout the entire base. In addition, Roosevelt Roads serves as an important refueling station for all NATO ships and, therefore, must maintain a large store of fuel. Numerous releases to soil and surface water associated with fuel storage are cited in this report (for example, SWMUs #7, #8, and #9). The maintenance and repair of aircraft generates considerable waste, observed during the VSI as the Waste Oil Drum Storage Area (SWMU #37), VC-8 Waste Storage Pad (SWMU #34), and Aerial Target Systems Department Drainage Ditch (SWMU #44). Oil/water separators are a common means of reclaiming waste POLs for recycling or disposal. The Fire Training Pit Oil/Water Separator (SWMU #12), Aircraft Wash Rack Oil/Water Separator (SWMU #35), and Drone Fuel Drain Oil/Water Separator (SWMU #4) were observed during the VSI. When there is a spill in the harbor, SWMUs #21 through #24, known collectively as the Oil Spill Removal System, contain and remove the waste oil. In the days before oil/water separators were used as a matter of course, waste POLs were disposed of at random. The Army Cremator Disposal Site (SWMU #1), Langley Drive Disposal Site (SWMU #2), Station Landfill (SWMU #3), and Abandoned Engine Oil Drums (SWMU #26) were all used for POL disposal. Waste POLs are burned at the Fire Training Pit (SWMU #14). As a matter of course, waste POLs do not pass through DRMO, but are transported offsite for reclamation or disposal by either private or DRMO contractors.

d. Hazardous Wastes. Hazardous wastes were observed to be stored at the AIMD Hazardous Waste Storage Pad (SWMU #33), DRMO Hazardous Waste Storage Facility (SWMU #17), and Ignitable Storage Facility (SWMU #18). According to the NACIP study, other areas, including the Army Cremator Disposal Site (SWMU #1), Langley Drive Disposal Site (SWMU #2), and Station Landfill (SWMU #3), are suspected of having been used for hazardous waste disposal. Roosevelt Roads has two RCRA permitted hazardous waste units, the DRMO Hazardous Waste Storage Facility, and the Ignitable Storage Facility (SWMUs #17 and #18, respectively). Table 4 lists hazardous wastes stored in SWMUs #17 and #18 at the DRMO facility.

History of Releases

There have been various release events at the Roosevelt Roads facility. Specifically, in their NACIP study report (Ref. 48), the U.S. Navy documented releases of fuel, PCBs, pesticides, and other as yet unidentified materials. These instances are described below.

Three unlined landfills (SWMUs #1, #2, and #3) have been in operation for overlapping periods of time beginning in the 1940s up until the present. Corroded 55-gallon drums of unidentified substances, pesticides, asbestos, solvents, and contaminated OTTO Fuel II have been disposed of at these units (Ref. 48).

Numerous releases have been identified with the Tow Way Road Fuels Farm (SWMU #7), including 420,000 gallons of Bunker C fuel released to soil and surface water in the 1950s, approximately 65,000 gallons of diesel fuel released to soil in 1978, approximately 91,000 gallons of JP-5 (aviation kerosene) released to soil and surface water in November 1986, and an estimated 420,000 gallons of diesel fuel released to the soil over a 15 to 20 year period.

In the early 1970s between 4,000 and 7,000 gallons of Bunker C fuel sludge was buried in unlined pits, which are identified in this report as Tow Way Road Disposal Pits (SWMU #8). Approximately 30,000 to 40,000 gallons of leaded sludge were buried in unlined Leaded Sludge Pits (SWMU #9).

Over a period of years (not extending beyond 1978) a maximum of 3,000 gallons of PCB-contaminated transformer oil was poured on the ground at the Transformer Maintenance Area (SWMU #10) and an estimated 1,600 gallons was poured out at PCB Spill Area (SWMU #45).

Table 4

HAZARDOUS WASTES
at
NAVAL STATION ROOSEVELT ROADS (Ref. 59)

WASTE DESCRIPTION	WASTE NUMBER	WASTE CODE
Beryllium Dust	P015	H
Lithium/Sulfur Dioxide Batteries	D003	R
Nickel/Cadmium Batteries	D003/D006	R, T
Mercury Batteries	D009	T
Mercury Batteries in Acetic Acid	D002/D009	C, T
ATON Batteries	D002	C
Alkaline Batteries	D002	C
Lead/Acid Batteries	D002/D008	C, T
Lead/Acid Batteries (Drained)	D008	T
Battery Electrolyte[1]	D002/D008	C, T
Acetic Acid	D002	C
Chromic Acid (Alodine)	D002/D007	C, T
Hydrochloric Acid	D002	C
Sulfuric Acid	D002	C
Ammonium Hydroxide	D002	C
Cleaning Compound[2]	D002	C
Mercury	U151/D009	T
Blasting Booth Dust[3]	D007/D008	T
Gasoline (Unleaded)	D001	I
Petroleum Fuels (Leaded)	D001/D008	I
Jet Fuel (JP-4 or JP-5)	D001	I

Table 4

HAZARDOUS WASTES
at
NAVAL STATION ROOSEVELT ROADS (cont.) (Ref. 59)

Kerosene (contaminated)	D001	I
Adhesives[4]	D001	I
Calibration Fluid	D001	I
Cleaning Compound (Mineral Spirits)	D001	I
Isopropyl Alcohol	D001	I
Sealing Compound	D001/F003	I
Icing Inhibitor	D001	I
Inspection Penetrant	D001/F003	I
Decontaminating Agent, STB	D003	R
Denatured Alcohol	D001	I
Duplicating Fluid	D001	I
Waste Paints[5]	D001	I
Painting Wastes[6]	D001/D002 D007/D008 F002/F003 F005	I, C, T
Chlordane	U036	T
Malathion (with carrier solvent)	D001	I
Photographic Developer	D002/D011	C, T
Photographic Fixer	D002/D011	C, T
Photographic Toners	D001	I
Photographic Hardener	D011	T
Photographic Stabilizer	D011	T

Table 4

HAZARDOUS WASTES
at
NAVAL STATION ROOSEVELT ROADS (cont.) (Ref. 59)

Photographic Starter	D011	T
Photographic Replinisher	D002/D011	C, T
Photo Auto Reversal Chemical	D011	T
Hypo-Solution : $(NH_4)_2S_2O_3$	D011	T
Hypo-Solution : $Na_2S_2O_3$ - $5H_2O$	D011	T
Corrosion Inhibitor	D001	I
Naphtha	D001	I
Acetone	F003/U002	I
Ethyl Ether	F003/U117	I
Isobutanol	F005/U140	I, T
Methanol	F003/U154	I
Methylene Chloride	F001/F002 U080	T
Methyl Ethyl Ketone (MEK)	F005/U159	I, T
Tetrachloroethylene	F001/F002 U210	T
Toluene	F005/U220	T
1,1,1 Trichloroethane	F001/F002 U226	T
Trichloroethylene	F001/F002 U228	T
Trichlorofluoromethane	F002/U121	T

Table 4
HAZARDOUS WASTES
at
NAVAL STATION ROOSEVELT ROADS (cont.) (Ref. 59)

Trichlorotrifluoroethane	F002	T
Xylene	F003/U239	I
Chlorinated Flourocarbons	F001	T
1,1,2-Trichloroethane	F002/U227	T
MEK and Paint	F005/D007 D008	I, T
Paint Removers	D002/F002	C, T
Dye Penetrant	D001/F001 F002	I, T
Carbon Remover	F002	T
Dry Cleaning Solvent (PD-680-I)	D001	I
Stoddard Solvent	D001	I
Inspection Penetrant	D001/F002	I, T
Petroleum Lubricant	D001	I
Aerosol Cans (Partially Full)	D001/F001 F002/F003 F005	I, T
Miscellaneous Waste Ignitables	D001	I
Miscellaneous Waste Acids	D002	C
Miscellaneous Waste Caustics	D002	C
Miscellaneous Waste Reactives	D003	R
Misc. Halogenated Solvents[7]	F001/F002	T
Misc. Halogenated Solvents[8]	F001/F002	T

Table 4

HAZARDOUS WASTES
at
NAVAL STATION ROOSEVELT ROADS (cont.) (Ref. 59)

Misc. Non-Halogenated Solvents	F003/F005	I, T
Miscellaneous POL's[9]	D001/F001 F002/F003 F005	I, T
Magnesium Batteries	D003	R
Grease Contaminated with Oils	D001/D007 D008	I, T
Freon Contaminated Hydraulic Fluid	F002	T

NOTES:

1. Battery electrolyte refers to the sulfuric acid/water mixture drained from lead acid batteries.
2. Cleaning compound refers aircraft surface cleaning compound whose NSN# is 6850-00-935-0995, and is commonly known as TURCO.
3. Blasting booth dust is the spent sandblasting media which includes glass beads contaminated with heavy metals.
4. Adhesives refers to variety of adhesive materials that contain low flash point solvents.
5. Waste paints include acrylics, enamels, epoxy paints, lacquers, oil based paints, polyurethane paints, varnish, primers, deck coating, and shellac.
6. Painting wastes refers to waste paints or painting related materials that are contaminated with one or more of the following materials: oils, thinners, dirt, halogenated solvents, non-halogenated solvents, corrosive strippers and heavy metals.
7. Mixed waste containing, before use, a total of 10% or more of the F-listed halogenated solvents.
8. Mixed waste containing, before use, less than a total of 10% of the F-listed halogenated solvents.
9. POL's (Petroleum, Oils, and Lubricants) potentially contaminated with one or more ignitable wastes or F-listed solvents .

3.0 ENVIRONMENTAL SETTING

Location and Surrounding Land Use

The Naval Station Roosevelt Roads (NAVSTA) is located on the extreme eastern coast of Puerto Rico near the municipality of Ceiba, approximately 33 miles southeast of the capital City of San Juan. The nearest major town is Fajardo, which is 10 miles north of the station.

NAVSTA occupies 8,055 acres and is bordered on all sides but the west by the Caribbean Sea. Immediately to the west of the station and adjacent to its western boundary is the town of Ceiba (Figure 1). The land to the southwest is used for agricultural purposes and includes Bosque Estatal de Ceiba, which is a mangrove forest. Along the station's western border, from south to north, are several settlements including Esperanza, Daguao, Quebrada Seca, Aguas Claras and Ceiba. The town of Ceiba is the largest (27.5 square miles) with a population of 15,000 people. Land use in these adjacent areas is primarily residential, with some commercial uses interspersed. There are no industrial uses adjacent to the station (Ref. 48).

Climate and Meteorology

The climate of the Roosevelt Roads area is characterized as warm and humid, with frequent showers occurring throughout the year. Consistent easterly trade winds blow throughout the year and moderate the temperature. The mean annual temperature ranges from 88° F in August to 64° F in January. Rain usually occurs at least nine days in every month, with an average of 60 inches per year. A dryer winter season occurs from December through April. The hurricane season is from mid-June through mid-September, with maximum winds exceeding 95 knots during severe hurricanes. An average of two tropical storms per year occurs in the area, one of which usually reaches hurricane intensity (Ref. 48)

Surface Water

Originating in the Sierra de Luquillo mountains to the west, surface waters generally flow eastward across Roosevelt Roads in a network of rivers and streams that eventually reach the Caribbean Sea. Surface waters generally have high turbidity and naturally-occurring organics due to the periodic heavy rains which can easily erode soils from steep slopes, exposed areas, and disturbed stream beds. The Daguao River and Quebrada Seca Stream collect surface waters from the hills immediately north of the station, and in periods of heavy rain, on-station flooding occurs. Increased development in the town of Ceiba, especially in areas adjacent to the station's northern border, has significantly increased the surface runoff reaching the station, causing ponding and erosion in the northern parts of the Naval Station. The Daguao-Quebrada Seca watershed covers an area measuring approximately 7.6 square miles (4,864 acres) (Ref. 48).

Topography and Surface Drainage

The regional area of the Naval Station consists of an interrupted narrow coastal plain with small valleys extending from the Sierra de Luquillo Range, which has been deeply eroded by streams into valleys several hundreds of feet deep. Slopes of 30° to 45° are not uncommon. The Station elevation ranges from sea level to 295 feet. There is a series of three hilly areas on the station (Figure 4), two of which separate the southern airfield area from the Port/Industrial, Housing, and Personnel Support areas. The third set of hills is in the Bundy area. These ridge lines not only separate sections of the station, but also dictate the degree of allowable development. Relief near the coast is low and lagoons and swamps are common (Ref. 48).

Soils, Geology, and Hydrogeology

The soil associations found at the Naval Station are predominantly of two types typical of humid areas, namely the Swamps-Marshes (SM) Association and the Mabi-Rio-Arriba-Cayagua (MRAC) Association. These two associations cover one half of the station's surface area and are equally distributed. The remaining area is covered primarily by the Descalabrado-Guayama (DG) and Caguabo-Mucara-Naranjito (CMN) associations (Ref. 48).

The SM Association consists of deep, sandy or clayey soils, that are very poorly drained. They contain organic matter from decaying mangrove trees. This association is found in level or nearly level areas that are slightly above sea level but are wet. When the tide is high, they are covered or affected by saltwater or brackish water. These soils are underlain by coral, shells, and marl at varying depths. The high concentration of salts inhibits the growth of vegetation, with the exception of mangrove trees, and in small scattered patches, other salt-tolerant plants (Ref. 48).

The MRAC Association consists generally of deep, somewhat poorly drained and moderately well drained, nearly level to moderately steep soils found on foot and side slopes, terraces, and alluvial fans. These soils are basically clayey, and are located predominantly in the areas surrounding Ofstie Field (Ref. 48).

The DG Association generally consists of shallow, well drained, strongly sloping to very steep soils on volcanic uplands. Soils of this association are found primarily in the hilly areas located directly inland and adjacent to the soils of the SM Association (Ref. 48).

The CMN Association consists generally of shallow and moderately deep, well drained, sloping to very steep soils on volcanic uplands. This association is represented at the Naval Station by the Sabana series, which are found on the side slopes and hilly terrain west of Langley Drive in the Fort Bundy area. Steep slopes, susceptibility to erosion, and depth to bedrock are the main limitations of these soils; thus, their use is limited to pasture and woodland (Ref. 48).

The remaining soils on the station consist mainly of deep and moderately deep, well drained soils on nearly level to low rolling hills. In some areas, the soils are strongly sloping and poorly drained (Ref. 48).

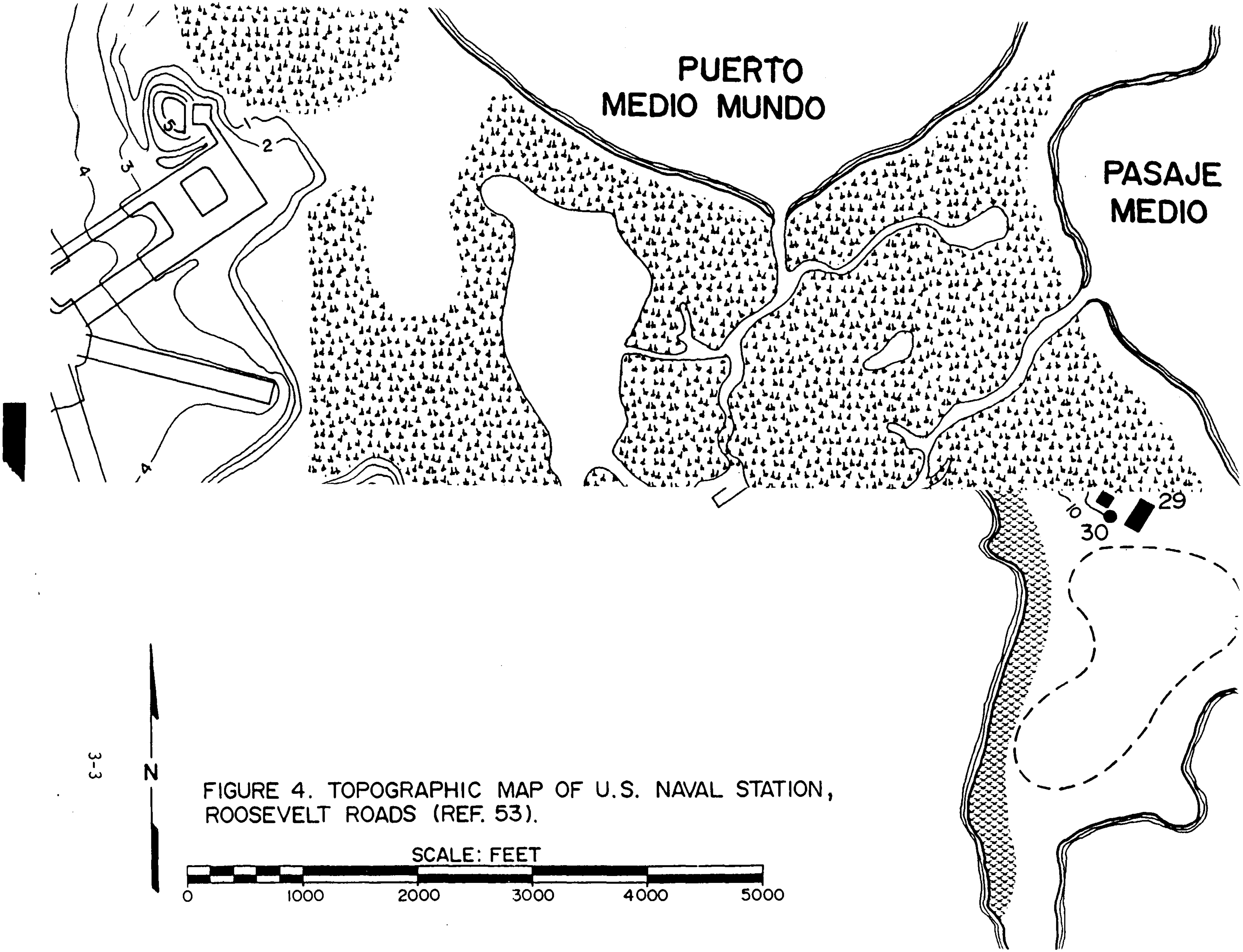

FIGURE 4. TOPOGRAPHIC MAP OF U.S. NAVAL STATION, ROOSEVELT ROADS (REF. 53).

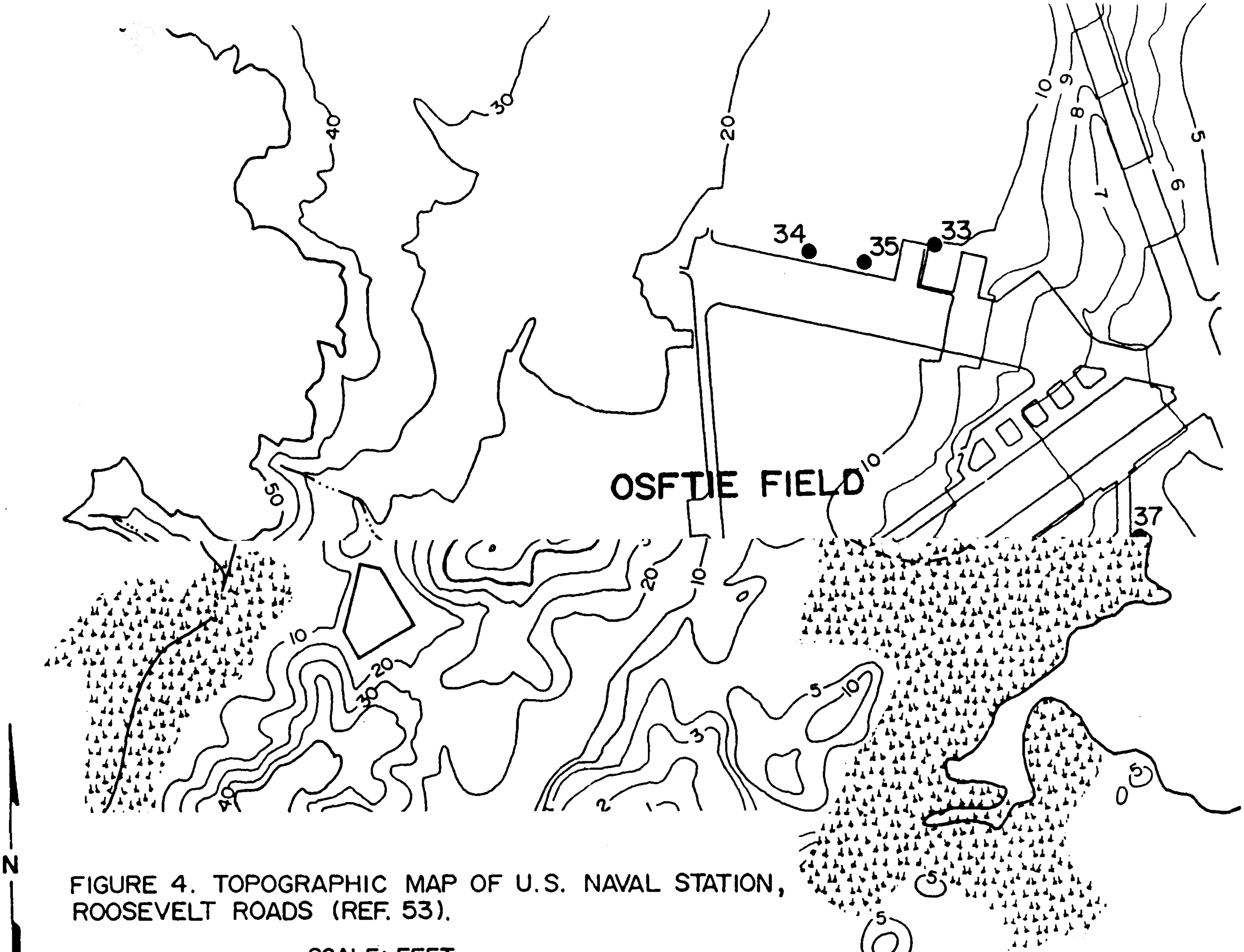

FIGURE 4. TOPOGRAPHIC MAP OF U.S. NAVAL STATION, ROOSEVELT ROADS (REF. 53).

SCALE: FEET

0 1000 2000 3000 4000 5000

The underlying geology of the station area is predominantly volcanic composed of lava and tuff, as well as sedimentary rocks derived from discontinuous beds of limestone. The volcanic rocks and interbedded limestones have been complexly faulted, folded, metamorphosed, and intruded by dioritic rocks. This complex geological restructuring occurred sometime after the deposition of the limestone, when Puerto Rico was separated from the other major Antillean Islands by block faulting and was arched, uplifted, and tilted to the northeast (Ref. 48).

In addition to the predominant volcanic and sedimentary rock, the northwestern and western sectors of the base are underlain by unconsolidated alluvial and old alluvial deposits from the Quaternary period (Ref. 48).

The primary geologic formations on and near NAVSTA Roosevelt Roads are various beach deposits, alluvium, quartz diorite and granodiorite, quartz keratophyre, the Daguao formation, and Figuera lava. The station is traversed by the Pena Pobre fault zone (Ref. 48).

Little information exists concerning the hydrogeology of NAVSTA Roosevelt Roads. Some wells were developed upgradient of the station in Ceiba, but were abandoned due to high levels of salinity. The principal aquifer of concern underlying Roosevelt Roads is alluvium consisting of lenticular beds of clay, sand, gravel, and rock fragments. These deposits are generally less than 100 feet thick and overlie the Daguao Formation, a massive, interbedded unit composed of volcanic breccia, lava, and subordinate volcanic sandstone and crystal tuff. According to the NACIP study, the water table is very near the surface (i.e., less than 10 feet) and, in places, at depths of two feet or less (Ref. 48). Groundwater present in the alluvial aquifer was formerly used to irrigate sugar cane fields, but is currently not utilized (Ref. 31a).

In June 1975, six observation wells were constructed at the Station Landfill (SWMU #3). The wells ranged in depth from 7.4 to 14.3 feet below ground surface. Depth to water in the wells, measured on two occasions (June 17, 1975 and July 1, 1975), ranged from 0.65 to 12.5 feet below ground surface. Water quality analysis was also provided, and indicated the groundwater to be relatively salty with chloride concentrations as high as 20,000 mg/l and total dissolved solids concentrations as high as 31,700 mg/l (Ref. 37).

4.0 DESCRIPTIONS OF SOLID WASTE MANAGEMENT UNITS AND OTHER AREAS OF CONCERN

The SWMUs and other AOCs identified during the PR are listed below. Descriptions and known details of the units are given in the following section.

Descriptions of Solid Waste Management Units and Other Areas of Concern

Solid Waste Management Units

1. Army Cremator Disposal Site
2. Langley Drive Disposal Site
3. Station Landfill
4. Drone Fuel Drain Oil/Water Separator
5. Dumpsters
6. Former Paint Storage (Building 145)
7. Tow Way Road Fuels Farm
8. Tow Way Road Disposal Pits
9. Leaded Sludge Pits
10. Transformer Maintenance Area (Building 90)
11. PCB Storage Compound (Building 38)
12. Fire Training Pit Oil/Water Separator
13. Old Pest Control Shop (Building 258 and Surrounding Area)
14. Fire Training Pit
15. Hospital Incinerator (Building 1928)
16. Waste Explosive Storage (Building 1666)
17. DRMO Hazardous Waste Storage Facility (Building 1973)
18. Ignitable Storage Facility (Building 2009)
19. Pesticide Waste Storage (Building 121)
20. Waste Oil Tank Truck (near Building 860)
21. Donuts
22. Ships Waste Offload Barges
23. Oil Spill Separator Tanks
24. Oil Spill Oil/Water Separator
25. Past DRMO Hazardous Waste Storage
26. Abandoned Engine Oil Drums (behind Building 544)
27. Capehart Area Wastewater Plant
28. Bundy Area Wastewater Plant
29. Industrial Area Wastewater Plant
30. Former Incinerator Site (adjacent to landfill entrance)
31. Waste Oil Collection Area (PWD Storage Yard)
32. Battery Collection Area (PWD Storage Yard)
33. AIMD Hazardous Waste Storage Pad
34. VC-8 Waste Storage Pad
35. Aircraft Wash Rack Oil/Water Separator (VC-8 yard)
36. Vehicle Wash Rack Oil/Water Separator (near Berthing Pier)

-- Continued --

Continued.

Solid Waste Management Units

37. Waste Oil Drum Storage Area (near Hangar 200)
38. Sewer Drainage System
39. Spent Battery Storage Building (Building 3158)
40. Seabee Oil Collection Area
41. Rinse Rack near Seabee Pesticide Storage
42. Water Treatment Plant Sludge Lagoons
43. Drone Washdown Area
44. Aerial Target Systems Drainage Ditch
45. PCB Spill Area
46. Pole Storage Yard
47. Local Disposal Areas

Areas of Concern

A. Torpedo Shop
B. Former PWD Storage Area (Building 25)
C. Transformer Storage Area (near Building 2042)
D. Naval Station Outfalls

1. UNIT NAME: Army Cremator Disposal Site (Photos 1 and 2)

Unit Description: This unit is located south of the intersection of the access road to the Ammo Pier and Langley Drive. According to the NACIP study (Ref. 48), for approximately 20 years this site was the primary Station Landfill (SWMU #3) for the main base. Fort Bundy also utilized this area during that period. Waste material was disposed of by piling, burning, and then compacting. Also according to Ref. 48, the eventual migration of contaminants to Ensenada Honda is probable, since some of the material lies directly in the mangrove swamp which is subject to periodic flooding by high tides. The Ensenada Honda mangrove area provides a habitat for several endangered species (Ref. 48). In 1984, the NACIP IAS team spotted several large mounds of drums during an overflight. The drums were located near the mangroves and were rusted, but some appeared to be intact. An on-ground visual inspection was attempted, but the vegetation was too dense and the drums could not be located (Ref. 48). Facility officials estimate the size of this unit to be 40 acres (Ref. 52).

The VSI team observed an oily, silver-toned substance floating at the water's edge. Dead mangroves were observed several feet out from the water's edge and extending up and down the shoreline (Ref. 57). This was due to a spill of JP-5 (aviation kerosene) in November 1986 (Ref. 20), according to a facility representative. An area measuring approximately 50 feet in diameter completely devoid of vegetation was found within the boundaries of this unit (Photo 2).

Date of Start-up: This unit was first used as a disposal area in the early 1940s (Ref. 48).

Date of Closure: This unit was abandoned in the early 1960s (Ref. 48).

Wastes Managed: According to the NACIP study, waste material was disposed of by piling, burning, and then compacting. An estimated 100,000 tons of waste including scrap metal, inert ordnance, batteries, tires, appliances, cars, cables, dry cleaning solvent cans, paint cans, gas cylinders, construction debris, dead animals, and residential waste was disposed of at this site (Ref. 48).

Release Controls: There are no release controls identified with this unit.

History of Release: By management design (trash burning), there were daily releases to the atmosphere (Ref. 48). Wastes were disposed of directly in the swamp (Ref. 48), constituting release to surface water and probably release to groundwater. The mangroves which border the Army Cremator Disposal Site are regularly flooded by tidal action (Ref. 31a). The VSI team observed an oily, silver-toned substance floating at the water's edge in addition to observing an area at the edge of the swamp that was completely devoid of vegetation (Ref. 57).

2. UNIT NAME: Langley Drive Disposal Site (Photo 3)

Unit Description: This unit is located along Langley Drive, approximately 2,000 feet north of the Navy Exchange Complex and 300 feet east of the drive towards Ensenada Honda. According to the NACIP report, there are no records of historic disposal practices at this site (Ref. 48). However, the Navy documents this unit as having been used for the disposal of both hazardous and nonhazardous wastes (Ref. 52). The NACIP team was led to the site by a Public Works employee who knew of the site (Ref. 48), and found materials including large, nondescript metal and concrete objects, various sized sample containers (one containing pellets), old fuel lines, flexible metal hoses, steel cables, hardened tar, rubble, and 10 to 15 full 55-gallon drums, which were corroded. As described in the NACIP report, the larger debris appeared "to have been disposed of in a manner consistent with filling in the mangrove swamps to create new land. The drums, on the other hand, rest on the surface of the made land for the most part, and seem to have been disposed of at a later date" (Ref. 48). Some of the drums were also described to have been rusted through, exposing a discolored green crust about 1/2 inch thick, encasing a whitish compound with the consistency of semi-dry plaster (Ref. 48). As estimated by the Navy, this unit covers 4 acres (Ref. 52).

The VSI team observed in this area a dump site covering an area of approximately 40 feet x 150 feet. Within the perimeter were lengths of thick cable, broken concrete blocks, ringed metal hoses, and six severely corroded drums. At least one of the drums was filled with a white, damp chalky substance (Ref. 57).

Date of Start-up: The Navy documents 1939 as the date of start-up (Ref. 52). According to the NACIP report, no records of this unit existed until 1984 when the NACIP IAS team was led to this unit by a Public Works employee (Ref. 48).

Date of Closure: This unit has been inactive since 1959 (Ref. 52).

Wastes Managed: According to the NACIP report, materials found on the site include large metal and concrete objects, various sized sample containers (one containing pellets), old fuel lines, flexible metal hoses, steel cables, hardened tar, rubble, and 10 to 15 full 55-gallon drums (Ref. 48). The VSI team also found lengths of thick cable, broken concrete blocks, ringed metal hoses, and six severely corroded drums on the site. At least one of the drums was filled with a soft, whitish, damp chalky substance (Ref. 57).

Release Controls: There are no release controls identified with this unit.

History of Release: The NACIP team noted 10 to 15 full 55-gallon drums in 1984 (Ref. 48). The VSI team found six severely corroded drums. The white chalky substance within the drums was observed to be exposed to wind and rain, indicating ongoing releases to the surrounding environment (Ref. 57).

In addition, this unit is regularly flooded by tidal action (Ref. 31a) and surface runoff (Ref. 26).

3. UNIT NAME: Station Landfill (Photos 4 and 5)

Unit Description: This unit is located south of the Industrial Area Wastewater Plant (Bldg. 1758) on the peninsula that separates Ensenada Honda from Puerca Bay. The NACIP study (Ref. 48) reports that the Station Landfill (SWMU #3) has been the active base landfill since the Army Cremator Site was abandoned in the early 1960s. The landfill covers 85 acres and is separated into several different disposal "areas", a number of which are undetectable from the ground. According to the Navy, previous disposal methods involved excavating a trench to the water table, filling the trench with waste, spreading and compacting with a bulldozer, then covering the waste with soil (Ref. 48). It is estimated that from 40 to 60 tons of waste per day were disposed of in the past. According to the NACIP study, the water table is very near the surface (i.e., less than 10 feet) and, in places, at depths of two feet or less (Ref. 48). This unit is surrounded by surface water (Ref. 53). It is not within the 50 year floodplain (Ref. 33).

In June 1975, six observation wells were bored to the aquifer at various points within and around the perimeter of this unit (Ref. 37).

In an attempt to locate the "drum ditch" referred to in the NACIP study, the VSI team entered the Station Landfill from the east side, several hundred yards north of the Tea House/Cabras Island intersection. One half-buried, cracked fiberglass drum with a polyester lining was observed. No other drums were located. Approximately 30 yards north of the drum, a crushed, corroding Volkswagon Beetle was observed (Ref. 57).

Date of Start-up: This unit has been active since the early 1960s (Ref. 48).

Date of Closure: Hazardous waste disposal was stopped in 1978. This unit is presently active.

Wastes Managed: Waste materials disposed of at this site include residential wastes, scrap metal, cables, paint waste, solvents, PCBs, contaminated OTTO Fuel II, Agentine, Askarel, pesticides, lubricating oil, unlabeled 55-gallon drums, dead animals, inert ordnance, digested sewage sludge, construction debris, asbestos, and possibly Super Tropical Bleach (STB), a decontaminating agent (Ref. 48). One fiberglass drum with a polyethylene liner and a decaying Volkswagon Beetle were observed at this unit during the VSI (Ref. 57).

Release Controls: The only known release control at this site is a soil cover.

History of Release: Disposal practices at this unlined unit historically involved disposing of waste in trenches at or near the water table constituting a direct release to soil/groundwater (Ref. 48).

William Biemborn, of NUS Corporation, reported in September 1986 that U.S. Geological Survey tests had detected levels of lead and zinc above background levels in the groundwater at this unit (Ref. 31a).

4. UNIT NAME: Drone Fuel Drain Oil/Water Separator (Photo 6)

Unit Description: Drones that are not destroyed during launching presentations are rescued from the sea and brought back to Building 860, Aerial Target Systems Department. Since 1970, all waste drone fuel has been drained directly into a below ground oil/water separator (Ref. 48). Observed during the VSI to be built of concrete covered with steel grating at ground level, the oil/water separator measured approximately 10 feet x 10 feet x 10 feet deep. After separation, the waste petroleum goes to a private contractor and the wastewater to the sanitary sewer system (Ref. 57).

Date of Start-up: During the VSI, it was determined that the drone fuel drain oil/water separator has been in operation since 1970 (Ref. 57).

Date of Closure: This unit is presently active.

Wastes Managed: This unit manages JP-4 and JP-5 jet fuel (Ref. 57).

Release Controls: In 1983, a valve was installed on the pipe between the oil/water separator and the storm sewer to prevent the overflow that had been reaching the storm sewer during heavy rainfall (Ref. 48). The overflow valve was not observed during the VSI.

History of Release: Between 1970 and 1983 during periods of heavy rainfall, the oil/water separator would overflow into the adjacent storm sewer system (Ref. 48). No sign of release was observed at the time of the VSI.

5. UNIT NAME: Dumpsters (No Photo)

Unit Description: This unit consists of numerous metal dumpsters located at various points throughout the facility, which are used to receive various types of refuse and waste products. Listed in Table 3 are the building number, size, type of dumpster, and collection frequency associated with each dumpster (Ref. 51).

Date of Start-up: Start-up dates for these dumpsters could not be determined. Each is emptied on a regular schedule (Ref. 51).

Date of Closure: These dumpsters are presently active.

Waste Managed: Wastes handled in these dumpsters include burnable wastes (e.g., refuse), non-burnable wastes (e.g., metal), salvageable wastes (e.g., metal), and non-salvageable wastes (e.g., sand).

Release Controls: Other than the fact that these units are constructed of metal, there are no release controls identified with this unit.

History of Release: No releases were noted for any of the dumpsters observed.

Table 5. Type II Dumpsters (Ref. 51).

Bldg. No.	Description	Collection Frequency (per week)	Total Capacity (cubic yds.)
1211	Golf Club Snack Bar	5	6
643	Softball Field	2	2
615	Animal Shelter	2	4
724	OPCON Center	5	6
598	COMNAVFORCARIB	2	6
594	Dental Clinic	2	6
729	COMO	5	12
1687	Gymnasium	2	2
510	Auto Repair	2	2
1686	Laundry	2	8
529	Navy Exchange Whse	5	28
530	Toyland	2	12
536	Commissary Whse. (Gate 4)	2	6
532	Commissary Store Whse.	2	2
520	Bundy Gas Station	2	6
745	Navy Exchange Auto Shop	2	4
519	Patio Shop	1	12
525	Navy Vending Service	1	4
629	Theater	1	2
500	Administration Bldg.	2	6
639	Chapel	1	2
572	Navy Exchange Laundromat	2	4
580	Special Services	2	4
584	Printing Whse.	2	4
583	Printing Office	2	6
504	Security Dept.	2	4
731	Bundy UEPH	5	6
732	Bundy UEPH	2	6
733	Bundy UEPH	2	8
734	Bundy UEPH	2	8
630	Package Store	2	4
781	Stables	1	4
801	Flying Club	1	2
827	Crash Crew Bldg.	2	4
880	Missile Maint. Shop	1	2
378	Weapons Dept.	2	6
1625	VC-8 Hangar	5	16
379	AIMD Hangar	5	16
790	Photographic Bldg.	2	4
426	Ops Snack Bar	5	8
1203	Pass Office (Gate 1)	1	2
88	Filtration Plant	2	2
663	AFWIF University	1	2
386	AFWIF ROC	5	6
1817	COMOPS Center	5	14

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Table 5. Continued.

Bldg. No.	Description	Collection Frequency (per week)	Total Capacity (cubic yds.)
296	AFCN	1	4
1511	NEX Rental Car	5	4
737	Telephone Exchange	3	2
1796	Navy Exchange	5	32
1970	Commissary Store	5	32
	Family Service Center	2	6
1707	UEPH Bldg. "A"	5	6
1708	UEPH Bldg. "B"	5	6
1709	UEPH Bldg. "C"	5	6
1808	Enlisted Dining Fac.	5	18
206	Disco Club	5	8
1813	UEPH Bldg. "1"	2	8
1814	UEPH Bldg. "2"	2	8
1815	UEPH Bldg. "3"	2	8
1209	Marine Barracks	2	12
1807	Correctional Center	1	4
422	LOX/LIN Plant	1	4
201	Auto Hobby Shop	1	4
982	Weapons Field Office	1	4
256	AFWIF Supply Center	1	4
1981	AFWIF Electronic-Warfare Shop	2	4
825	Drone Storage	2	4
860	Drone Shop	5	4
876	Development Dept. (AFWIF)	5	4
200	Hangar Area	2	8
798	Structural Fire Station	2	2
1973	DPDO	1	4
1738	Navy Exchange Gas Station-Time Square	2	2
113	Sanitation & Pest Control	2	2
377	Ground Electronics-Maintenance Shop	2	4
60	Warehouse	2	4
IT-4	EOD	1	2
467	Wood Hobby Shop	2	4
	Marina Compound	1	12
53	Cold Storage	2	2
1684	Seabreeze Club	5	10
1790	Hospital	5	12
1810	Medical Warehouse	2	6
1791	Corpsman Barracks	5	6
27	GSK Warehouse	2	4
787	UDT (Dry Dock)	2	8
788	Fleet Analysis Center-Corona (Telemetry Site)	1	4
31	Public Works Dept.	2	54

-- Continued --

Table 5. Continued.

Bldg. No.	Description	Collection Frequency (per week)	Total Capacity (cubic yds.)
1207	Supply Warehouse	5	6
42	NEX Warehouse	2	6
192	Fuel Lab	2	2
48	POL Ops	2	4
486	Tea House (Pavilion)	2	4
	Officer's Beach	2	2
124	Gas Station Ind. Area	1	2
899	UOPH, Algodones	2	4
897	UOPH, Algodones	2	4
895	UOPH, Algodones	2	4
895	UOPH, Algodones	2	4
888	UOPH, ALgodones	2	4
891	UOPH, Algodones	2	4
889	UOPH, Algodones	2	4
886	Child Care Center	2	4
	Elementary School	2	8
1567	Mini Mart	5	24
1741	Teen Club	2	2
	High School	2	14
	Community Beach	2	12
2042	ACSS Warehouse	1	6
51	Army Reserves	1	4
	Army Reserve Compound	1	4
31	Public Works	1	30
887	BOQ Apartment	2	4
1756	Housing PW Shop	2	4

6. UNIT NAME: Former Paint Storage (Building 145) (Photo 7)

Unit Description: It was determined during the VSI that this is an inactive, nonregulated unit. Building 145 was observed to be a partially subterranean concrete bunker with three openings on the roof. Two of these openings were covered by wooden boxlike structures. The third opening was uncovered. At the time of the VSI, Building 145 was empty. According to facility representatives, all waste materials were removed by a private contractor in July 1988. Several old paint covered gloves and pieces of clothing, broken pallets, and several empty paint cans were observed outside this unit. Inside this unit were several articles of protective clothing floating in water that had collected on the floor.

Date of Start-up: This unit was used as storage for at least 25 years, according to the NACIP report (Ref. 48).

Date of Closure: This unit has been inactive since July 1988 (Ref. 57).

Wastes Managed: The NACIP team (Ref. 48) observed containers of paint and shoe polish, adhesives, old office furniture, 25 or more 55-gallon drums, and 100 or more 5-gallon pails. Reportedly, the condition of the containers ranged from being intact and neatly stacked to randomly placed, leaking, and obviously reused for waste material. An ambient air characterization conducted by the NACIP team indicated that the contents of many of the containers were highly volatile (Ref. 48).

Release Controls: The walls, roof, and floor of this unit are concrete (Ref. 57).

History of Release: Release to the air was documented by the NACIP team (Ref. 48). Otherwise, there are no documented releases to the environment identified with this unit and no evidence of release was observed during the VSI.

7. UNIT NAME: Tow Way Road Fuels Farm (Photos 8 and 9)

Unit Description: This unit is a fuel storage compound located on Tow Way Road on a hill overlooking Ensenada Honda. All tanks at the unit are buried under grassy slopes. No aboveground tanks were observed during the VSI (Ref. 57). Large volume releases have been documented from this unit over a period of 30 years (Refs. 20, 26, and 48)

Date of Start-up: The date of start-up for this unit could not be determined during the VSI. Documented releases date back to the late 1950s (Ref. 48).

Date of Closure: This unit is presently active.

Wastes Managed: Wastes managed at this unit include diesel and Bunker C fuel.

Release Controls: During the VSI, it was noted that at the bottom of the hill there were two earthen retaining walls, both with gates (Ref. 57). Since the time of the JP-5 spill from Tank 85, a permanent boom has been placed on the Tow Way Road Fuels Farm stormwater outfall (Ref. 20), which is one of the Naval Station Outfalls (SWMU #47).

History of Releases: The NACIP study (Ref. 48) reported the following history regarding this unit. Over a 15 to 20 year period, an estimated 420,000 gallons of diesel fuel leaked from underground storage tanks 56A and 56B. These tanks were removed in 1984. The NACIP team observed diesel fuel on top of the groundwater that had seeped into the holes where the tanks had been removed. In the late 1950s, a fuel line to Tank 82 burst, spilling an estimated 420,000 gallons of Bunker C fuel that ran downhill into Ensenada Honda. In 1978, an estimated 65,000 gallons of diesel fuel leaked from Tank 1080 (Ref. 48).

In November 1986, approximately 91,000 gallons of JP-5 (unleaded aviation kerosene) leaked from Tank 85. Facility representatives estimated that 70,000 gallons entered Ensenada Honda. Less than two weeks after the spill, a Judge Advocate General (JAG) investigation was underway

(Ref. 20). The dead mangroves observed at the Army Cremator Disposal Site (SWMU #1) were the result of the JP-5 spill from Tank 85, according to facility representatives.

Observed by the VSI team were small areas of dried sludge directly downhill from Tank 82, fuel vapors rising up from the manhole over Tank 84, and fluid dripping steadily from a pipe that extended laterally outward from Tank 83. Stressed vegetation was evident directly below the dripping pipe. Facility representatives reported a recent minor spill from Tank 83 (Ref. 57).

8. UNIT NAME: Tow Way Road Disposal Pits (No Photo)

Unit Description: In 1972 or 1973, Tanks 83 (2,100,000-gallon capacity) and 1080 (1,340,000-gallon capacity) were cleaned out and an estimated 3,900 to 7,500 cubic yards of Bunker C fuel sludge was deposited in two pits. The disposal pits, located within 100 feet of the tanks, were left open until the sludge solidified (a process estimated to take six to seven years), and then covered with several feet of soil (Ref. 48).

The tanks were located on a hill between Ensenada Honda and mangroves to the north were covered by grassy slopes (Ref. 57). No visible signs of buried sludge were observed during the VSI.

Date of Start-up: Disposal pits were dug and filled with Bunker C fuel sludge in 1972 or 1973.

Date of Closure: The pits contain sludge from Tanks 83 and 1080 collected during a one-time cleaning operation in 1972 or 1973 (Ref. 48). The pits no longer actively collect waste.

Wastes Managed: The waste managed by this unit is Bunker C fuel sludge.

Release Controls: Both disposal pits have a soil and vegetation cover. As far as can be determined, these pits are unlined.

History of Release: By nature of design, there is ongoing release to soil/groundwater.

9. UNIT NAME: Leaded Sludge Pits (No Photo)

Unit Description: Tanks 212 to 215 are located along Manila Bay Road, north of Forrestal Drive. Tanks 216 and 217 are on a hilltop about 4,000 feet southeast of Tanks 212 to 215, north of Forrestal Drive. These tanks were installed in 1940 and, according to the U.S. Navy, were cleaned approximately every five years until 1978. The location of Tanks 210 and 211 could not be determined during this RFA. According to the NACIP report (Ref. 48), both tanks were abandoned in 1950 and had been cleaned once in a manner consistent with the other tanks. Leaded sludge removed from the tanks was disposed of in a series of pits (8 feet x 8 feet x 8 feet) within 300 feet of the tank being cleaned (Ref. 48). After the sludge settled in the pits, it was covered with 3 to 4 feet of soil. The pits are located on hillsides at elevations 15 to 45 feet above an adjacent mangrove swamp. The slope from the tanks to the swamp varies from 10% to 40%. It is estimated that a total of 34,000 to 53,000 gallons of highly leaded sludge were buried at this site (Ref. 48). The VSI team was unable to locate the buried pits.

Date of Start-up: The date of start-up for this unit was 1940 (Ref. 48).

Date of Closure: The last date this disposal practice was utilized was 1978.

Wastes Managed: The waste managed at this unit is leaded aviation gasoline sludge (Ref. 48).

Release Controls: The only release controls identified with this unit are the 3 to 4 feet thick soil covers on the disposal pits.

History of Release: By nature of design, there is ongoing release to soil/groundwater.

10. UNIT NAME: Transformer Maintenance Area (Building 90) (Photo 10)

Unit Description: The Transformer Maintenance Area (Substation 2) is located adjacent to Building 90. According to the NACIP report, a maximum of 3,000 gallons of transformer oil, probably containing PCBs, were poured out on the ground in the vicinity of this site from 1964 to 1979, creating a potential threat to the health of the workers who currently work at the site (Ref. 48). Surface drainage is both to the southwest and east, eventually joining in a drainage ditch that flows southwest into Ensenada Honda (Ref. 26).

Date of Start-up: The date of start-up for this site is 1964 (Ref. 48).

Date of Closure: Transformer maintenance is still performed here, although transformer oil has not been poured out on the ground since 1979 (Ref. 48).

Wastes Managed: The wastes managed at this unit were PCB-contaminated transformer oils (Refs. 31a and 48).

Release Controls: There are no release controls identified with this unit.

History of Release: Between 1964 and 1979, a maximum of 3,000 gallons of transformer oil were poured on the ground in the vicinity of Building 90 (Ref. 48).

During the VSI, oil stains were observed on the soil adjacent to the building. Also noted was a trash can (approximately 20 gallon capacity), which was filled with oil and leaking onto the ground (Ref. 57).

11. UNIT NAME: PCB Storage Compound (Building 38) (Photo 11)

Unit Description: The PCB Storage Compound (Building 38) is TSCA regulated, according to facility representatives. Inside this unit is a cyclone fence which surrounds a curbed concrete pad (the pad and fence are both inside Building 38). PCB-contaminated items (e.g., old transformers and full 55-gallon drums) are temporarily stored on the concrete pad inside the cyclone fence. These items are ultimately disposed of by a DRMO contractor (Ref. 23).

Date of Start-up: The date of start-up for this unit was not determined during the VSI.

Date of Closure: This unit is presently active.

Wastes Managed: PCB-contaminated items are stored inside this unit (Refs. 23, 48, and 57).

Release Controls: Items identified as PCB-contaminated are stored inside Building 38 on a concrete pad that has an 8-inch curb and is surrounded by a cyclone fence. Observed outside the cyclone fence (still inside the building) were drums believed to contain PCB-contaminated soil (Ref. 57). These drums were moved inside the cyclone fence shortly after the VSI team visited this unit, according to facility representatives.

History of Release: No release history has been identified with this unit. At the time of the VSI, oil contaminated sorbent was observed inside the fence on the concrete pad. Several drums were observed just outside the fence (inside the building). The facility representative present at the time stated that the oil spill was from a non-PCB transformer (<50 ppm PCBs) and that laboratory results were pending regarding the contents of the drums (Ref. 57).

12. UNIT NAME: Fire Training Pit Oil/Water Separator (Photo 12)

Unit Description: The Fire Training Pit Oil/Water Separator is an in-ground concrete tank measuring approximately 7 feet x 30 feet x 10 feet deep. The ground level opening is covered by heavy grating. This unit collects and separates the oil/water waste generated from the fire training pit.

Date of Start-up: The date of start-up for this unit is 1983.

Date of Closure: This unit is presently active.

Wastes Managed: Waste oils are burned at this unit during training exercises (Refs. 48 and 57).

Release Controls: This unit is constructed from concrete. Overflow from the separator is controlled by a manually operated valve (Ref. 57). Wastewater from this unit flows through the Sewer Drainage System (SWMU #38) to be processed by one of the Naval Station Wastewater Treatment Plants (one of SWMUs #27, #28, or #29). Periodically, oils from this unit are pumped back into the Fire Training Pit (SWMU #14) (Ref. 26).

History of Release: During the VSI, an area of dead grass was observed directly adjacent to the separator. Oil stains on the curbing and guardrail uprights were observed suggesting further release to soil (Ref. 57).

13. UNIT NAME: Old Pest Control Shop (Bldg. 258 and Surrounding Area) (Photo 13)

Unit Description: This unit includes Building 258, the area immediately surrounding the building and the drainage ditch behind the building. The Old Pest Control Shop was located in Building 258 from the late 1950s through 1983. According to the NACIP study (Ref. 48), incidental spillage of pesticides occurred in and around the building during that time. Pesticides were stored inside the building, as well as on the parking apron and, according to the NACIP team, pesticide odors were still very strong in the vicinity approximately one year later (Ref. 48). In 1976, a 55-gallon drum of malathion, which was stored outside the building, ruptured and spilled on the ground. The contents eventually washed into the drainage ditch in back of the building. This ditch, according to the U.S. Navy, also received excess pesticide and rinse waters from equipment cleaning. Surface drainage is westward into this drainage ditch which discharges into Ensenada Honda (Ref. 26). The NACIP team reported that the drainage ditch did not show any signs of stressed vegetation, although the area surrounding the building was devoid of vegetation. Past environmental engineering surveys cite numerous aquatic kills in Ensenada Honda due to pesticides entering the drainage ditch (Ref. 48). Building 258 now houses the Navy scuba diving club (Ref. 57).

At the time of the VSI, a faint but discernible pesticide odor was present behind the building and inside what is now the diving club pump room. No signs of stressed vegetation were observed. The president of the diving club, Mr. Seufert, reported that club members had decontaminated the inside of the building before occupying it. According to Mr. Seufert, decontamination involved washing the inside walls and floor with bleach before sealing with a vinyl coating. The meeting room was then tiled, but the pump room was not (Ref. 57).

Date of Start-up: The date of start-up for this unit is the late 1950s.

Date of Closure: This unit has been inactive since 1983 (Ref. 48). Mr. Seufert stated that Building 358 might be torn down soon because of concern over the pesticide hazard (Ref. 57).

Wastes Managed: Wastes managed at this unit included DDT, Paris Green, maldane, malathion, chlordane (Ref. 48), para-dichlorobenzene, and pentachlorophenol (Ref. 31a). There is no information available, either from records or interviewees, regarding the amounts or concentrations of the pesticides used (Ref. 48).

Release Controls: No release controls were identified outside the building or in the ditch. Building 258 was observed to be a Quonset hut with concrete walls and floor.

History of Release: According to the NACIP report, former Pest Control Shop employees remember incidental spillage occurring in and around Building 258 (Ref. 48). In 1976, a 55-gallon drum of malathion ruptured outside the building, spilling the contents onto the ground (Ref. 48). During the VSI, there was no evidence observed indicating a release; however, a faint odor representative of pesticides was noted inside the pump room and outside by the southwest side of the building (Ref. 57).

14. UNIT NAME: Fire Training Pit (Photo 14)

Unit Description: The Fire Training Pit measures approximately 75 feet in diameter and is surrounded by concrete curbing that is approximately 10 feet wide and slopes in toward the pit. According to a facility representative this unit is concrete-lined and was built in 1983 (Ref. 57). Observed adjacent to this unit was an oil/water separator noted in this report as Fire Training Pit Oil/Water Separator (SWMU #12). Observed within the concrete curbing of the pit was a metal structure (what appeared to be the tank from a railroad tankcar and large pieces of scrap metal) underlain by a layer of rocks which rest on the concrete lining. The metal structure, rocks, and concrete curbing were completely black. Immediately adjacent to the pit was an area of darkly stained soil measuring approximately 40 feet x 100 feet. Vegetation was observed to be growing in the stained area adjacent to the pit.

Date of Start-up: This unit has been operational since 1983 (Ref. 48).

Date of Closure: This unit is presently active (Ref. 57).

Wastes Managed: Wastes managed at this unit include waste oil (Ref. 57). The facility representative present at the time of the VSI reported that waste oil and fuel burned here came from various sources, depending upon the fire training schedule. Therefore, he could not be more specific about particular wastes managed here.

Release Controls: This unit has a concrete liner, concrete curbing, and associated oil/water separator (SWMU #12).

History of Release: A large area of darkly stained soil observed adjacent to this unit (Ref. 57) indicates release to soil. By management design (i.e., burning), there is release to air.

15. UNIT NAME: Hospital Incinerator (Building 1928) (Photo 15)

Unit Description: As described in the NACIP report, this unit is a "package" incinerator with burners located in the main chamber at the base of the stack. The unit operates under the auspices of Commonwealth of Puerto Rico air pollution regulations. According to the U.S. Navy, it is used exclusively to burn pathological waste generated by the hospital (Ref. 48).

This unit's capacity was estimated at 1/2 cubic yard by the VSI team. At the time of the VSI, the Hospital Incinerator was observed to be constructed of metal and lined inside with fire bricks. This unit rests on a concrete pad (no curbing) and is protected by a roof and two walls made of corrugated metal (Ref. 57).

Date of Start-up: The facility representative present during the inspection of this unit did not know the date of start-up.

Date of Closure: This unit is presently active.

Wastes Managed: Wastes managed by this unit include biological and pathological wastes generated by the hospital (Ref. 48).

Release Controls: This unit rests on a concrete pad without curbing. The unit is protected by a corrugated metal roof and walls on two sides (Ref. 57).

History of Release: There are no documented releases identified with this unit in the file material. No evidence of release at this unit was observed during the VSI.

16. UNIT NAME: Waste Explosive Storage (Bldg. 1666) (No Photo)

Unit Description: This unit was included on the original Part A RCRA Application for NAVSTA Roosevelt Roads submitted in November 1980. However, this unit is merely cited, and not included in the revised RCRA Part A Application; no listing of wastes that had been stored at this unit is provided (Ref. 49). According to the U.S. Navy, this building is not being permitted because it is used as a temporary accumulation point only, and wastes are stored there for less than 90 days (Ref. 49).

According to AFWTF Director, Mr. Nestor Paradis, this unit is a "unique military operation" and requires special security clearance for entry. The VSI team was therefore denied access, and no VSI was conducted at this unit.

Date of Start-up: The date of start-up for this unit could not be determined during this RFA.

Date of Closure: This unit is presently active, according to facility representatives.

Wastes Managed: The types of wastes managed at this unit could not be determined during this RFA.

Release Controls: There are no release controls identified with this unit.

History of Release: There are no documented releases identified with this unit in the PR file material. Since the VSI team was not allowed to observe this unit, evidence of present release could not be determined.

17. UNIT NAME: DRMO Hazardous Waste Storage Facility (Bldg. 1973) (Photo 16)

Unit Description: This unit is a hazardous waste container storage facility and has been operated under RCRA interim status since 1980 (Ref. 49). Building 1973 is located in the Defense Reutilization and Marketing (DRMO) Office Yard. This unit has a storage capacity of 17,400 gallons (Ref. 49) and is divided into 4 storage bays containing caustics, acids, general toxics, and oxidizers (Ref. 49). According to the U.S. Navy, only nonflammable hazardous wastes are stored at this unit (Ref. 49). Prior to the use of this unit for hazardous waste storage, hazardous wastes were stored at Past DRMO Hazardous Waste Storage (SWMU #25).

During the VSI, it was observed that this unit was clean, orderly, and secured, with the exception of caustics, such as sodium hydroxide and potassium hydroxide, being stored in the "acid" storage bay. There was no evidence of release to secondary containment (Ref. 57).

Date of Start-up: This unit has been operating under RCRA interim status since 1980 (Ref. 49).

Date of Closure: This unit is presently active.

Wastes Managed: This unit stores nonflammable hazardous waste. The following page contains a list of hazardous wastes generated at Naval Station Roosevelt Roads (Ref. 49).

Release Controls: Dedicated storage bays separated by solid concrete block walls and dedicated containment trenches were release controls observed during the VSI. A facility representative stated that inspections are conducted approximately once a month, on average. He further stated that the concrete slab of each storage bay is coated with epoxy (Ref. 57).

History of Release: There are no documented releases identified with this unit in the PR file material. There was no evidence of release observed during the VSI.

HAZARDOUS WASTES
at
NAVAL STATION ROOSEVELT ROADS (Ref. 59)

WASTE DESCRIPTION	WASTE NUMBER	WASTE CODE
Beryllium Dust	P015	H
Lithium/Sulfur Dioxide Batteries	D003	R
Nickel/Cadmium Batteries	D003/D006	R, T
Mercury Batteries	D009	T
Mercury Batteries in Acetic Acid	D002/D009	C, T
ATON Batteries	D002	C
Alkaline Batteries	D002	C
Lead/Acid Batteries	D002/D008	C, T
Lead/Acid Batteries (Drained)	D008	T
Battery Electrolyte[1]	D002/D008	C, T
Acetic Acid	D002	C
Chromic Acid (Alodine)	D002/D007	C, T
Hydrochloric Acid	D002	C
Sulfuric Acid	D002	C
Ammonium Hydroxide	D002	C
Cleaning Compound[2]	D002	C
Mercury	U151/D009	T
Blasting Booth Dust[3]	D007/D008	T
Gasoline (Unleaded)	D001	I
Petroleum Fuels (Leaded)	D001/D008	I
Jet Fuel (JP-4 or JP-5)	D001	I

HAZARDOUS WASTES
at
NAVAL STATION ROOSEVELT ROADS (cont.) (Ref. 59)

Kerosene (contaminated)	D001	I
Adhesives[4]	D001	I
Calibration Fluid	D001	I
Cleaning Compound (Mineral Spirits)	D001	I
Isopropyl Alcohol	D001	I
Sealing Compound	D001/F003	I
Icing Inhibitor	D001	I
Inspection Penetrant	D001/F003	I
Decontaminating Agent, STB	D003	R
Denatured Alcohol	D001	I
Duplicating Fluid	D001	I
Waste Paints[5]	D001	I
Painting Wastes[6]	D001/D002 D007/D008 F002/F003 F005	I, C, T
Chlordane	U036	T
Malathion (with carrier solvent)	D001	I
Photographic Developer	D002/D011	C, T
Photographic Fixer	D002/D011	C, T
Photographic Toners	D001	I
Photographic Hardener	D011	T
Photographic Stabilizer	D011	T

HAZARDOUS WASTES
at
NAVAL STATION ROOSEVELT ROADS (cont.) (Ref. 59)

Photographic Starter	D011	T
Photographic Replinisher	D002/D011	C, T
Photo Auto Reversal Chemical	D011	T
Hypo-Solution : $(NH_4)_2S_2O_3$	D011	T
Hypo-Solution : $Na_2S_2O_3 - 5H_2O$	D011	T
Corrosion Inhibitor	D001	I
Naphtha	D001	I
Acetone	F003/U002	I
Ethyl Ether	F003/U117	I
Isobutanol	F005/U140	I, T
Methanol	F003/U154	I
Methylene Chloride	F001/F002 U080	T
Methyl Ethyl Ketone (MEK)	F005/U159	I, T
Tetrachloroethylene	F001/F002 U210	T
Toluene	F005/U220	T
1,1,1 Trichloroethane	F001/F002 U226	T
Trichloroethylene	F001/F002 U228	T
Trichlorofluoromethane	F002/U121	T

HAZARDOUS WASTES
at
NAVAL STATION ROOSEVELT ROADS (cont.) (Ref. 59)

Trichlorotrifluoroethane	F002	T
Xylene	F003/U239	I
Chlorinated Flourocarbons	F001	T
1,1,2-Trichloroethane	F002/U227	T
MEK and Paint	F005/D007 D008	I, T
Paint Removers	D002/F002	C, T
Dye Penetrant	D001/F001 F002	I, T
Carbon Remover	F002	T
Dry Cleaning Solvent (PD-680-I)	D001	I
Stoddard Solvent	D001	I
Inspection Penetrant	D001/F002	I, T
Petroleum Lubricant	D001	I
Aerosol Cans (Partially Full)	D001/F001 F002/F003 F005	I, T
Miscellaneous Waste Ignitables	D001	I
Miscellaneous Waste Acids	D002	C
Miscellaneous Waste Caustics	D002	C
Miscellaneous Waste Reactives	D003	R
Misc. Halogenated Solvents[7]	F001/F002	T
Misc. Halogenated Solvents[8]	F001/F002	T

HAZARDOUS WASTES
at
NAVAL STATION ROOSEVELT ROADS (cont.) (Ref. 59)

Misc. Non-Halogenated Solvents	F003/F005	I, T
Miscellaneous POL's[9]	D001/F001 F002/F003 F005	I, T
Magnesium Batteries	D003	R
Grease Contaminated with Oils	D001/D007 D008	I, T
Freon Contaminated Hydraulic Fluid	F002	T

NOTES:

1. Battery electrolyte refers to the sulfuric acid/water mixture drained from lead acid batteries.
2. Cleaning compound refers aircraft surface cleaning compound whose NSN# is 6850-00-935-0995, and is commonly known as TURCO.
3. Blasting booth dust is the spent sandblasting media which includes glass beads contaminated with heavy metals.
4. Adhesives refers to variety of adhesive materials that contain low flash point solvents.
5. Waste paints include acrylics, enamels, epoxy paints, lacquers, oil based paints, polyurethane paints, varnish, primers, deck coating, and shellac.
6. Painting wastes refers to waste paints or painting related materials that are contaminated with one or more of the following materials: oils, thinners, dirt, halogenated solvents, non-halogenated solvents, corrosive strippers and heavy metals.
7. Mixed waste containing, before use, a total of 10% or more of the F-listed halogenated solvents.
8. Mixed waste containing, before use, less than a total of 10% of the F-listed halogenated solvents.
9. POL's (Petroleum, Oils, and Lubricants) potentially contaminated with one or more ignitable wastes or F-listed solvents .

18. UNIT NAME: Ignitable Storage Facility (Building 2009) (Photo 17)

Unit Description: This unit is a hazardous waste container storage facility that has been under RCRA interim status since November 1980 (Ref. 49). Building 2009 is located in the Defense Reutilization and Marketing Office (DRMO) yard. This unit has a storage capacity of 2,600 gallons and has been designed and designated for the storage of ignitable hazardous wastes in containers (Ref. 49). Building 2009 is a metal structure measuring approximately 20 feet x 20 feet underlain by a concrete slab with 4-inch curbing. The walls and roof are constructed of corrugated metal. The slab appeared stained, but no evidence of recent spillage was observed (Ref. 57).

Date of Start-up: According to the Part B Permit Application (Ref. 49), this unit has been operating under interim status since November 1980.

Date of Closure: This unit is presently active.

Wastes Managed: This unit is a storage facility for ignitable hazardous wastes stored in drums (Ref. 49). A facility representative stated that, at the present time, paint waste made up the majority of waste stored in this unit. He mentioned that aviation fuel waste was also stored here in drums (Ref. 57).

Release Controls: This unit is inspected approximately once a month, according to a facility representative. Four-inch curbing around the concrete slab of this metal building was observed during the VSI (Ref. 57).

History of Release: There are no documented releases identified with this unit in PR file material. There was no evidence of release observed during the VSI.

19. UNIT NAME: Pesticide Waste Storage (Building 121) (Photo 18)

Unit Description: This unit is a hazardous waste storage facility which is used for the storage of outdated pesticides (Ref. 48). This unit was included in the original Part A RCRA Permit Application; however, it was not included in the revised application because of plans to close this unit (Ref. 49). At the time of the VSI, this unit was still being used for pesticide waste storage (Ref. 57).

The VSI team observed this unit to be a building surrounded by an unlocked cyclone fence; however, the building itself was secured, denying the VSI team entry. Tall grasses, vines, and woody vegetation grew thick immediately around the outside of the building and outside the cyclone fence. The smell of pesticides was evident (Ref. 57). According to facility representatives, their office is still awaiting the completion of the closure plan for this unit.

Date of Start-up: This unit has been active since at least 1980 (Ref. 49).

Date of Closure: This unit is currently active. Facility representatives stated that a closure plan is being prepared for this unit (Ref. 57).

Wastes Managed: Wastes managed at this unit include various pesticide waste (Ref. 48).

Release Controls: As observed during the VSI, the walls, floor, and underlying pad are concrete (Ref. 57).

History of Release: There was no evidence of release from this unit encountered in the PR file material. The VSI team noted release (odors) to the atmosphere. The cyclone fence surrounding this unit was unlocked, but the building itself was locked. Observations of the inside of this unit were, therefore, not possible.

20. <u>UNIT NAME</u>: Waste Oil Tank Truck (Photo 19)

<u>Unit Description</u>: Located at the northern edge of the Aerial Target Systems Department yard (in front of building 860), this unit is a truck that temporarily stores waste oil, solvents, and fuel. According to a facility representative, wastes are stored in the 1,500 gallon steel tank of this unit. Periodically, a contractor pumps out the accumulated waste. If this unit fills up before the contractor arrives, facility representatives will tow this unit approximately 75 feet into the middle of the yard and let the tank drain into the Drone Fuel Drain Oil/Water Separator (SWMU #4) (Ref. 57).

<u>Date of Start-up</u>: According to on-site personnel, the start-up date was approximately 1982 (Ref. 57).

<u>Date of Closure</u>: This unit is presently active.

<u>Wastes Managed</u>: This unit temporarily stores waste fuel, oil, and solvents from drone maintenance and repair (Ref. 57).

<u>Release Controls</u>: This unit is a steel tank.

<u>History of Release</u>: No evidence of release was observed during the VSI (Ref. 57).

21. UNIT NAME: Donuts (#1 - #4) (No Photo)

Unit Description: These four units are part of the Oil Spill Removal System (Ref. 48), which also is comprised of the Ships Waste Offload Barges (SWMU #22), Oil Spill Separator Tanks (SWMU #23), and Oil Spill Separator (SWMU #24). A donut is basically a motorized storage tank having a circular, bloated shape (hence the name donut). As described by facility representatives during the VSI, a fuel or oil spill in the harbor is first contained with containment booms and oil skimmers. Donuts are then motored to the spill area where they pump the waste into their respective 10,000 gallon storage tanks. Back in the dock, the donuts are emptied into one of the Ships Waste Offload Barges (SWOBs) (SWMU #22), the next step in the Oil Spill Removal System (Ref. 57).

Date of Start-up: The date of start-up for these units could not be determined.

Date of Closure: These units are presently active (Ref. 57).

Wastes Managed: These units transport oil from spills, as well as bilge and ballast wastewater (Ref. 57).

Release Controls: These units are closed containers.

History of Release: The units are designed and operated to recover material which has been released to surface water.

22. UNIT NAME: Ships Waste Offload Barges (SWOB) #1 and #2 (No Photo)

Unit Description: These two units are part of the Oil Spill Removal System which is also comprised of Donuts (SWMU #21), Oil Spill Separator Tanks (SWMU #23), and the Oil Spill Oil/Water Separator (SWMU #24). Naval personnel reported the following about the Ships Waste Offload Barges (SWOBs). The capacity of these floating barges is 40,000 gallons each. In addition to collecting material from large spills and bilge and ballast wastewater from ships, these units act as a collection point for waste from the donuts (SWMU #21) during spill events, and oily waste from the general vehicle maintenance shops (at those times when DRMO is late in removing accumulated waste). Three onshore Oil Spill Separator Tanks (SWMU #24) receive the SWOB waste (Ref. 57).

Date of Start-up: The date of start-up for this unit could not be determined.

Date of Closure: These units are presently active (Ref. 57).

Wastes Managed: These units store and transport waste oil and fuel, and bilge and ballast wastewater (Ref. 57).

Release Controls: Aside from being completely contained, these units have bumpers that help prevent structural damage.

History of Release: No past releases are identified with these units and no mention was made of release by facility representatives during the VSI. These units are designed and operated to recover material which has been released to surface water.

23. UNIT NAME: Oil Spill Separator Tanks #1 - #3 (Photo 20)

Unit Description: Located approximately 100 feet inshore from the Fuel Pier are three Oil Spill Separator Tanks which process waste pumped in from the Ships Waste Offload Barges (SWMU #22). The Oil Spill Separator Tanks are large steel boxes, each with a pipe extending out laterally from the bottom. After the water settles to the bottom of the tank a valve on the pipe is opened and the contents allowed to spill out until all the water has been removed. The separated oil is then transferred to the Oil Spill Oil/Water Separator (SWMU #24). This added process of separation is necessary because the majority of liquid pumped up by Donuts (SWMU #21) and SWOBs (SWMU #22) consists of sea water. Each Oil Spill Separator Tank is constructed of steel and has 2,000 gallon capacity, according to facility representatives (Ref. 57).

Date of Start-up: The date of start-up for these units could not be determined.

Date of Closure: These units are presently active.

Wastes Managed: The Oil Spill Separator Tanks manage wastes received from the SWOBs (i.e., waste fuel and oil and bilge and ballast wastewater) (Ref. 57).

Release Controls: These units were observed to be underlain by a concrete pad with approximately 8-inch curbing (Ref. 57).

History of Release: It was noted during the VSI that the concrete pad, curbing, and areas of surrounding asphalt were stained black.

24. UNIT NAME: Oil Spill Oil/Water Separator (No Photo)

Unit Description: The Oil Spill Oil/Water Separator is a below ground structure built of concrete with steel grating covering the top at ground level. It has a capacity of 1,500 gallons, as reported by facility representatives. This unit receives discharge from Oil Spill Separator Tanks (SWMU #23). After separation, the waste oil is removed by DRMO (Ref. 57). The final disposal of wastewater was not determined during this RFA.

Date of Start-up: The date of start-up for this unit was not determined during this PR or VSI.

Date of Closure: This unit is presently active (Ref. 57).

Wastes Managed: This unit is the final step, before disposal by DRMO, in the Oil Spill Removal Process. Wastes managed include separated oil from the Oil Spill Separator Tanks (SWMU #23) (Ref. 57).

Release Controls: Other than the fact that this unit is constructed of concrete, there were no release controls identified during this RFA. The existence of an overflow control device could not be determined.

History of Release: There are no previous releases identified from this unit and no sign of release was observed at the time of the VSI.

25. UNIT NAME: Past DRMO Hazardous Waste Storage (Photo 21)

Unit Description: This unit is an area measuring approximately 40 feet x 100 feet that is located immediately adjacent to the Ignitable Storage Facility (SWMU #18) (Ref. 57). A facility representative stated that this unit was active prior to the use of the Ignitable Storage Facility (SWMU #18) and DRMO Hazardous Waste Storage Facility (SWMU #17) for hazardous waste storage. Closure plans are being written for this unit, according to facility representatives. Evidence of past release was observed during the VSI. Several oily stains, the largest measuring approximately 20 feet in diameter (Ref. 57), are evident in Photo 21. This site is currently being used to store hazardous materials according to a facility representative.

Date of Start-up: The start-up date for this unit could not be determined during this RFA.

Date of Closure: This unit no longer actively collects and stores waste, so could be considered inactive.

Wastes Managed: This unit managed hazardous waste, the exact nature of which could not be determined during this RFA.

Release Controls: No release controls are identified with this unit.

History of Release: Several areas of stained gravel were observed during the VSI (Ref. 57).

26. UNIT NAME: Abandoned Engine Oil Drums (Photo 22)

Unit Description: Located behind Building 544 and surrounded by thick brush are approximately 25 30-gallon drums, some with polyethylene liners. Some of the drums contain engine lubricating oil and one of the labels had the numbers 9150-231-6654 stamped on it. A tar-like substance was observed leaking onto the ground (Ref. 57).

Date of Start-up: The date of start-up for this unit could not be determined during this RFA.

Date of Closure: This unit was active at the time of the VSI.

Wastes Managed: Since most of the drums were unlabeled, it was not possible to identify all the waste types located at this unit. Several of the drums contain engine lubricating oil.

Release Controls: No release controls were observed for this unit.

History of Release: Many of the drums were observed during the VSI to be severely corroded, and a tar-like substance was observed on the bare ground around the drums (Ref. 57).

27. UNIT NAME: Capehart Area Wastewater Plant (Bldg. 1691) (Photo 23)

Unit Description: The NACIP study (Ref. 48) reports the following concerning this domestic sewage treatment plant. This unit serves the Capehart housing area and has a total capacity of 0.46 million gallons per day. This treatment plant is divided into two parallel units and both are similar extended aeration plants. Digested sludge is dewatered in two drying beds and hauled periodically to the Station Landfill (SWMU #3). Chlorinated effluent is discharged to the adjacent coastal waters through a submarine outfall. Sludge generation is estimated at 70 tons per year (10% moisture) (Ref. 48). This unit and the other two Naval Station Wastewater Treatment Plants (SWMUs #28 and #29) were issued a NPDES Permit in March 1986 (Ref. 30).

The VSI team was unable to gain access to this unit because the gate was locked and there was no operator on-site. Information regarding the processes of this unit has been requested from facility representatives, but had not been received before completion of this report.

Date of Start-up: The date of start-up for this unit could not be determined during this RFA.

Date of Closure: According to facility officials, this unit is presently active.

Wastes Managed: As reported by the NACIP study, this unit receives sanitary waste from the Capehart housing area (Ref. 48).

Release Controls: Because this unit was not observed during the VSI, no release controls were identified for this unit.

History of Release: Data obtained from chemical characterization of effluent discharged by this unit revealed that this unit is in violation of the Puerto Rico Environmental Quality Board Water Quality Standards Regulations, according to Ref. 50. Specific violations were not cited in "Scope of Work; Study for Elimination of NPDES Violations at the U.S. Naval Station, Roosevelt Roads" (Ref. 50).

28. UNIT NAME: Bundy Area Wastewater Plant (Bldg. 1757) (Photo 24)

Unit Description: The operator of this unit stated that the Bundy Area Wastewater Plant has a capacity of 200,000 gallons per day. Flow varies greatly because this unit services a military training area nearby which is used sporadically. Influent flows through a system involving a communitor, primary clarifiers, a contact basin, trickling filters, secondary clarifiers, a chlorine contact basin, and final discharge through one of the Naval Station Outfalls (AOC D). Four drying beds with sand filters are used to dry digested sludge which is disposed of in the Station Landfill (SWMU #3). According to the NACIP report, approximately 6.5 tons of sludge (90% solids) are produced yearly from this unit (Ref. 48). Detailed information (including flow charts) was requested from facility officials at the time of the VSI (Ref. 57). A NPDES Permit for this unit and the two other Naval Station Wastewater Treatment Plants (SWMUs #27 and #29) was issued in March 1986 (Ref. 30).

Date of Start-up: The date of start-up for this unit could not be determined during this RFA.

Date of Closure: This unit is presently active.

Wastes Managed: This unit's operator stated that incoming domestic sewage is from the Bundy substation which varies greatly because it services a military training area nearby (Ref. 57).

Release Controls: Release controls for this unit consist of manual and automatic level controls (Ref. 57).

History of Release: Data obtained from chemical characterization of effluent discharged by this unit revealed that this unit is in violation of the Puerto Rico Environmental Quality Board Water Quality Standards Regulations, according to Ref. 50. Specific violations were not cited in "Scope of Work; Study for Elimination of NPDES Violations at the U.S. Naval Station, Roosevelt Roads" (Ref. 50).

29. UNIT NAME: Industrial Area Wastewater Plant (Bldg. 1758) (Photo 25)

Unit Description: The Industrial Area Wastewater Plant has a capacity of .937 million gallons per day and processes 0.7 million gallons per day on average. This unit and the two other Naval Station Wastewater Treatment Plants (SWMUs #27 and #28) were issued a NPDES Permit in March 1986 (Ref. 30). According to a facility representative, this unit uses a trickling filter system with anaerobic digestion to serve the southeastern section of the base, including the Public Works Complex (Ref. 57). Influent was observed during the VSI to be stored in a plastic-lined aeration lagoon prior to processing. Chlorinated effluent is discharged to the adjacent coastal waters through a 14-inch submarine outfall (Ref. 48). Sixty tons of dry sludge per year is disposed of in the adjacent Station Landfill (SWMU #3) (Ref. 48). Additional detailed information has been requested from facility representatives.

Date of Start-up: This unit has been in operation since 1970 (Ref. 57).

Date of Closure: This unit is presently active.

Wastes Managed: Wastes managed include sewage from the Public Works Department and the southeast section of the base (Ref. 48) including wastewater from the Aircraft Wash Rack Oil/Water Separator (SWMU #35) (Ref. 57).

Release Controls: The aeration lagoon has a plastic liner in addition to manual and automatic level controls.

History of Release: Data obtained from chemical characterization of effluent discharged by this unit revealed that this unit is in violation of the Puerto Rico Environmental Quality Board Water Quality Standards Regulations, according to Ref. 50. Specific violations were not cited in "Scope of Work; Study for Elimination of NPDES Violations at the U.S. Naval Station, Roosevelt Roads" (Ref. 50).

30. UNIT NAME: Former Incinerator Site (near Station Landfill entrance) (Photo 26)

Unit Description: Installed in 1973 and dismantled in 1983, this unit was used to burn classified material, contaminated diesel oil, JP-5 fuel (usually mixed with some lube oil), solvents, and sludge residue. During its period of operation, the NACIP study (Ref. 48) estimated that 600 gallons of oil were processed here per week.

A facility representative reported that, in 1984, the present unit was installed in the same location as the dismantled incinerator and has never been activated. The new unit is surrounded by a cyclone fence that was unlocked at the time of the VSI. Dense vegetation made approach difficult. There was no indication through visual observation that the new unit had ever been active.

Date of Start-up: The date of start-up for this unit is 1973.

Date of Closure: This unit was dismantled in 1983.

Wastes Managed: Classified material, contaminated diesel oil, JP-5 fuel (usually mixed with some lube oil), solvents, and sludge residue were burned at this unit, according to the NACIP study (Ref. 48).

Release Controls: The NACIP report makes no mention of release controls and the VSI team was unable to observe this unit since it was dismantled in 1983.

History of Release: This unit was designed to release to air.

31. UNIT NAME: Waste Oil Collection Area (PWD Storage Yard) (Photo 27)

Unit Description: The Transportation Shop services Public Works Department vehicles inside Building 31 and in the yard just north of the building. Approximately 30 yards from the Transportation Shop warehouse is a concrete pad used for the temporary storage of 55-gallon waste oil drums, although none were present at the time of the VSI. A 6-inch concrete curb surrounds the pad which measures approximately 13 feet x 20 feet. A steel drainage pipe with a broken valve is set into the curbing, and at the time of the VSI, was in the open position (Ref. 57). The yard surrounding this unit is asphalt.

Date of Start-up: The date of start-up for this unit could not be determined during this RFA.

Date of Closure: This unit is presently active.

Wastes Managed: Wastes managed at this unit include waste lubricating oil (Ref. 57).

Release Controls: This unit is a concrete pad with 6-inch concrete curbing around it (Ref. 57).

History of Release: No leakage was evident at the time of the VSI; however, with the drain pipe valve broken in the open position any spills on the concrete pad would flow directly onto the Public Works Department yard.

32. UNIT NAME: Battery Collection Area (PWD Storage Yard) (Photo 28)

Unit Description: This area is approximately 100 yards northeast from the Transportation Shop warehouse. Several dozen batteries in various stages of decay were observed in the bed of a truck and on a nearby pallet on the ground. None of the batteries were corroded to the point of leakage, although most appeared to contain electrolyte (Ref. 57).

Date of Start-up: During the VSI, it could not be determined how long batteries have been stored here.

Date of Closure: This area was observed to be active.

Wastes Managed: This unit is used for the temporary storage of old vehicle batteries.

Release Controls: No release controls were observed during the VSI.

History of Release: No evidence of release was observed during the VSI (i.e., no stains were observed) (Ref. 57).

33. UNIT NAME: AIMD Hazardous Waste Storage Pad (Photo 29)

Unit Description: The unit is located outside, against the northern wall of Building 379. It was described by facility representatives as a temporary hazardous waste storage area. The wastes stored at this unit are generated by Aircraft Intermediate Maintenance Department (AIMD) maintenance and according to the NACIP report (Ref. 48) include wastes generated from cleaning, painting, paint stripping, minor calibration, complete overhaul of avionic components, and battery cleaning and recharging operations.

Date of Start-up: The date of start-up for this unit was not determined during this RFA.

Date of Closure: This unit is active.

Wastes Managed: Observed during the VSI were beryllium waste, hydraulic fluid and solvents generated from aircraft maintenance (Ref. 57).

Release Controls: The temporary hazardous waste storage area was located on a curbed concrete pad with a manual overflow control valve (Ref. 57).

History of Release: There are no documented releases identified from this unit in the PR file material. During the VSI, minor amounts of unidentified damp white powder were observed in the grass several feet outside the storage pad (Ref. 57).

34. UNIT NAME: VC-8 Waste Storage Pad (Photo 30)

Unit Description: This unit is located outside, behind a trailer at the northeastern edge of the Fleet Composite Squadron Eight (VC-8) airfield. It was observed to be a concrete pad with one foot curbing. One-half of the pad is used for bousers and one-half for drum storage. Measuring 8 feet x 13 feet, the bouser pad supports a tank with approximately a 500 gallon capacity. Immediately adjacent is the 5 feet x 10 feet drum storage pad. Stored at this unit are waste aviation fuel and waste paint resulting from aircraft maintenance. The drums were grounded at the time of the VSI. During heavy rainfall, the manual overflow control valve is sometimes opened to prevent overflow. The discharge runs into an adjacent ditch (Ref. 57).

Date of Start-up: The date of start-up for this unit could not be determined.

Date of Closure: This unit is presently active.

Wastes Managed: This unit is used for the temporary storage of waste aviation fuel and waste paint (Ref. 57).

Release Controls: This concrete pad was observed to have 1-foot concrete curbing and a manual overflow control valve. In addition, the drums and storage tank are grounded (Ref. 57).

History of Release: No sign of release was observed during the VSI.

35. UNIT NAME: Aircraft Wash Rack Oil/Water Separator (VC-8 Yard) (Photo 31)

Unit Description: This unit is located approximately 50 feet from Building 396, and is designed to collect and separate oil and washwater from aircraft washdown. This belowgrade, concrete unit measures approximately 5 feet x 15 feet x 5 feet deep. According to a facility representative, after separation the water goes to the Industrial Area Wastewater Plant (SWMU #29) and the sludge goes to the Station Landfill (SWMU #3) (Ref. 57).

Date of Start-up: The date of start-up for this unit could not be determined during this RFA.

Date of Closure: This unit is presently active.

Wastes Managed: Oily washwater from aircraft washdown is managed at this unit (Ref. 57).

Release Controls: A manual overflow control valve was observed during the VSI.

History of Release: No evidence of release was observed during the VSI.

36. UNIT NAME: Vehicle Wash Rack Oil/Water Separator (Photo 32)

Unit Description: This unit is not surrounded by any immediate buildings, but is in the general vicinity of the Berthing Pier. As required by USDA regulations, the Department of Defense washes vehicles at the vehicle wash rack. The purpose of this activity is to remove soil borne contaminants (insects, microbes, etc.). In the process, some oily waste is washed into the Vehicle Wash Rack Oil/Water Separator. This is an underground concrete unit measuring approximately 8 feet x 18 feet x an undetermined depth. Steel grating covered two thirds of the surface opening at the time of the VSI. According to a facility representative, this separator has been operational for approximately five years (Ref. 57).

Date of Start-up: This unit has been active since approximately 1983 up until the present.

Date of Closure: This unit is presently active.

Wastes Managed: Wastes managed at this unit include oily washwater.

Release Controls: Other than the fact that this unit is constructed from concrete, there are no release controls associated with this unit.

History of Release: No evidence of release was observed during the VSI (Ref. 57).

37. UNIT NAME: Waste Oil Drum Storage Area (near Hangar 200) (Photo 33)

Unit Description: This unit consists of 19 55-gallon drums resting on wooden pallets, situated on a raised concrete pad behind Hangar 200. The drums were observed to contain waste gasoline and lubricating oil from AIMD operations (Ref. 57).

Date of Start-up: The date of start-up for this unit could not be determined during this RFI.

Date of Closure: This unit is presently active.

Wastes Managed: Waste gasoline and lubricating oil are stored here.

Release Controls: The drums were resting on a covered, concrete pad without curbing at the time of the VSI.

History of Release: During the VSI, minor oil stains were observed on the concrete pad and a minor area on the nearby grass was observed to have stressed vegetation (Ref. 57).

38. <u>UNIT NAME</u>: Sewer Drainage System (No Photo)

<u>Unit Description</u>: This unit is an underground sewer drainage system that includes both the sanitary and storm sewer systems. During this RFA, it could not be determined if this unit is comprised of two separate, dedicated sewage systems, or one single unit. In addition, the particular piping material used for construction (e.g., PVC, metal piping) could not be determined. Past and present waste management practices involve various wastes washing into this facility's drainage system. The NACIP report documented release to the Sewer Drainage System of excess pesticides from the Old Pest Control Shop (SWMU #13) and overflow from the Drone Fuel Drain Oil/Water Separator (SWMU #4) (Ref. 48). During the VSI, evidence of overflow that may enter the Sewer Drainage System was observed at the Fire Training Pit Oil/Water Separator (SWMU #12) (Ref. 57).

<u>Date of Start-up</u>: The date of start-up for this unit could not be determined during this VSI.

<u>Date of Closure</u>: This unit is presently active.

<u>Wastes Managed</u>: Wastes managed include excess pesticides and oil/water separator overflow.

<u>Release Controls</u>: There are no release controls identified with this unit.

<u>History of Release</u>: Release to this unit has been documented in the NACIP report (Ref. 48) and the possibility of release to this unit was observed during the VSI. However, due to the location of this unit (i.e., underground) a visual determination could not made regarding the likelihood of release to the surrounding environment.

39. <u>UNIT NAME</u>: Spent Battery Storage (Building 3158) (Photo 34)

<u>Unit Description</u>: This unit consists of a storage building and covered battery drainage area. This building stores waste batteries and battery acid that are wastes generated by Naval Mobile Construction Battalion (NMCB or "Seabees") operations. The metal battery drain tank (shaped rather like a funnel) is underlain by a curbed concrete pad. Battery contents are poured into the drain tank and the battery acid is caught below in a container. The curbing around the pad is cracked and stained, indicating that there have potentially been past releases to the soil (Ref. 57).

<u>Date of Start-up</u>: The date of start-up for this unit could not be determined during this RFA.

<u>Date of Closure</u>: This unit is presently active.

<u>Wastes Managed</u>: This unit manages waste batteries and waste battery acid (Ref. 57).

<u>Release Controls</u>: The battery drain tank is underlain by a curbed (and cracked) concrete pad.

<u>History of Release</u>: The curbing around the pad was observed during the VSI to be cracked and stained (Ref. 57), suggesting the likelihood of a release to soil.

40. UNIT NAME: Seabee Oil Collection Area (Photo 35)

Unit Description: This unit is located in the Alpha Company Maintenance Yard and consists of a mobile storage tank (capacity approximately 300 gallons) stored on a gravel yard. The tank is used to collect used lubricating oil before DRMO disposes of it (Ref. 57). Adjacent to the mobile storage tank is a curbed concrete pad that contained several drums and pails at the time of the VSI.

Date of Start-up: The date of start-up for this unit could not be determined during this RFA.

Date of Closure: This unit is presently active.

Wastes Managed: This unit temporarily stores used lubricating oil.

Release Controls: There are no release controls associated with the mobile storage tank. The adjacent drums and pails were contained on a curbed concrete pad.

History of Release: During the VSI, stained gravel was observed under the mobile storage tank (Ref. 57).

41. UNIT NAME: Rinse Rack near Seabee Pesticide Storage (Photo 36)

Unit Description: This unit was observed to be an uncurbed concrete slab measuring approximately 12 feet x 20 feet that is located directly adjacent to the Seabee Pesticide Storage Building (Building 3152) (Ref. 57). The drain within this slab is made up of four strips (6 inches wide). Each strip runs parallel to and is located within the perimeter of the slab. The overall effect is of an inner rectangular "frame." The drain is covered by steel grating. The VSI team was informed by naval personnel that this unit is most commonly used to rinse out the spray trailer which usually contains a mosquito pesticide (Ref. 57).

Date of Start-up: The date of start-up for this unit could not be determined during this RFA.

Date of Closure: This unit is presently active.

Wastes Managed: This unit processes rinsate from the mosquito control trailer. It was not determined during the VSI whether expired pesticides are washed down the drain of this unit or sent to DRMO (Ref. 57).

Release Controls: No release controls were observed during the VSI.

History of Release: No sign of release was observed during the VSI.

42. UNIT NAME: Water Treatment Plant Sludge Lagoons (Photos 37 and 38)

Unit Description: Raw water is supplied by mountain rainwater from the Rio Blanco River (Ref. 33) west of the Naval Station. Water treatment at Naval Station Roosevelt Roads involves aeration, prechlorination, coagulation, sedimentation, filtration, fluoride adjustment, and disinfection (Ref. 33). Located several hundred feet west of the Roosevelt Roads Water Treatment Plant are two open sludge lagoons measuring approximately 160 feet x 90 feet x 20 feet deep (Ref. 57). According to a facility representative, the lagoons are natural, unlined ponds. Sludge from the Water Treatment Plant sedimentation tanks is released periodically into one of the sludge lagoons. Thick vegetation was observed growing along the edges of both lagoons. The plant operator reported that the sludge in these lagoons consists of river mud with aluminum sulfide and lime added during the water filtration and sediment settling processes. In order to prevent a system backup during heavy rainfall the lagoon gates are opened. This happens about once a year, according to the plant operator. Discharge flows into a surface water canal that eventually reaches the mangroves. The operator also stated that the sludge in these lagoons had been removed and deposited offsite once in the seven years of his tenure there (Ref. 57).

Date of Start-up: According to the plant operator, the sludge lagoons have been in operation for at least seven years.

Date of Closure: This unit is presently active.

Wastes Managed: This unit manages river mud containing aluminum sulfide and lime (Ref. 57).

Release Controls: Overflow is addressed through the use of manual and automatic level controls.

History of Release: Approximately once a year the lagoon gates are opened and the sludge discharged into a surface water canal. The sludge from both lagoons was removed and deposited offsite once in a seven year period.

43. UNIT NAME: Drone Washdown Area (Photo 39)

Unit Description: Directly in front of the garage doors of Building 860, Aerial Target Systems Department, is a concrete lined drainage ditch covered by steel grating which measures approximately 350 feet x 2 feet x 3 feet deep (Ref. 57). As stated by a facility representative, drones are recovered from the sea after military exercises and brought to Building 860. Here the saltwater and marker dye is rinsed off over the steel grating. This unit drains into the drainage ditch north of Building 860. According to the NACIP study (Ref. 48), from about 1960 until the mid-1970s, between 2,500 and 5,000 gallons of contaminated JP-4 and JP-5 drone fuel was drained in the approximate area where this unit is now, eventually discharging into the ditch north of Building 860, Fuel and Chemical Storage Compound Drainage Ditch (SWMU #44). The current practice is to drain unused drone fuel directly into the Drone Fuel Drain Oil/Water Separator (SWMU #4) (Ref. 57).

Date of Start-up: Facility representatives stated that this unit has been in operation for at least 10 years (Ref. 57).

Date of Closure: This unit is presently active.

Wastes Managed: This unit manages washwater containing sea salt and marker dye.

Release Controls: This unit is concrete-lined.

History of Release: By construction design, this unit releases to the drainage ditch north of Building 860. According to the NACIP report, between 2,500 and 5,000 gallons of contaminated JP-4 and JP-5 was drained into this unit over a 15 year period. The practice was stopped in the mid-1970s (Ref. 48).

44. UNIT NAME: Aerial Target Systems Drainage Ditch (Photo 40)

Unit Description: This unit is a concrete lined ditch that parallels the north edge of the Aerial Target Systems Department yard. According to the NACIP report, between 2,500 and 5,000 gallons of JP-4 and JP-5 fuel was discharged into this unit (Ref. 48) from the area cited in this report as the Drone Washdown Area (SWMU #4). In addition, a fuel and chemical storage pad for the Aerial Target Systems Department (Building 860) is located adjacent to this unit. The fuel and chemical storage pad stores products used in the maintenance and repair of drones, such as JP-4, JP-5, rust preventive, and solvents (Ref. 57). Extending out from the storage pad and over the Aerial Target Systems Drainage Ditch is a drain pipe with a valve. A small patch of dead vegetation was observed directly below the drain pipe.

Date of Start-up: The date of start-up for this unit could not be determined during this RFA.

Date of Closure: This unit is presently active.

Wastes Managed: Wastes managed here include JP-4, JP-5, rust preventative, and solvents.

Release Controls: This unit is lined with concrete. Vegetation was observed growing up through seams in the concrete.

History of Release: A small patch of dead vegetation was observed directly below a drainage pipe that extends out over this unit. Between 2,500 and 5,000 gallons of JP-4 and JP-5 fuel was discharged into this unit over a 15 year period. Washwater from the Drone Washdown Area (SWMU #4) containing sea salt and marker dye is discharged to this unit as a matter of routine. This ditch flows southward (Ref. 26), eventually discharging into Ensenada Honda (Ref. 48).

45. <u>UNIT NAME</u>: PCB Spill Area (Photo 41)

<u>Unit Description</u>: According to the NACIP study (Ref. 48), outside of Building 38 near the northeast corner, transformer maintenance was performed from 1956 until 1964. An estimated 1,600 gallons of transformer oil, probably containing PCBs, were poured out on the ground during that time (Ref. 48). The exact location of the spill area was difficult to ascertain at the time of the VSI. Oil stains were observed on a concrete pad near the northeast corner of Building 38 (Ref. 57). No evidence of release to soil was observed.

<u>Date of Start-up</u>: Transformer oil was first poured onto the ground in 1956, according to the NACIP report (Ref. 48).

<u>Date of Closure</u>: The date of closure for this unit is 1964 (Ref. 48).

<u>Wastes Managed</u>: Wastes managed at this unit include transformer oil possibly contaminated with PCBs (Ref. 48).

<u>Release Controls</u>: No release controls in the spill area were identified in the PR material or observed during the VSI.

<u>History of Release</u>: Between 1965 and 1964, approximately 1,600 gallons of transformer oil were poured out on the ground (Ref. 48).

46. <u>UNIT NAME</u>: Pole Storage Yard (Photo 42)

<u>Unit Description</u>: This unit was cited in the NACIP report as a Public Works Department hazardous waste storage area that had been used to store transformers and 55-gallon drums of PCB-contaminated material (Ref. 48). The reference further stated that the area showed evidence of oil spillage. A facility representative confirmed that this unit had formerly been used to store transformers. Within this unit was a covered concrete pad, observed to be used for the storage of products including insulators, telephone poles, small cardboard boxes of electrical equipment, and several full 5-gallon pails, one marked as electrical lubricant (Ref. 57). This unit was surrounded by a cyclone fence. Telephone poles were piled near the entrance. No evidence of release was observed.

<u>Date of Start-up</u>: The date of start-up for this unit could not be determined during this RFA.

<u>Date of Closure</u>: This unit is presently active as a product storage area. Waste is not presently stored here.

<u>Wastes Managed</u>: According to the NACIP report, this unit formerly managed transformer oil, possibly containing PCBs (Ref. 48).

<u>Release Controls</u>: Release controls included a covered concrete pad without curbing. No release controls were associated with the rest of the yard.

<u>History of Release</u>: The NACIP reported cited periodic spillage of transformer oil and noted evidence of oil spillage in the area (Ref. 48). No evidence of release was observed during the VSI.

47. UNIT NAME: Local Disposal Areas

Unit Description: Throughout this facility are an unspecified number of satellite disposal points, existing both as dedicated areas associated with specific process points, and also as general refuse accumulation areas. Facility representatives did not know the specific locations of all disposal points and refuse accumulation areas, nor the specific composition of materials disposed of at these units.

Date of Start-up: Due to the unspecified number of units and general lack of documentation regarding these units, a date of start-up could not be determined.

Date of Closure: These units are considered to be presently active.

Wastes Managed: Specific wastes managed at these units could not be determined during this RFA, but are thought to include process-specific waste materials and general refuse.

Release Controls: There are no release controls identified with these units.

History of Release: Lack of documentation regarding these units (e.g., waste types, secondary containment) prohibits an accurate assessment of release history.

A. AREA OF CONCERN: Torpedo Shop (No Photo)

Area of Concern Description: The Torpedo Shop assembles MK 30, MK 46, and MK 48 torpedoes for the Atlantic Fleet Weapons Training Facility (AFWTF) and the Weapons Department (Ref. 48). Following a "run" by one of the target or practice torpedoes, the torpedo is recovered, the fuel removed, and the torpedo washed with Agentine, a dry cleaning solvent. The waste produced by this process includes OTTO Fuel II, clothing contaminated in the assembly and maintenance of the torpedoes, detergent, Agentine, alcohol (Neosol), sodium sulfide, denatured ethyl alcohol, acetone, oil, and silver cell batteries. According to the U.S. Navy, approximately 120 55-gallon drums of solvent and fuel waste are generated yearly by this unit (Ref. 48). Contaminated OTTO Fuel II and other waste is stored temporarily before being shipped to Cape Canaveral, Florida (Ref. 48). According to the NACIP study, disposal of inoperable explosives generated by this unit is carried out by Explosive Ordnance Detachment (EOD) personnel at the Eastern Maneuver Area (EMA) on Vieques Island (Ref. 48). According to AFWTF Director, Mr. Nestor Paradis, this unit is a "unique military operation" and requires special security clearance for entry. The VSI team was therefore denied access, and no VSI was conducted at this unit.

B. AREA OF CONCERN NAME: Former PWD Storage Area (No Photo)

Area of Concern
Description: This AOC is in the location of Building 25 (NACIP Site 10). At one time used by the Public Works-Supply Department to store DRMO-bound materials (Ref. 48), Building 25 was observed during the VSI to have collapsed. The materials stacked on its unmortared brick floor were overgrown with vegetation. It appeared that the majority of material stored there consisted of old clothing, empty wooden boxes, and small empty shells. No sign of release was noted during the VSI; however, it is possible that some amount of material was completely covered by vines and could not be observed during the VSI (Ref. 57). The topography of this area slopes gently (2%) southeast toward Puerca Bay (Ref. 26), which lies at a distance of approximately 1,500 feet.

C. <u>AREA OF CONCERN NAME</u>: Transformer Storage Area (Photo 43)

<u>Area of Concern Description</u>: This AOC is comprised of two raised concrete pads that, at the time of the VSI, were used for storage of transformers (Ref. 57). During the VSI, 40 transformers were observed to be stored on the storage pad to the south, which measured approximately 20 feet x 50 feet. This pad was covered by ripped canvas stretched over a wooden frame. The north pad was uncovered and contained at least 25 transformers and 20 to 40 batteries. The products stored at this unit were in good condition. Standing oil inside the north pad and release to the soil through a crack in the concrete were observed. Transformers of various sizes were scattered around both the south pad and the north concrete pad (Ref. 57).

D. AREA OF CONCERN NAME: Naval Station Outfalls (No Photo)

Area of Concern Description: There are a number of outfalls at the Roosevelt Roads facility. These outfalls may be associated with the Sewer Drainage System (SWMU #38), the various on-site WWTPs, and/or other drainage areas or ditches which exist within the facility boundaries. These outfalls include both regulated (e.g. NPDES) and nonregulated outfalls. The facility representatives knew neither the specific location of all outfalls nor the specific chemical composition of the effluent being discharged at each of these outfalls. These areas are a concern since there have been repeated past violations of releases from regulated discharge units (e.g., NPDES) (Ref. 50).

5.0 EXECUTIVE SUMMARY

A RCRA Facility Assessment was conducted at the Naval Station (NAVSTA) Roosevelt Roads Rico to identify solid waste management units (SWMUs) and other areas of concern (AOCs) and assess the potential for release of hazardous wastes and hazardous constituents from these units to the environment. The description of SWMUs and AOCs and the assessment of potential for release was based upon a Preliminary Review (PR) of existing information and a Visual Site Inspection (VSI) of the facility. The primary source of existing information was the Region II office of the Environmental Protection Agency in New York City, New York.

Roosevelt Roads covers an area greater than 8,000 acres and provides general support for numerous tenant activities. Those SWMUs and AOCs identified in this report were concluded to be representative of waste management activities at the Naval Station Roosevelt Roads. Areas (including process areas, storage facilities, etc.) not observed during the VSI were situated indoors (i.e., fully enclosed) which prevents any possible releases to environmental pathways, and/or had no documented release to the environment associated with them.

The RFA resulted in the identification of 47 SWMUs and 4 other AOCs. The primary units of concern include three unlined landfills (SWMUs #1, #2, and #3,) fuel storage and disposal areas (SWMUs #7, #8, and #9), the Old Pesticide Shop (SWMU #13), and the Naval Station Outfalls (AOC E) and Local Disposal Areas (AOC F). All of these represent potential releases to soil, groundwater, and surface water, and require extensive sampling to determine the existence of release of hazardous constituents to the environment.

Additional units which are of concern include the NAVSTA Roosevelt Roads Wastewater Treatment Plants (SWMUs #27, #28, and #29), several oil/water separators (SWMUs #4, #24, #35, #36), Donuts (SWMU #21), Ships Waste Offload Barges (SWMU #22), and the Sewer Drainage System (SWMU #38). The structural integrity of these units needs to be verified to insure that release of hazardous constituents to the environment is not occurring.

In summary, further actions were suggested at 35 of the 47 SWMUs and 4 AOCs. Suggested further actions include soil sampling, groundwater investigations, surface water and sediment sampling, verification of unit integrity, requests for additional information, suggestions of better facility management, and referral to another agency. Table 5 summarizes the SWMUs and AOCs and suggestions for further action, if any, at each unit. This table and discussions in Section 7.0 provide additional descriptions of further actions which have been recommended and the basis for these recommendations.

Table 6. Summary of Suggested Further Actions.

Unit Name	Further Action
1. Army Cremator Disposal Site	Sampling
2. Langley Drive Disposal Site	Sampling
3. Station Landfill	Sampling
4. Drone Fuel Drain Oil/Water Separator	Integrity Testing
5. Dumpsters	No Further Action
6. Former Paint Storage (Building 145)	Additional Information
7. Tow Way Road Fuels Farm	Sampling, Integrity Testing
8. Tow Way Road Disposal Pits	Sampling
9. Leaded Sludge Pits	Sampling
10. Transformer Maintenance Area	Refer to TSCA
11. PCB Storage Compound (Building 38)	Additional Information
12. Fire Training Pit Oil/Water Separator	Sampling, Repairs
13. Old Pest Control Shop	Sampling
14. Fire Training Pit	Sampling
15. Hospital Incinerator (Building 1928)	No Further Action
16. Waste Explosive Storage (Building 1666)	Additional Information
17. DRMO Hazardous Waste Storage Facility	No Further Action
18. Ignitable Storage Facility (Bldg. 2009)	No Further Action
19. Pesticide Waste Storage (Building 121)	Review Regulatory Status
20. Waste Oil Tank Truck (near Building 860)	No Further Action
21. Donuts	Integrity Testing
22. Ships Waste Offload Barges (SWOBs)	Integrity Testing
23. Oil Spill Separator Tanks	Sampling, Repairs
24. Oil Spill Oil/Water Separator	Integrity Testing
25. DRMO Past Hazardous Waste Storage	Sampling
26. Abandoned Engine Oil Drums (behind Bldg. 544)	Sampling
27. Capehart Area Wastewater Plant	Integrity Testing, Sampling
28. Bundy Area Wastewater Plant	Integrity Testing, Sampling
29. Industrial Area Wastewater Plant	Integrity Testing, Sampling
30. Former Incinerator Site (adjacent to landfill entrance)	No Further Action
31. Waste Oil Collection Area (PWD Storage Yard)	Repairs
32. Battery Collection Area (PWD Storage Yard)	Relocate
33. AIMD Hazardous Waste Storage Pad	Sampling, Improve Management
34. VC-8 Waste Storage Pad	Build Cover
35. Aircraft Wash Rack and Oil/Water Separator	Integrity Testing
36. Vehicle Wash Rack (near Berthing Pier)	Integrity Testing
37. Waste Oil Drum Storage Area (near Hangar 200)	Sampling
38. Sewer Drainage System	Integrity Testing, Additional Information
39. Spent Battery Storage Building (Bldg. 3158)	Sampling
40. Sea Bee Oil Collection Area	Sampling

-- Continued --

Table 6. Continued.

Unit Name	Further Action
41. Rinse Rack near Sea Bee Pesticide Storage (Building 3152)	Additional Information
42. Water Treatment Plant Sludge Lagoons	No Further Action
43. Drone Washdown Area	No Further Action
44. Aerial Target Systems Drainage Ditch	Sampling
45. PCB Spill Area	Sampling, Refer to TSCA
46. Pole Storage Yard	Sampling
47. Local Disposal Areas	Survey, Sampling
A. Torpedo Shop	Additional Information
B. Former PWD Storage Area (Building 25)	Inventory
C. Transformer Storage Area (near Bldg. 2042)	Sampling
D. Naval Station Outfalls	Survey, Sampling

6.0 RELEASE PATHWAYS

Groundwater

Groundwater at Roosevelt Roads flows generally southeast, except in the areas of high ground on the peninsulas which constitute the Industrial Area, where SWMUs #3, #7, #8, #9, #15, #19, and #45 are located. In these areas, due to the steep slopes, relatively shallow well-drained soils, and proximity to bedrock at the surface, subsurface contaminant migration will be in the direction dictated by local topography (Ref. 48). This will generally be north and northwest into the mangrove swamps and south and southeast into Ensenada Honda. The only known possible sources of usable groundwater are lenticular beds of clay, sand, gravel and rock fragments which occur at less than 30 meters depth. However, the facility is located on alluvial deposits of sand, silt clay and gravel, floodplain and terrace deposits which contain shallow groundwater (Ref. 48). Furthermore, the facility is surrounded on three sides by ocean. Given the shallow depth to groundwater and the existence of several unlined units at the facility (e.g., SWMUs #1, #2, #3, #8 and #9), potential for release to groundwater is considered high.

Soil

Typical surface soils at the facility range from sandy to clayey soils which are moderately well to poorly drained (Ref. 48). The presence of many unlined units (e.g., SWMUs #1, #2, and #3) and units where wastes are placed directly on top of the soil surface (e.g., SWMUs #10, #13, #43, #45, and #46, and AOCs C and F) results in the potential for release to soil being considered high.

Air

The overall potential for release to air is considered low due to the nature of SWMUs and AOCs at U.S. Naval Station Roosevelt Roads. Most waste is either not exposed to the atmosphere or the waste being managed is not volatile. Four units were observed to have a high potential for release during the VSI. These units are SWMUs #7, #14, #15, and #19. All four were observed to have release to air during the VSI (Ref. 57). By the nature of the design (i.e., burning), SWMU #14 and #15 cause additional release to air.

Surface Water

The potential for release to surface water is considered high. Surface waters that flow across Roosevelt Roads originate in the Sierra de Luquillo mountains to the west and hilly terrain to the north (Ref. 48). Station flooding is normal during periods of heavy rainfall. This situation has been aggravated by development in the northern town of Cieba. Surface runoff would occur throughout the series of on-site drainage ditches (e.g., SWMU #44), which empty either into the Rio Daquao watershed or into the mangroves that fringe Ensenada Honda, Puerca Bay or Port Medio Mundo (Ref. 48). The high elevation of certain units (e.g., SWMUs #7 and #8) in conjunction with documented release to soil constitutes a high potential for release to surface water. In addition, the presence of shallow groundwater and unlined units immediately adjacent to surface water (SWMUs #1, #2, and #3) suggests the potential for migration to surface water via groundwater. Furthermore, the various mangrove swamps are subject to tidal influence daily. High tides or increased flow from the streams and drainage ditches that terminate in the swamps would increase the migration of contaminants.

Subsurface Gas

The overall potential for generation of subsurface gas is considered low since most of the wastes are managed aboveground. However, a moderate to high potential for generation of subsurface gas exists at the unlined units where general refuse and volatiles were disposed; for example, the unlined solid waste landfills (SWMUs #1 and #3) and SWMUs #7, #8, and #9, which have documented long-term release of fuel and sludge to the soil (Ref. 57). No immediate threat to human health exists in these cases because no units with a high potential for subsurface gas generation are located near populated areas. However, a hazard to human health and safety may exist in the event of subsurface excavation.

7.0 SUMMARY OF CONCLUSIONS AND SUGGESTED FURTHER ACTIONS

The following section is a summary of conclusions and suggestions for further actions for solid waste management units (SWMUs) at U.S. Naval Station Roosevelt Roads, Roosevelt Roads, Puerto Rico. Each SWMU and area of concern (AOC) is evaluated to determine if it represents a potential for release to soil/groundwater, surface water, air, and/or subsurface gas. The PR and VSI phases of the RFA identified 47 SWMUs and 4 additional AOCs. Of these, it was determined that 36 SWMUs and 4 AOCs have a potential for release to one or more environmental pathways or a determination could not be made (as in the case of SWMU #16 and AOC A). The conclusions and further actions for these units are discussed in detail.

The remaining 11 SWMUs were determined to have low/no potential for release to all environmental pathways.

A preliminary assessment of the potential for release from each unit was made based upon information collected during the Preliminary Review (PR) and Visual Site Inspection (VSI). For each unit where suggestions for further action have been made, the potential for release to environmental media (soil/groundwater, surface water, air, and subsurface gas) is assessed. For example, the potential for release was described as high at the units which exhibited visual evidence of contamination, where there was documented release, or where design or operation was considered to potentially allow a release. A moderate potential for release was used to describe units where there may be release during certain operational periods or depending on volume or procedure for handling the waste. A low potential for release was used to describe units located inside buildings, units in good condition, or those which managed very small quantities of waste.

In some cases, it is suggested that further action at a unit be based upon collection of additional information or requirements of the EPA or other entity. These instances are described in the individual SWMU or AOC evaluation provided in this section. In addition, suggestions at several of the units include verification of unit integrity.

1. UNIT NAME: Army Cremator Disposal Site

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is high, since this unit is an unlined landfill. According to the Navy, this unit has been used for the disposal of hazardous wastes (Ref. 52).

Surface Water: Areas of this unit are located directly in the mangrove swamp (Ref. 48) which is subject to flooding by periodic high tides; therefore, the potential for release to surface water is high.

Air: Most of this unit is now covered with dense vegetation; however, in the absence of information regarding the rusty drums noted in the NACIP report (Ref. 48) and the (possibly volatile) oily sheen observed during the VSI, it must be assumed that the potential for release to air is low to moderate.

Subsurface Gas: There is a moderate potential for the release of methane from this unlined landfill. In addition, there is a moderate potential for the release of volatile organics because this unit is unlined and was used for the disposal of trash likely to contain volatile wastes, including gas cylinders, paint cans, and dry cleaning solvent cans.

Suggested Further Action: It is suggested that aerial photographs of this unit (if they exist) be obtained and studied in order to determine the location of the drums observed by the NACIP IAS team (Ref. 48), and that an appropriate geophysical method (e.g., magnotometer, ground penetrating radar) be employed to locate any buried materials that may be present. Soil samples should be taken from each area where drums are found. The area observed by the VSI team to be devoid of vegetation should have soil samples taken from within the barren area itself. In addition, surface water and soil sediment samples should be taken along the edge of the mangroves. Samples should be analyzed to determine the existence of a release of hazardous constituents to the environment.

2. UNIT NAME: Langley Drive Disposal Site

Conclusions: Soil/Groundwater: This unit is an unlined landfill located at the edge of the mangrove swamp. According to the NACIP study, certain areas of the swamp appeared to have been filled in with waste to create new land (Ref. 48). In addition, corroded drums (the contents of which were exposed to the environment) were observed during the VSI. The potential for release to soil/ groundwater is, therefore, high.

Surface Water: The potential for release to surface water is high because this is an unlined unit where waste was used to fill in the swamp (Ref. 48) and where the contents of corroded drums were observed to be exposed to the environment at the time of the VSI.

Air: The potential for release to air is indeterminate until the constituents of the drums have been determined.

Subsurface Gas: The potential for subsurface gas generation can not be determined due to the lack of historical information available regarding specific types of wastes (e.g. those that would be likely to generate subsurface gas) disposed of here.

Suggested Further Action: The Navy documents this unit as having been used for the disposal of hazardous and nonhazardous waste (Ref. 52). It is suggested that the contents of the drums be analyzed to determine the existence of hazardous constituents and then disposed of properly. It is further suggested that an appropriate geophysical method (e.g., magnotometer, ground penetrating radar) be employed to locate any buried wastes that may be present at this unit. Further action should be based upon the results of laboratory analysis and recently gathered geophysical data.

3. UNIT NAME: Station Landfill

Conclusions: Soil/Groundwater: This unit is an unlined landfill. Disposal practices commonly entailed digging to the water table (Ref. 48). This constitutes release to groundwater. Ref. 31a states that the U.S. Geological Survey detected elevated levels of lead and zinc in groundwater at this unit.

Surface Water: This unlined unit is surrounded by surface water, and has a water table very near the surface. The potential for release to surface water is high because of the surrounding surface water and the possibility of subsurface migration.

Air: This unit has a soil cover. Thus, the potential for release to air is low.

Subsurface Gas: There is a moderate potential for the generation of subsurface gas, because volatiles were disposed of at this unit.

Suggested Further Action: This unit has documented release to soil/groundwater and probable release to surface water. It is suggested that an appropriate geophysical method (e.g., magnotometer, ground penetrating radar) be employed to determine the location of wastes buried within the perimeter of this extensive unit. It is further suggested that extensive soil, groundwater, and surface water sampling be employed to determine the existence of a release of hazardous constituents to the environment and to further determine the likelihood of subsurface migration. Further action will be based upon the results of these analyses.

4. UNIT NAME: Drone Fuel Drain Oil/Water Separator

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is dependent upon the integrity of the unit.

Surface Water: Past release to the Sewer Drainage System (SWMU #38) has been documented. This issue is addressed in the Suggested Further Actions for SWMU #38.

Air: The potential for release to air is high because of the type of waste managed at this unit (i.e., jet fuel).

Subsurface Gas: The potential for generation of subsurface gas is dependent upon the integrity of this unit.

Suggested Further Action: It is suggested that the integrity of this unit be tested using a standard method (e.g., visual inspection, pressure testing). Should the unit integrity be found unsatisfactory, soil sampling should be conducted adjacent to this unit. (This may require drilling through concrete). The depth of samples taken should either correspond to the depth of the unit, or progress until there is evidence supporting the existence of a release (e.g., staining). Analyses should include a set of indicator parameters based upon the chemical and physical characteristics of the wastes present at this unit. The documented release to Sewer Drainage System (SWMU #38) is addressed elsewhere in this report.

5. UNIT NAME: Dumpsters

Conclusions: Soil/Groundwater: There is a low potential for release to soil/groundwater because these units are constructed of metal.

Surface Water: These units are metal containers. The potential for release to surface water is low.

Air: Since these units have covers that may occasionally be left open, the potential for release to air could be considered low to moderate.

Subsurface Gas: Since the potential for release to soil/groundwater is low the potential for generating subsurface gas is also low.

Suggested Further Action: Other than continuing to empty these units on schedule in order to avoid a release to the environment through spillage, there is no further action suggested at this time.

6. UNIT NAME: Former Paint Storage (Building 145)

Conclusions: Soil/Groundwater: Because this unit is self-contained, and wastes are no longer being stored at this unit, the potential for releases to the soil or groundwater is low.

Surface Water: Because this unit is self-contained, and wastes are no longer being stored at this unit, the potential for releases to surface water is low.

Air: Although the NACIP study cited release to air, the contents of this building had been removed shortly before the VSI. The potential for release to air is low.

Subsurface Gas: Although this unit contained highly volatile chemicals in the past, no releases to surface water or soil/groundwater have been documented. Also, because this unit is self-contained, the potential for generating subsurface gas is low.

Suggested Further Action: It is suggested that the regulatory status of this unit be determined and that, if not already in progress, formal closure plans be implemented for this unit. Otherwise, no further action is suggested at this time.

7. UNIT NAME: Tow Way Road Fuels Farm

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is high because all of these tanks are underground and several underground leaks have been documented.

Surface Water: Although this unit has earthen retaining walls to contain spills, large volumes of fuel have leaked from Tanks 56A, 56B, and 85, constituting release to surface water.

Air: Release to air was noted during the VSI. The potential for release from spilled fuels is high.

Subsurface Gas: A large volume of volatile organics have been released into the soil from spills and leaking underground storage tanks. This creates a high potential for the generation of subsurface gas. There is no immediate threat to human health because of this unit's location (removed from populated areas of the Naval Station). However, a hazard to human health and safety is probable in the event of subsurface excavation.

Suggested Further Action: It is suggested that all tanks within the boundaries of this unit be subjected to integrity testing (e.g., pressure testing) to determine if there is a need for tank replacement. Soil and groundwater samples should be collected to determine the extent of release. The depth of soil samples taken should either correspond to the depth of the unit or should progress until there is evidence supporting the existence of a release (e.g., staining). Analysis should include a set of indicator parameters based upon the chemical and physical characteristics of the wastes present at this unit. Further action should be based upon these results.

8. <u>UNIT NAME</u>: Tow Way Road Disposal Pits
9. <u>UNIT NAME</u>: Leaded Sludge Pits

<u>Conclusions</u>: <u>Soil/Groundwater</u>: The potential for release to soil/groundwater is high because sludge waste was buried in unlined pits.

<u>Surface Water</u>: The Leaded Sludge Pits (SWMU #9) are located on hillsides at elevations 15 to 45 feet above the adjacent Machos mangrove swamp with slopes from 10% to 40% toward the swamp (Ref. 48). The approximate area of the Tow Way Road Disposal Pits (SWMU #8) was observed to be hilly (Ref. 57). The potential for release to surface water via surface runoff is high.

<u>Air</u>: No release to air was noted during the VSI. The sludge pits are covered with soil, thus, the potential for release to air is low.

<u>Subsurface Gas</u>: There is potential for the generation of subsurface gas due to the semivolatile nature of the waste at this unit.

<u>Suggested Further Action</u>: It is suggested that an appropriate geophysical method (e.g., ground penetrating radar) be employed to locate the pits and that soil and groundwater samples be collected adjacent to each pit. Samples should also be collected at elevations below the pits and all samples analyzed to determine the existence of a release of hazardous constituents and the likelihood of subsurface migration. Further action should be based on these results.

10. UNIT NAME: Transformer Maintenance Area

Conclusions: Soil/Groundwater: An estimated maximum of 3,000 gallons of transformer oil, probably containing PCBs, was poured directly on the soil surrounding this unit. The potential for release to soil/groundwater is high.

Surface Water: Although PCBs are preferentially adsorbed onto soils, their high concentrations in the soil around this unit create a high potential for impacting surface waters via surface runoff erosion.

Air: Transformer oil is not volatile; therefore, there is low potential for release to air.

Subsurface Gas: Transformer oil is not volatile; therefore, there is low potential for subsurface gas generation.

Suggested Further Action: It is suggested that the regulatory status of this unit be determined and that if this unit is not already regulated (e.g., undergoing closure plans or TSCA regulated) the unit should be referred to the appropriate TSCA personnel.

11. UNIT NAME: PCB Storage Compound

Conclusions: Soil/Groundwater: Since this unit is located inside a building and appears to be well contained, the potential for release to soil/groundwater is low.

Surface Water: The potential for release to surface water is low because this is an indoor unit and appears to be well contained.

Air: Because PCBs are not volatile, the potential for release to air is low.

Subsurface Gas: Because PCBs are not volatile and because this unit is located indoors, the potential for subsurface gas generation is low.

Suggested Further Action: It is suggested that the results of the analysis of the spilled materials be obtained to confirm that they are non-PCB. If the spilled materials are, in fact, non-PCB, no further action beyond continuing to comply with TSCA regulations is suggested at this time.

12. UNIT NAME: Fire Training Pit Oil/Water Separator

Conclusions: Soil/Groundwater: Evidence of direct release to soil/groundwater was observed during the VSI (stained curbing, guardrail uprights, and dead vegetation adjacent to this unit).

Surface Water: Although there is the possibility of subsurface migration, this unit is not in close proximity to surface water. Therefore, the potential for release to surface water could be considered moderate.

Air: The potential for release to air is high due to the volatile nature of wastes managed here.

Subsurface Gas: The potential for subsurface gas generation is dependent upon the integrity of this unit.

Suggested Further Actions It is suggested that an automatic overflow control valve be installed on this unit and that the final disposition of wastewater be determined. It is further suggested that soil and groundwater samples be collected in conjunction with sampling for the Fire Training Pit (SWMU #14) in order to determine the existence of release of hazardous constituents to the environment. Further action will be based upon results of analysis.

13. <u>UNIT NAME</u>: Old Pest Control Shop (Building 258 and surrounding area)

<u>Conclusions</u>: <u>Soil/Groundwater</u>: Continual release to the soil in the vicinity of this unit has been documented for a period of nearly 30 years.

<u>Surface Water</u>: Because the drainage ditch behind this unit received excess pesticides and pesticide rinse water, and since this drainage ditch flows into Ensenada Honda, the potential for release to surface water is high.

<u>Air</u>: During the VSI, faint pesticide odors were noted. This constitutes a moderate potential for release to air.

<u>Subsurface Gas</u>: Due to the volatile nature of pesticides and the extent of release to the soil at this unit, there is a moderate potential for the generation of subsurface gas.

<u>Suggested Further Action</u>: It is suggested that extensive soil and groundwater sampling be performed at this unit to determine the existence and nature of release of hazardous constituents to the environment. Areas sampled should include outside near the south side of Building 258 and in and around the ditch that is approximately 40 feet from the building. Analyses should include a set of indicator parameters based upon the physical and chemical characteristics of pesticides stored here in the past. As an interim measure, it is suggested that recreational use of the building be discontinued immediately until sampling results confirm that building's safety. Further action will be based upon these results.

14. UNIT NAME: Fire Training Pit

Conclusions: Soil/Groundwater: Evidence of release to soil/groundwater was observed during the VSI. The potential for release to soil/groundwater is high.

Surface Water: Although this unit is not directly adjacent to surface water, the potential for release to surface water can be considered high due to the action of rainwater (and the resulting surface migration) on the curbing and stained area, both of which displayed evidence of release to soil.

Air: Due to the volatile nature of wastes managed at this unit, the potential for release to air is considered high.

Subsurface Gas: The potential for subsurface gas generation is considered high due to the volatile nature of wastes managed at this unit. There is no immediate threat to human health because of this unit's location (removed from populated areas of the Naval Station). However, a hazard to human health and safety is probable in the event of subsurface excavation.

Suggested Further Actions: It is suggested that soil and groundwater samples be collected in order to determine the existence of release. The samples should be taken at a depth corresponding to either the depth of the unit, or progress until there is evidence supporting the existence of a release (e.g., staining), whichever is deeper. Analysis should include a set of indicator parameters based upon the chemical and physical characteristics of wastes managed at this unit. Further action will be based upon the results of analyses.

15. UNIT NAME: Hospital Incinerator (Building 1928)

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is low due to the self-contained design of this unit and the volume and nature of waste management (i.e., burning small quantities of waste).

Surface Water: There is a low potential for release to surface water due to management design (self-contained chamber) and the manner of disposal (i.e., burning).

Air: This unit is permitted by the Environmental Quality Board to release to air.

Subsurface Gas: There is a low potential for the generation of subsurface gas since no wastes are in contact with soil.

Suggested Further Action: Other than continuing to comply with Environmental Quality Board regulations, no further action is suggested at this time.

16. UNIT NAME: Waste Explosive Storage

Conclusions: No determinations can be made concerning the potential for release to soil/groundwater, surface water, air, and subsurface gas due to the fact that the VSI team was denied access to this unit.

Suggested Further Action: The VSI team was denied access to this unit. No further action can be suggested until information required to make release determinations is obtained.

17. UNIT NAME: DRMO Hazardous Waste Storage Facility

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is low, since the wastes are stored indoors on concrete.

Surface Water: The wastes are stored indoors on concrete, resulting in a low potential for release to surface water.

Air: The potential for release to air is generally considered low; however, it was noted during the VSI that caustics were stored in a bay designated for acids. In the event of spillage and mixing of incompatible wastes, a release to air could occur.

Subsurface Gas: The waste is stored in drums on concrete; thus, the potential for generation of subsurface gas is low.

Suggested Further Action: Caustics were observed to be stored in the acid storage bay during the VSI. Other than continued compliance with RCRA requirements, including proper storage of incompatible wastes, no further action is suggested at this time.

18. UNIT NAME: Ignitable Storage Facility (Building 2009)

Conclusions: Soil/Groundwater: Since this unit is underlain by a curbed concrete pad and is inside a building, the potential for release to soil/groundwater is considered low.

Surface Water: The potential for release to surface water is low because this is an indoor unit underlain by a concrete pad with curbing.

Air: Because this is an indoor unit, the potential for release to air is considered low.

Subsurface Gas: The wastes managed at this unit have no contact with soil. The potential for subsurface gas generation is low.

Suggested Further Actions: Other than continued compliance with RCRA regulations, no further action is suggested at this time.

19. UNIT NAME: Pesticide Waste Storage

Conclusions: Soil/Groundwater: Release to the soil/ groundwater is unknown because visual inspection of the interior of this unit was not possible.

Surface Water: Release to the surface water is unknown as visual inspection was not possible. The strong odor outside this unit suggests release to the floor inside. However, the potential for release to the surface water is unknown. The door to this structure was locked, making an inspection of the integrity of the concrete floor impossible and the area surrounding this unit was overgrown with vegetation, making an inspection of the concrete pad difficult.

Air: As the VSI team approached this building, the smell of pesticides was strong and became overpowering inside the cyclone fence. The potential for release to air is very high at this unit.

Subsurface Gas: The potential for releases as subsurface gas is dependent upon releases into the soil and the volatility of the pesticide. At present, these factors are unknown.

Suggested Further Action: It is suggested that the current regulatory status of this unit be reviewed and the unit inspected to ensure compliance with interim status requirements. Further action will be based upon this information.

20. <u>UNIT NAME</u>: Waste Oil Tank Truck

<u>Conclusions</u>: <u>Soil/Groundwater</u>: This unit is usually parked on the grass at the edge of the yard around Building 860. The potential for release to soil/groundwater is moderate, if a release were to occur.

<u>Surface Water</u>: The potential for release to surface water is low based on distance to nearest surface water.

<u>Air</u>: This unit is enclosed; therefore, the potential for release to air is low.

<u>Subsurface Gas</u>: Because the unit is above-ground the potential for subsurface gas generation is low.

<u>Suggested Further Action</u>: It is suggested that this unit be moved from the grass to the concrete yard of Building 860 and kept there as a routine matter. In the event of a spill, the waste oil can be washed into the Drone Fuel Drain Oil/Water Separator (SWMU #4). Otherwise, no further action is suggested at this time.

21. UNIT NAME: Donuts (#1 - #4)

22. UNIT NAME: Ships Waste Offload Barges (#1 and #2)

Conclusions: Soil/Groundwater: These units are located in the ocean. The potential for release to soil/groundwater is considered low.

Surface Water: The potential for release to surface water is dependent upon the integrity of these units.

Air: Due to the fact that these units are contained, the potential for release to air is low.

Subsurface Gas: Since release from these units would not reach soil/groundwater, the potential for the generation of subsurface gas must be considered low.

Suggested Further Action: It is suggested that these units be tested for integrity (e.g., visual inspection, pressure testing) and repaired or replaced accordingly. Otherwise, no further action is suggested at this time.

23. UNIT NAME: Oil Spill Separator Tanks

Conclusions: Soil/Groundwater: Base on the extent of the stains observed during the VSI, release of waste oil from secondary containment to the asphalt appeared to be fairly common. The potential for release to soil/groundwater is high.

Surface Water: Since this unit is approximately 100 feet inshore from the dock, the potential for release to surface water is moderate to high.

Air: Due to the volatile characteristics of the waste managed, the potential for release to air is moderate to high.

Subsurface Gas: The potential for subsurface gas generation is moderate to high due to the volatile nature of wastes managed by this unit.

Suggested Further Action: It is suggested that soil samples be taken from the area showing evidence of a visible drainage path in order to determine the existence of release. It is also suggested that the concrete pad and curbing be replaced with one sufficient to contain the entire contents of the tanks in the event of a rupture or leak. Further action will be based upon the results of analysis.

24. UNIT NAME: Oil Spill Oil/Water Separator

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is dependent upon the integrity of this unit.

Surface Water: Due to this unit's location (i.e., approximately 100 feet from the dock), the potential for release to surface could be considered moderate to high, depending upon whether or not this unit has overflow controls and whether or not they work.

Air: The potential for release to air is moderate to high because this unit is open at ground level and the nature of wastes managed here.

Subsurface Gas: The potential for subsurface gas generation is dependent upon the potential for release to soil.

Suggested Further Actions: It is suggested that this unit be subjected to integrity testing to determine the likelihood of release to the environment. It is also suggested that the existence and integrity of an overflow control device be verified. Further action will be based upon these findings.

25. UNIT NAME: Past DRMO Hazardous Waste Storage

Conclusions: Soil/Groundwater: Visual evidence suggesting past release to soil/groundwater (i.e., stained gravel) was observed at the time of the VSI.

Surface Water: Since there is evidence suggesting release to soil/groundwater and the distance the surface water is approximately 500 to 1,000 feet (Figure 1), there is a moderate potential for release to surface water.

Air: Since this unit has had no recent releases and the spill areas observed visually are relatively minor, the potential for release to air could be considered low.

Subsurface Gas: The potential for subsurface gas generation can not be determined until the nature of release (i.e., whether volatiles are present) is determined.

Suggested Further Actions: Soil sampling in areas of staining should be conducted to determine if there has been release of hazardous constituents to the environment. Sampling should be done in conjunction with closure activities for this unit.

26. UNIT NAME: Abandoned Engine Oil Drums

Conclusions: Soil/Groundwater: Release to soil was observed during the VSI.

Surface Water: The potential for release to surface water is moderate. This unit is not directly adjacent to any body of water, but contaminants could reach surface water through subsurface migration.

Air: There is a moderate potential for release to air for this unit. The contents of the drums were exposed to the environment, but no odor was present. The leaking contents had a tar-like appearance, and at least one of the drums was labeled as engine oil, which is not volatile.

Subsurface Gas: Since volatile constituents were not confirmed at this site, the observed releases to soil warrant a moderate release potential to subsurface gas.

Suggested Further Action: It is suggested that the contents of the drums be determined. The drums should be disposed of in a manner that is appropriate regarding the physical and chemical characteristics of their contents. Soil sampling in the areas where release has occurred may be necessary to determine the potential harm to human health and the environment. Further action will be based on these determinations.

27. UNIT NAME: Capehart Area Wastewater Plant
28. UNIT NAME: Bundy Area Wastewater Plant
29. UNIT NAME: Industrial Area Wastewater Plant

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is dependent upon the structural integrity of these units.

Surface Water: These units are designed to release to surface water; however, the existence of hazardous constituents in the effluent is likely for SWMUs #28 and #29 because they are located near industrial operations.

Air: The potential for release to air is low for SWMUs #28 and #29 because virtually all the raw sewage was contained. It is likely that SWMU #27 is of similar construction.

Subsurface Gas: The potential for generation of subsurface gas is dependent upon the structural integrity of these units.

Suggested Further Actions: It is suggested that each of these units be tested for structural integrity of its component parts. There has been no determination made regarding the Sewer Drainage System (SWMU #38) and the nature of constituents that flow through it. It is therefore suggested that soil or surface water samples be collected near the outfall of each of these units to determine the potential for the release of hazardous constituents. Further action will be based upon the results of integrity testing, sample analyses, and whether each of these units will be able to come into compliance with NPDES regulations.

30. UNIT NAME: Former Incinerator Site

Conclusions: Soil/Groundwater and Surface Water: Based on the design of the unit and on information regarding the operation of the unit during the active life of the unit, there is a low potential for release to soil/groundwater and to surface water.

Air: This unit was designed to release to the atmosphere when active. However, because the unit is inactive and has been dismantled, there is a low potential for on-going releases to air.

Subsurface Gas: There is a low potential for subsurface gas generation based on the above-ground design of the unit.

Suggested Further Action: No further action is suggested at this time.

31. UNIT NAME: Waste Oil Collection Area (PWD Storage Yard)

Conclusions: Soil/Groundwater: Since the wastes are contained in closed 55-gallon drums and enclosed in a secondary containment structure, there is a low potential for release to soil/groundwater.

Surface Water: The potential for release to surface water is low because a relatively small volume of waste is involved, the unit is surrounded by an asphalt lot, and the wastes are contained in closed 55-gallon drums within a secondary containment structure.

Air: Since the wastes are contained in closed 55-gallon drums, the potential for release to air is low.

Subsurface Gas: Since the wastes are contained in closed 55-gallon drums, the potential for the generation of subsurface gas is low.

Suggested Further Action: Other than repairing the drain valve, there is no further action suggested at this time.

32. UNIT NAME: Battery Collection Area (PWD Storage Yard)

Conclusions: Soil/Groundwater: Since no leaking batteries were observed and this unit is located on asphalt, the potential for release to soil/groundwater is low.

Surface Water: Since no stains or leaking batteries were observed and this unit is located on asphalt, there is little potential for release to surface water.

Air: The potential for release to air is negligible since the batteries are sealed.

Subsurface Gas: The potential for the generation of subsurface gas is low, since the batteries are not leaking and the unit is located on asphalt.

Suggested Further Action: It is suggested that the facility remove and properly dispose of or recycle the batteries. In addition, it is suggested that the facility provide a designated battery storage area, designed to ensure that releases to environmental pathways do not occur.

33. UNIT NAME: AIMD Hazardous Waste Storage Pad

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is low since the wastes are stored in drums on concrete with secondary containment curbs. An unidentified white powder was observed on the soil adjacent to the unit during the VSI.

Surface Water: The wastes are stored in drums on concrete; thus, the potential for release to surface water is low.

Air: The wastes are stored in drums; therefore, the potential for release to air is low. Particulate release, however, may occur from unmanaged areas such as the area of white powder observed during the VSI.

Subsurface Gas: The wastes are stored in drums on concrete; therefore, the potential for generation of subsurface gas is considered low.

Suggested Further Action: It is suggested that the white powder observed during the VSI be sampled, characterized, and removed, and that future management practices prevent release from this unit.

34. UNIT NAME: VC-8 Waste Storage Pad

Conclusions: Soil/Groundwater: There is a moderate potential for release to soil/groundwater, because this unit has a manual overflow control valve, which must be opened during heavy rainfall.

Surface Water: There is a moderate potential for release to surface water due to surface runoff.

Air: There is a moderate potential for release to air due to the volatile nature of these wastes.

Subsurface Gas: There is a moderate potential for subsurface gas generation due to the fact that wastes come in contact with the soil during heavy rainfall and due to the type of wastes managed at this unit.

Suggested Further Action: It is suggest that Naval personnel build a cover for this unit to keep rainwater from flooding the concrete pad underlying this unit. Otherwise, no further action is suggested at this time.

35. UNIT NAME: Aircraft Wash Rack Oil/Water Separator
36. UNIT NAME: Vehicle Wash Rack Oil/Water Separator

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is dependent upon the structural integrity of these units.

Surface Water: No evidence of overflow was observed during the VSI. The potential for release to surface water is low.

Air: The potential for release to air is moderate due to the nature of wastes managed at these units.

Subsurface Gas: The potential for subsurface gas generation is dependent upon the release to soil/groundwater. If there has been release to soil/groundwater, the potential for generation of subsurface gas is moderate.

Suggested Further Action: It is suggested that these units be subjected to integrity testing to determine the likelihood of release to soil/groundwater, surface water, and the generation of subsurface gas. Further actions will be based upon the integrity of these units.

37. UNIT NAME: Waste Oil Drum Storage Area (near Hangar 200)

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is generally considered low to moderate, since waste oil and gasoline are stored in drums on a concrete pad with no curbing. An area of stained soil and stressed vegetation was observed adjacent to the unit during the VSI, however.

Surface Water: The waste is stored in drums over a concrete pad with no curbing. The potential for release to surface water is considered moderate.

Air: The unit is used for storage of waste oil and gasoline in drums; therefore, the potential for release to air is considered low.

Subsurface Gas: The unit is used for storage of waste oil and gasoline in drums on a concrete pad with no curbing. The potential for generation of subsurface gas is moderate.

Suggested Further Action: It is suggested that the area of stained soil and stressed vegetation be sampled to determine the existence of release of hazardous constituents to the environment and that management practices (including the addition of curbing) prevent such releases in the future. Further action will be based upon this determination.

38. UNIT NAME: Sewer Drainage System

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is dependent upon the structural integrity of the sewer system, which could not be determined during this RFA.

Surface Water: The potential for release to surface water is dependent upon the structural integrity of this unit, which could not be determined during this RFA.

Air: There is a low potential for release to air due to the underground design of this system.

Subsurface Gas: The potential for generating subsurface gas is dependent upon the structural integrity of this unit, which could not be determined during this RFA.

Suggested Further Action: The Sewer Drainage System consists of the sanitary and storm sewer systems. It is suggested that the relative interdependence and integrity of these systems be determined. Based upon the results of integrity testing, soil sampling may be warranted to determine if hazardous constituents have been released to the environment. Soil samples should be collected from those points along the sewer system where there is leaking or cracking. Analytical parameters should include fractions of Appendix VIII hazardous constituents (e.g., metals, volatiles, and semivolatiles), based upon the hazardous constituents in the facility wastewaters.

39. UNIT NAME: Spent Battery Storage Building (Building 3158)

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is considered high, since visible cracks and stains were observed in the concrete containment pad.

Surface Water: The potential for release to surface water considered moderate due to the possibility of subsurface migration.

Air: The wastes are spent batteries and battery acid; therefore, the potential for release to air is considered low.

Subsurface Gas: The potential for generation of subsurface gas is considered low because battery acid is not volatile.

Suggested Further Action: Soil samples should be collected adjacent to and through the pad to determine the nature and extent of release. The sampling effort should include collection of soil samples, with analysis for pH, to a depth of approximately two feet or until visible contamination is observed. In addition, it is further suggested that cracks in the concrete pad be repaired to prevent future release to soil.

40. <u>UNIT NAME</u>: Seabee Oil Collection Area

Conclusions: Soil/Groundwater: Stained gravel was observed directly below the mobile storage tank, indicating a direct release to soil.

Surface Water: Surface water is approximately a 1/4 mile from this unit. The potential for release to surface water is moderate.

Air: The potential for release to air could generally be considered low since the tank is a contained unit.

Subsurface Gas: Due to the nonvolatile nature of lubricating oil, the potential for subsurface gas generation is considered low.

Suggested Further Action: It is suggested that soil samples be collected beneath the mobile storage tank. Analysis should include a set of indicator parameters based upon the chemical and physical characteristics of the wastes managed by this unit. It is further suggested that a covered concrete pad with curbing be built for the mobile tank. Further actions will be based upon the results of analysis.

41. UNIT NAME: Rinse Rack near Seabee Pesticide Storage

Conclusions: Soil/Groundwater: This unit is made of concrete (at surface level at least) and appears to be in very good condition. The potential for release to soil/groundwater is therefore considered low.

Surface Water: Since the point of ultimate discharge has not been determined for this unit, the potential for release to surface water can not be assessed.

Air: At the time of the VSI, no pesticides had been applied for several months. However, during the time of pesticide application, the potential for release to air is moderate to high.

Subsurface Gas: The potential for subsurface gas generation is considered low since the potential release to soil/groundwater appears to be considered low.

Suggested Further Action: This unit was not in use at the time of the VSI. The point of ultimate discharge of wastes from this unit should be determined and evaluated in conjunction with further information regarding the disposal of excess pesticides (i.e., whether they are sent to DRMO or drained at this unit). Further action will be based upon these determinations.

42. UNIT NAME: Water Treatment Plant Sludge Lagoons

Conclusions: Soil/Groundwater: These units do not manage hazardous wastes, therefore, the potential for release of hazardous wastes or hazardous constituents to soil/groundwater is low.

Surface Water: Although once a year the gates to these units are opened and sludge is discharged to surface water, no hazardous constituents are managed by these units. The potential for release of hazardous constituents to surface water is low.

Air: The potential for release to air is considered low, since no volatiles are managed by this unit.

Subsurface Gas: There are no volatiles or organics managed by this unit. There is a low potential for subsurface gas generation.

Suggested Further Action: Raw water is supplied by mountain rainwater from the Rio Blanco River several miles west of the Naval Station. The sludge that remains after processing consists of river mud containing aluminum sulfide for clarification and lime for pH control. The VSI team had no reason to suspect that any product or waste at this unit contained hazardous constituents; therefore, no further action is suggested at this time.

43. UNIT NAME: Drone Washdown Area

Conclusions: Soil/Groundwater: This unit is designed to release to soil/groundwater. Past release of hazardous constituents to soil/groundwater has been documented.

Surface Water: Surface water generally flows northeast in the northern part of the Naval Station. There has been documented release to soil/groundwater. The potential for release to surface water and subsurface migration is high.

Air: Although jet fuel is highly volatile, release of jet fuel to soil/groundwater has not been documented for over 10 years. The potential for release of hazardous constituents to air could be considered low.

Subsurface Gas: The potential for subsurface gas generation in this immediate location is low because this unit is concrete lined. Wastes discharged from this unit have an affect upon the Aerial Target Systems Drainage Ditch (SWMU #44) and are addressed in the Suggested Further Actions for SWMU #44.

Suggested Further Actions: Due to the fact that release of hazardous constituents from this unit has not been documented for at least 10 years and because the ditch that received discharge of hazardous constituents is addressed as SWMU #44, no further action action is suggested at this time.

44. UNIT NAME: Aerial Target Systems Drainage Ditch

Conclusions: Soil/Groundwater: Visual evidence of release to soil/groundwater was observed during the VSI.

Surface Water: This unit has received discharge of hazardous constituents from the Drone Washdown Area (SWMU #43) in the past (Ref. 48), in addition to probable release from the adjacent fuel and chemical storage pad. Surface water in the northern part of the Naval Station flows northeast into the mangroves; therefore, the potential for release to surface water is moderate to high due to surface drainage.

Air: Due to the volatile nature of wastes managed by this unit, there is a high potential for release to air.

Subsurface Gas: Due to the nature of wastes managed by this unit (e.g., contaminated JP-4 and JP-5 from SWMU #43, rust preventive and solvents from the adjacent fuel and chemical storage pad), the potential for subsurface gas generation is high. There is no immediate threat to human health because this unit is not located in a highly populated section of the base. However, in the event of soil excavation, a hazard to human health and safety may exist.

Suggested Further Actions: It is suggested that soil samples be collected from both the area immediately around the dead vegetation, and at least 10 to 15 feet further north in the drainage ditch. Indicator parameters should include a set of parameters appropriate for the types of waste managed by this unit in order to determine the existence of release to the environment. Further action will be based upon these results.

45. UNIT NAME: PCB Spill Area

Conclusions: Soil/Groundwater: There has been documented release to soil/groundwater.

Surface Water: The potential for release to surface water is high due to erosion and subsurface migration along the Old Power Plant cooling water outlet.

Air: Due to the fact that transformer oil is generally not volatile, and maintenance was reportedly discontinued over 20 years ago, the potential for release to air could be considered low.

Subsurface Gas: Since transformer oil is not volatile, the potential for generating subsurface gas is low.

Suggested Further Action: It is suggested that soil samples be collected from stained areas within the area constituting the PCB Spill Area and that surface water samples be taken at the old cooling water outlet on the Enlisted Beach. Parameters for analysis will include an indicator parameter appropriate for the wastes managed (i.e., transformer oil matrix). It is also suggested that the PCB issue be addressed by referring this unit to TSCA. Further action will be based upon the results of analysis.

46. UNIT NAME: Pole Storage Yard

Conclusions: Soil/Groundwater: There has been documented release to soil/groundwater.

Surface Water: The potential for release to surface water is moderate to high due to the close proximity to surface water and the action of erosion.

Air: Since transformer oil is not volatile, the potential for release to air is low.

Subsurface Gas: The potential for subsurface gas generation is low because transformer oil is not volatile.

Suggested Further Actions: It is suggested that a determination be made regarding the previous location of transformers and 55-gallon drums stored within the Pole Storage Yard. Once these areas are located, it is suggested that soil samples be collected and analysis be performed using indicator parameters capable of characterizing the nature and existence of release to the environment. Further action will be based upon these results.

47. UNIT NAME: Local Disposal Areas

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is dependent upon the exact location of disposal areas and composition of disposed materials.

Surface Water: The potential for release to surface water is dependent upon the exact location of disposal areas and composition of disposed materials.

Air: The potential for release to air is dependent upon the exact location of disposal areas and composition of disposed materials.

Subsurface Gas: The potential for generating subsurface gas is dependent upon the exact location of disposal areas and composition of disposed materials.

Suggested Further Action: It is suggested that the facility implement a survey to determine the location of all satellite disposal areas and general refuse accumulation areas. If it is suspected that hazardous constituents are being released at any of these areas, then appropriate sampling (e.g., soil, sediment, groundwater, surface water) is suggested at local areas to determine if there has been a release of hazardous constituents to the environment.

A. <u>AREA OF CONCERN NAME</u>: Torpedo Shop (Building 394)

<u>Conclusions</u>: <u>Soil/Groundwater</u>: Activities at this unit are conducted inside the building; however, the potential for release to soil/groundwater is uncertain, since visual inspection of the unit was not allowed.

<u>Surface Water</u>: Activities are apparently conducted inside a building resulting in a low potential for release to surface water.

<u>Air</u>: Volatile emissions may occur from the waste products, such as waste fuel and solvents, generated at this unit.

<u>Subsurface Gas</u>: The potential for generation of subsurface gas is uncertain, since visual inspection of the unit was not allowed.

<u>Suggested Further Action</u>: Further action should be suggested after additional information is obtained to determine the manner in which wastes are generated, stored and disposed.

B. AREA OF CONCERN NAME: Former PWD Storage Area

Conclusions: Soil/Groundwater: The potential for release to soil/groundwater is dependent upon the existence of hazardous constituents in the waste.

Surface Water: The potential for release is dependent upon the existence of hazardous constituents in the waste.

Air: The potential for release to air is dependent upon the existence of hazardous constituents in the waste.

Subsurface Gas: The potential for release is dependent upon the existence of hazardous constituents in the waste.

Suggested Further Action: It is suggested that this unit be cleared of vegetative cover and an inventory be made regarding general type, amount and location of wastes currently stored here. Public Works Department records should be reviewed to determine type, amount and, if possible, location of wastes stored here in the past. Further action will be based upon this information.

C. AREA OF CONCERN NAME: Transformer Storage Area

Conclusions: Soil/Groundwater: During the VSI, release to soil/groundwater was observed.

Surface Water: This unit is near surface water. The potential for release to surface water is high due to surface drainage.

Air: Since transformer oil is not volatile, the potential for release to air is low.

Subsurface Gas: Transformer oil is not volatile, so although there has been release to soil, the potential for generating subsurface gas is low.

Suggested Further Action: It is suggested that soil samples be collected from each pad. Analysis should include an indicator parameter appropriate for the wastes managed (i.e., transformer oil matrix). Further action should be based upon these results.

D. AREA OF CONCERN NAME: Naval Station Outfalls

Conclusions: Soil/Groundwater: Dilution is usually so great at the point of discharge to surface water, that release to soil/groundwater could be considered low.

Surface Water: Naval Station Outfalls discharge directly to surface water; therefore, the potential for release to surface water is high.

Air: Dilution is usually so great that the potential for release to air could be considered low.

Subsurface Gas: Due to the low potential for release to soil/groundwater, the potential for generating subsurface gas is low.

Suggested Further Actions: It is suggested that the facility implement a survey to determine the location of all outfalls at the Roosevelt Roads facility and the nature of the effluent being discharged at each of the outfalls. If it is suspected that hazardous constituents are being released at any outfall, then sampling (e.g. effluent and sediment) is suggested at the outfall discharge point to determine if there has been a release of hazardous constituents to the environment.

8.0 REFERENCES

Correspondence

1. To Flor del Valle, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division. February 10, 1988.
Topic: Late manifests; error in one manifest.

2. To: U.S. Naval Station From: Earth Industrial Waste Management, Inc. December 20, 1988.
Topic: Reconciliation of discrepancy addressed in reference 1.

3. To: Flor del Valle, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. February 10, 1988.
Topic: Manifest delivered to wrong location.

4. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. January 29, 1988.
Topic: Submitting manifests.

5. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. January 29, 1988.
Topic: Submitting a manifest.

6. To: Fred May, Underwood Industry, From: Felix Mestey, Environmental Quality Board PWD. January 21, 1988.
Topic: Signatures required on changed manifests.

7. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. January 12, 1988.
Topic: Submitting manifests.

8. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. January 15, 1988.
Topic: Submitting manifest.

9. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. January 15, 1988.
Topic: Submitting manifests.

10. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. January 15, 1988.
Topic: Submitting manifests.

11. To:Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. January 8, 1988.
Topic: Submitting manifest.

12. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. November 24, 1988.
Topic: Submitting manifests.

13. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. November 12, 1988.
    Topic: Late manifests.

14. Felix Mestey, Environmental Engineering Division PWD, From: Conrad Simon, Air and Waste Management Division EPA. October 23, 1988.
    Topic: Part B Permit Application Submission Request.

15. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. September 4, 1988.
    Topic: Submitting manifests.

16. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. August 13, 1988.
    Topic: Submitting manifests.

17. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. June 30, 1988.
    Topic: Submitting manifests.

18. To: Felix Mestey, Environmental Engineering Division PWD, From: Conrad Simon, Air and Waste Management Division EPA. June 30, 1988.
    Topic: RCRA "Notice of Violation and Compliance Demand".

19. To: Carlos Vazquez, Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. June 1, 1988.
    Topic: Submitting manifests.

20. To: Santos Rohena Betancourt, Puerto Rico Environmental Quality Board, From: Felix Mestey, Environmental Engineering Division PWD. December 8, 1986.
    Topic: Tank 85 spill status report with message reports and JP-5 Fuel Specification

21. To: Environmental Quality Board From: Felix Mestey, Environmental Engineering Division PWD. March 18, 1988.
    Topic: Submitting manifest with explanation for delay of another manifest.

22. To: William A. Beimborn, NUS Corporation, From: Allen Zack, Assistant District Chief, Caribbean District. March 25, 1988.
    Topic: Well Schedules on Vieques Island.

<u>Inspections</u>

23. PCB Inspection: Roosevelt Roads Naval Station, Ceiba, Puerto Rico. September 29, 1987.

24a. Federal Inspection of U.S. Naval Station, Roosevelt Roads, Ceiba. September 9 through 24, 1985.

24b. Requirement of Information through Section 114 of Title I of the CAA (as amended). November 13, 1985.

25a. Summary of Observations Made During Full RCRA Interim Status Inspection. September 29, 1981.

25b. Enforcement File, Compliance Record for U.S. NAVSTA Roosevelt Roads, Ceiba, Puerto Rico.

25c. Enforcement File, Compliance Record for Naval Ammunition Facility, Vieques Island.

Files

26. Trip Report for Site Visit to Roosevelt Roads and Vieques Island William Beimborn, Environmental Scientist, NUS Corporation. March 26, 1986.

27. Telecon Note between Marc Weitzel, Roosevelt Roads Land and Natural Resources Manager, U.S. F&WS and William Beimborn, Environmental Scientist, NUS Corporation concerning endangered species. March 24, 1986.

28. U.S. Naval Station Roosevelt Roads - Site A. William Beimborn, Environmental Scientist, NUS Corporation. April 21, 1986.

29. U.S. Naval Station Roosevelt Roads - Site B. William Beimborn, Environmental Scientist, NUS Corporation. April 8, 1986.

30. RCRA & NPDES Permit Review for Main Base and Vieques Island. William Beimborn, Environmental Scientist, NUS Corporation. June 4, 1986.

QA Review Draft; Final Version

31a. U.S. Naval Station Roosevelt Roads (Site A), Ceiba, Puerto Rico. William Beimborn, Environmental Scientist, NUS Corporation. September 12, 1986.

31b. Documentation for Hazard Ranking System (Site A). William Beimborn, Environmental Scientist, NUS Corporation. September 12, 1986.

32a. U.S. Naval Station Roosevelt Roads (Site B), Vieques Island, Puerto Rico. William Beimborn, Environmental Scientist, NUS Corporation. August 27, 1986.

32b. Documentation for Hazard Ranking System (Site B). William Beimborn, Environmental Scientist, NUS Corporation. August 27, 1986.

Environmental Assessment

33. EPA Environmental Evaluation Report on Emission Sources at U.S. Naval Station Roosevelt Roads, Ceiba, Puerto Rico. December 15, 1983.

34. EPA Environmental Evaluation Report on Emission Sources at Former Ramey AFB, USCG Base Borinquen, Aquadilla, PR. January 24, 1985.

35. Hazard Ranking System Scoring Summary for Naval Station Roosevelt Roads Main Base. William Beimborn, Environmental Scientist, NUS Corporation. September 11, 1986.

36. Hazard Ranking System Scoring Summary for Naval Station Roosevelt Roads (Site B). William Beimborn, Environmental Scientist, NUS Corporation. August 8, 1986.

37. Water Quality Sampling and Analysis at the Roosevelt Roads Solid Waste Disposal Site. Jose Raul Diaz, Caribbean District, WRD. September 9, 1975.

38. Hazardous Waste Inventory. USCG Base Borinquen, Puerto Rico.

<u>Documents</u>

39. Dangerous Properties of Industrial Materials, N. Irving Sax.

40. Public Water Supplies in Puerto Rico. 1983. U.S. Geological Survey, Open-File Data Report 84-126. F. Gomez-Gomez, F. Quinones, M. Lopez.

41. Soil Survey of Humacao Area of Eastern Puerto Rico. U.S. Soil Conservation Service in cooperation with the University of Puerto Rico.

42. Summary Appraisals of the Nation's Ground-Water Resources: Caribbean Region Geological Survey Professional Paper 813-U

43. Uncontrolled Hazardous Waste Site Ranking System. A User's Manual.

<u>Maps</u>

44. Photocopy of Hydrogeologic Map of Puerto Rico and Adjacent Islands.

45. Hydrogeologic Map of Puerto Rico and Adjacent Islands.

46. Topographic Map of NAF Vieques.

47. Location Map of NAF Vieques.

<u>Other Sources</u>

48. Initial Assessment Study of Naval Station Roosevelt Roads, Puerto Rico Naval Energy and Environmental Support Activity (NEESA) 13-051. September 1984.

49. Hazardous Waste Permit Application. Parts A and B for Naval Station Roosevelt Roads, Roosevelt Roads, Puerto Rico. Prepared for Atlantic Division Naval Engineering Command. April 1988.

50. Scope of Work, Study for Elimination of NPDES Violations at the U.S. Naval Station Roosevelt Roads. Undated.

51. Collection Schedule for Dumpsters at Naval Station Roosevelt Roads.

52. General Facility Information. National Survey of Hazardous Waste Generators. Questionnaire GA by U.S. EPA.

53. Blueprint Map of U.S. Naval Station Roosevelt Roads, PR. Revised by C. Nieves, April 11, 1986.

54. United States Geological Survey. Puerto Rico E Islas Limitrofes. 1952.

55. America - A Narrative History. Volume Two, Second Edition. George Brown Tindall. 1988. p. 932.

56. Hazardous Waste Management Plan for NAVSTA, Roosevelt Roads.

57. VSI Field Notes Recorded August 15 through August 29, 1988.

ATTACHMENT A

PHOTOGRAPH LOG

LIST OF PHOTOGRAPHS FROM VISUAL SITE INSPECTION
CONDUCTED AUGUST 15 TO AUGUST 22, 1988
NAVAL STATION ROOSEVELT ROADS, CIEBA, PUERTO RICO

The VSI team failed to photograph several SWMUs and AOCs. These areas were not specifically considered individual SWMUs and AOCs until after the VSI.

Photo 1. View of dead vegetation in mangrove swamp in the general vicinity of the Army Cremator Disposal Site (SWMU #1).

Photo 2. Area devoid of vegetation within the mangrove swamp in the general vicinity of the Army Cremator Disposal Site (SWMU #1).

Photo 3. Abandoned and corroded drums at the Langley Drive Disposal Site (SWMU #2).

Photo 4. View of inactive portion of the Station Landfill (SWMU #3). Area in picture is capped with temporary cover and volunteer vegetation.

Photo 5. View of fiberglass drum and liner at the Station Landfill (SWMU #3).

Photo 6. View of Drone Fuel Drain Oil/Water Separator (SWMU #4) located adjacent to Building 860.

Photo 7. Inside view of Former Paint Storage (SWMU #6) (Building 145). The floor is covered with standing water.

Photo 8. Northeast view of oily sludge near Tank 83 of the Tow Way Road Fuels Farm (SWMU #7).

Photo 9. Northwest view of Tank 83 of the Tow Way Road Fuel Farm (SWMU #7). Dead vegetation is evidence of recent spill of JP-5 fuel.

Photo 10. Transformer Maintenance Area (SWMU #10) behind Building 90. Note oil stains on concrete pad and lack of curbing around the pad.

Photo 11. PCB Storage Compound (SWMU #11) located inside Building 38.

Photo 12. View facing west of Fire Training Pit Oil/Water Separator (SWMU #12) linked to the fire training pit. The oil stains on the curbing and guardrail uprights are evidence of a recent wastewater overflow from this unit.

Photo 13. View of the Old Pest Control Shop (SWMU #13, Building 258). The building, facing northwest in this photograph, has been remodeled and is now used to house the Las Croabas Dive Club.

Photo 14. View of Fire Training Pit (SWMU #14). Note the oil stained ground surrounding the pit in the center of the photo.

Photo 15. North view of the Hospital Incinerator (SWMU #15).

Photo 16. View of one of four bays used to store hazardous wastes in the DRMO Hazardous Waste Storage Facility (SWMU #17, Building 1973).

Photo 17. View of Ignitable Storage Facility (SWMU #18, Building 2009).

Photo 18. West view of Pesticide Waste Storage (SWMU #19, Building 121).

Photo 19. Waste Oil Tank Truck (SWMU #20), located near Building 860.

Photo 20. Three Oil-Spill Separator Tanks which are part of the Oil Spill Removal System (SWMU #23).

Photo 21. View of Past DRMO Hazardous Waste Storage (SWMU #25). Note the stained gravel adjacent to the blue drums.

Photo 22. Northwest view of Abandoned Engine Oil Drums (SWMU #26) located behind Building 544.

Photo 23. View of sludge drying beds which are part of the Capehart Area Wastewater Treatment Plant (SWMU #27).

Photo 24. East-facing view of primary clarifiers and anaerobic sludge digestion tank at the Bundy Area Wastewater Treatment Plant (SWMU #28).

Photo 25. Gravity-operated trickling filter beds at the Industrial Area Wastewater Treatment Plant (SWMU #29).

Photo 26. East view of the Former Incinerator Site (SWMU #30) located near the entrance to the Station Landfill.

Photo 27. View of empty Waste Oil Collection Area (SWMU #31) located in the Public Works Department storage yard (Building 31). Note the deteriorated curbing around this unit.

Photo 28. Battery Collection Area (SWMU #32) located in the Public Works Department Storage Yard (Building 31).

Photo 29. AIMD Hazardous Waste Storage Pad (SWMU #33) for the Aircraft Intermediate Maintenance Department.

Photo 30. VC-8 Waste Storage Pad (SWMU #34) adjacent to VC-8 hangar.

Photo 31. View of Aircraft Wash Rack Oil-Water Separator (SWMU #35) located near the VC-8 hangar.

Photo 32. View of Vehicle Wash Rack Oil/Water Separator (SWMU #36) located near the berthing pier. The below ground oil-water separator is located to the right of the wash rack.

Photo 33. Waste Oil Drum Storage Area (SWMU #37) adjacent to Hangar 200.

Photo 34. East view of Building 3158, the Spent Battery Storage Building (SWMU #39) located within the Seabee compound.

Photo 35. View facing north of Seabee Oil Collection Area (SWMU #40) within the Seabee Compound. Mobile storage tank is on the right. Drum storage pad is on the left.

Photo 36. View of Building 3152 and the Rinse Rack near Seabee Pesticide Storage (SWMU #41).

Photo 37. View facing north of Water Treatment Plant Sludge Lagoon (SWMU #42).

Photo 38. View facing southwest of Water Treatment Plant Sludge Lagoon (SWMU #42).

Photo 39. Steel-grated drain used as a Drone Washdown Area (SWMU #43). Location is adjacent to Building 860.

Photo 40. View of Aerial Target Systems Drainage Ditch (SWMU #44).

Photo 41. View of general vicinity of PCB Spill Area (SWMU #45).

Photo 42. Telephone poles at Pole Storage Yard (SWMU #46).

Photo 43. View of Transformer Storage Area (AOC C) located near Building 2042.


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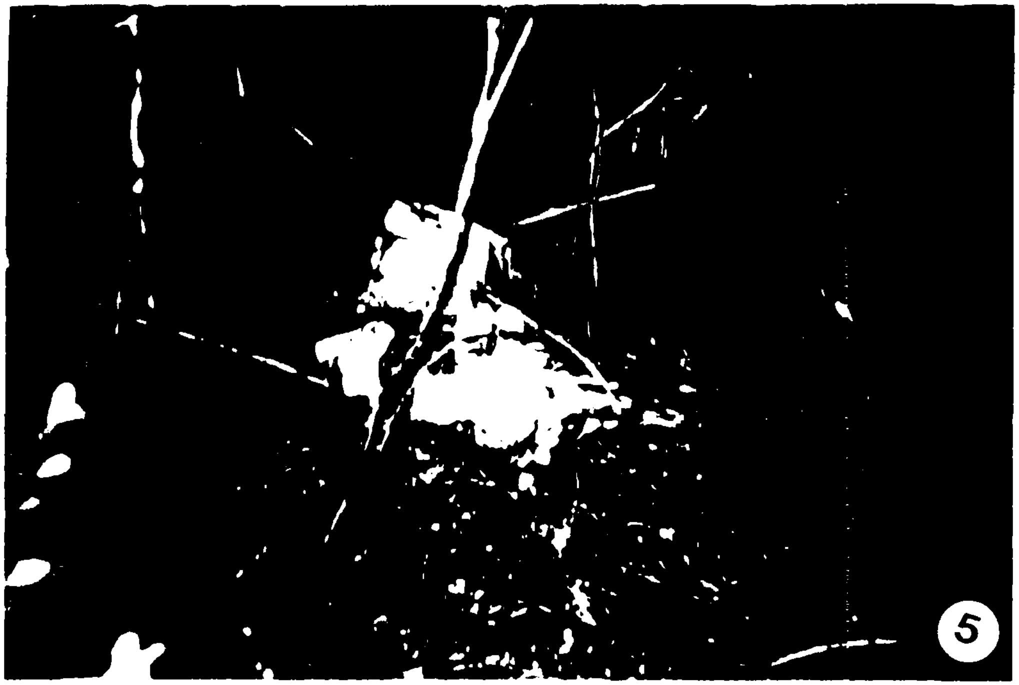
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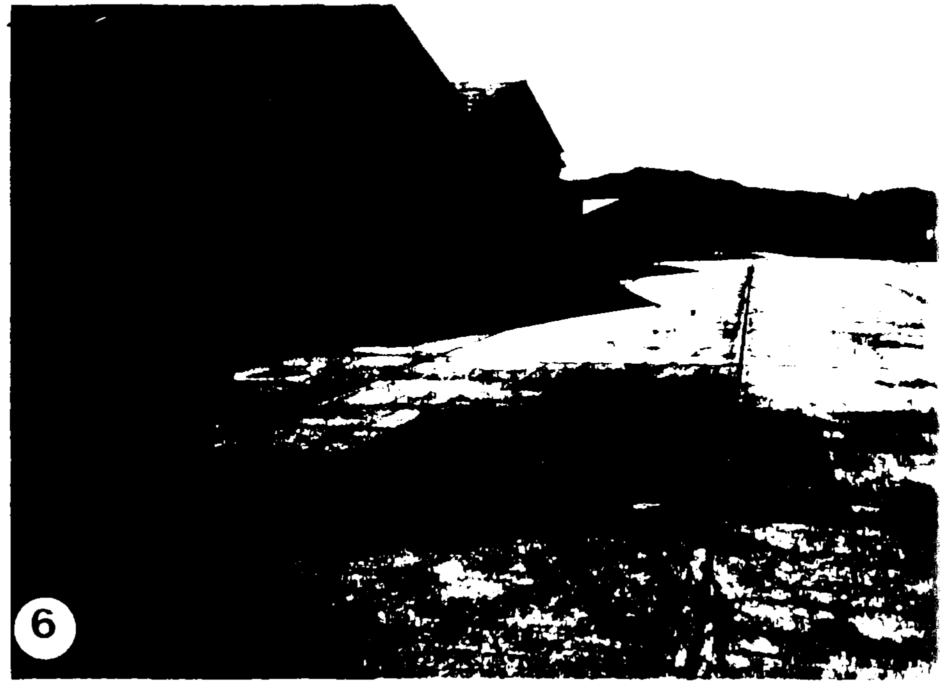
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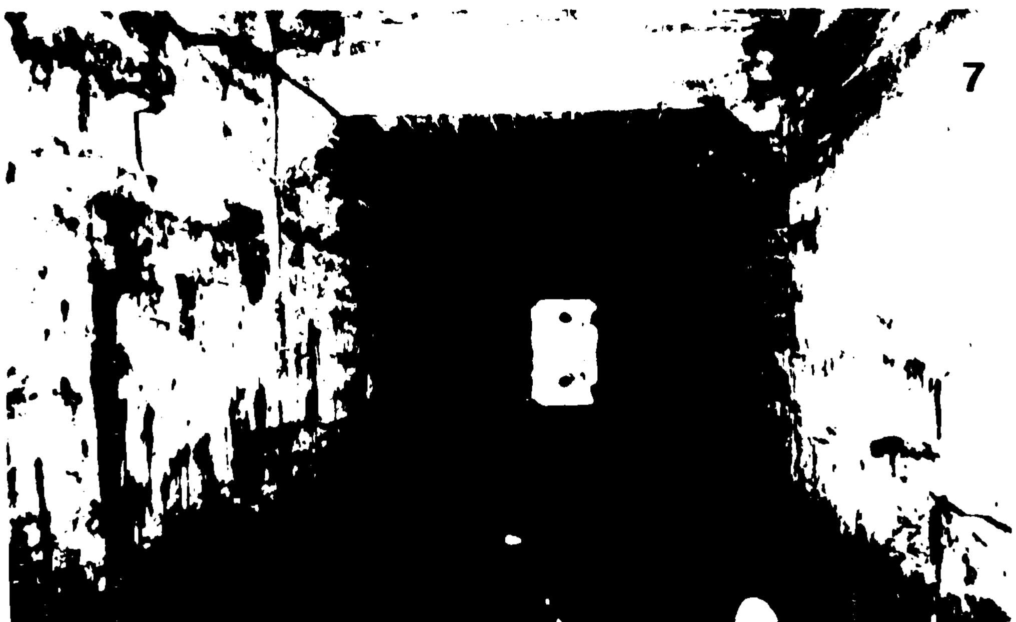
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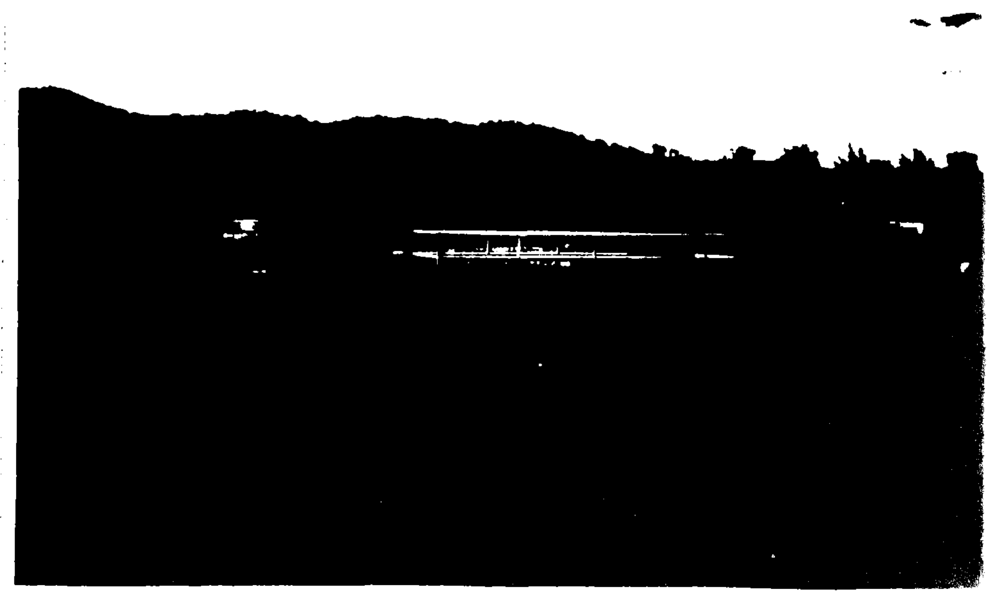


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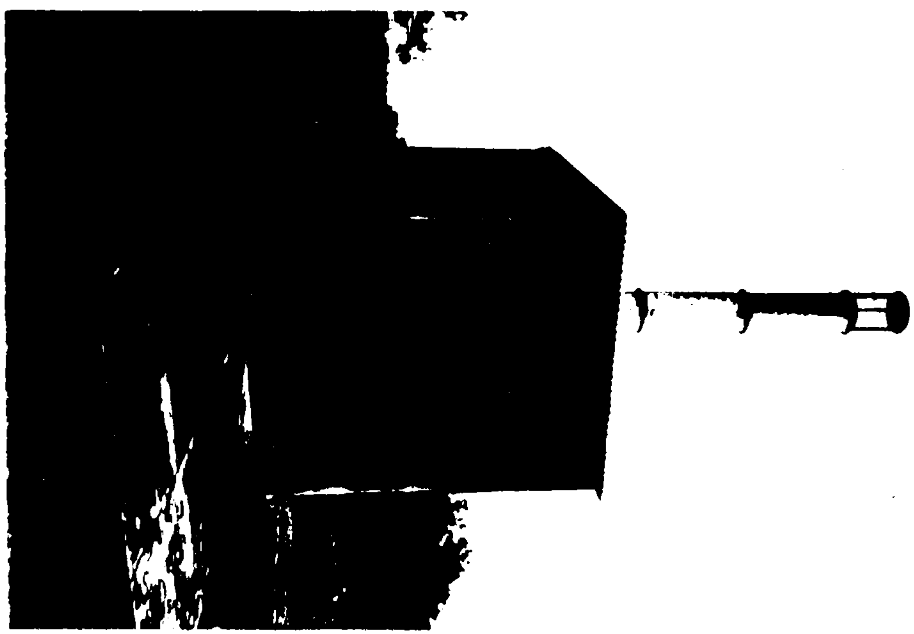
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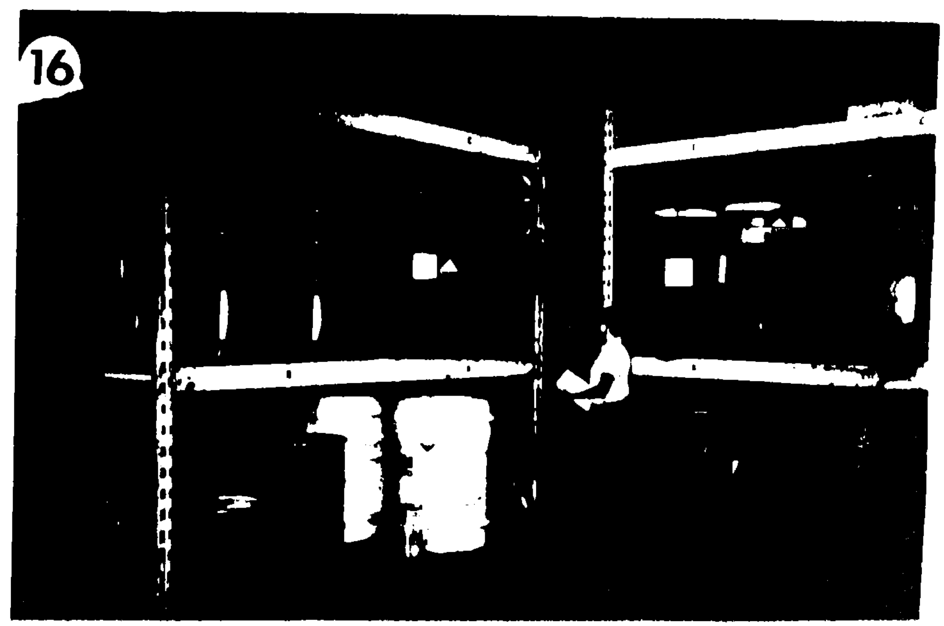
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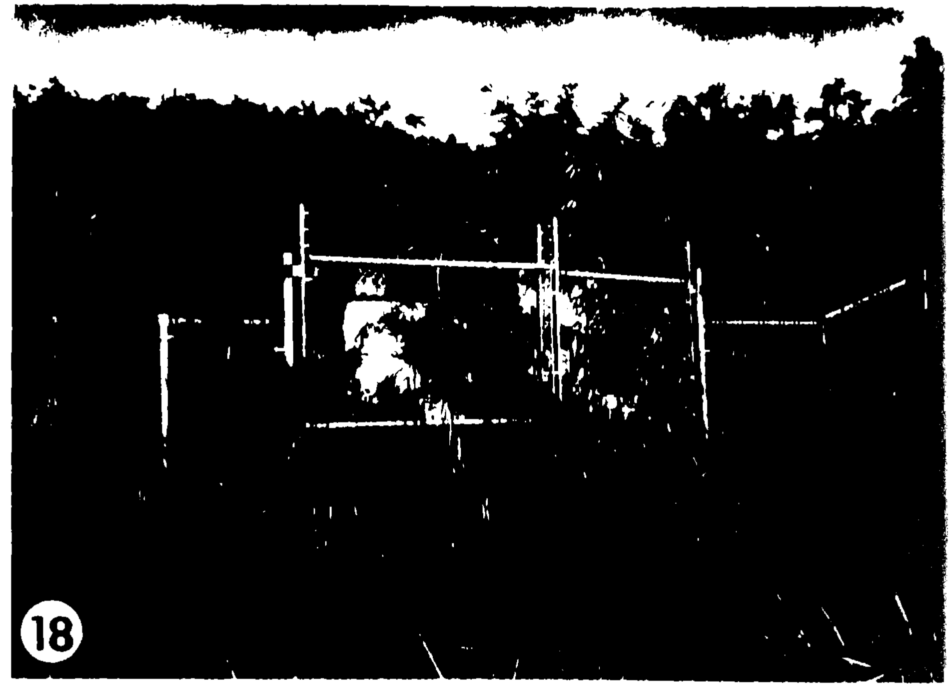
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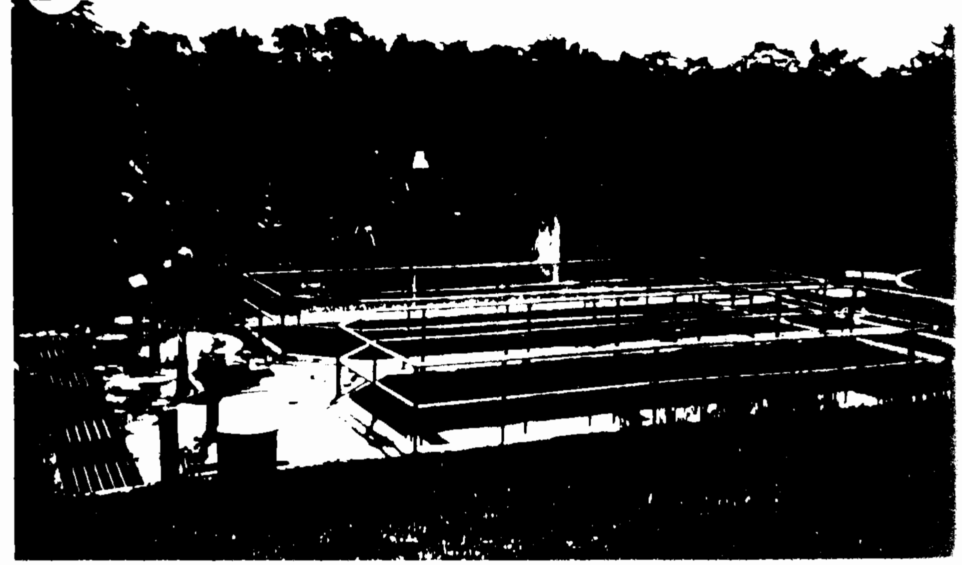

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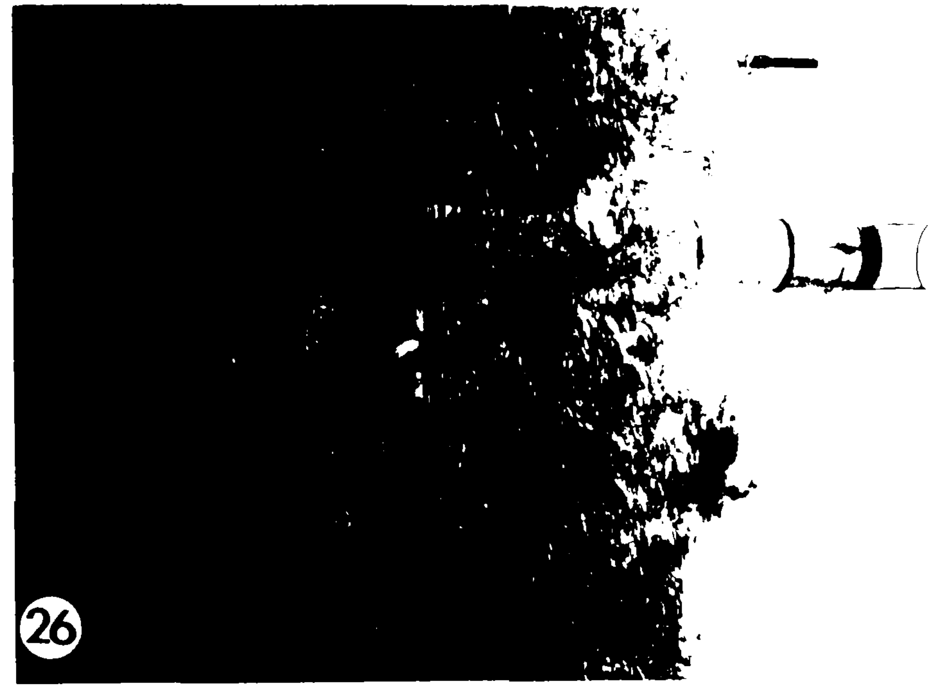

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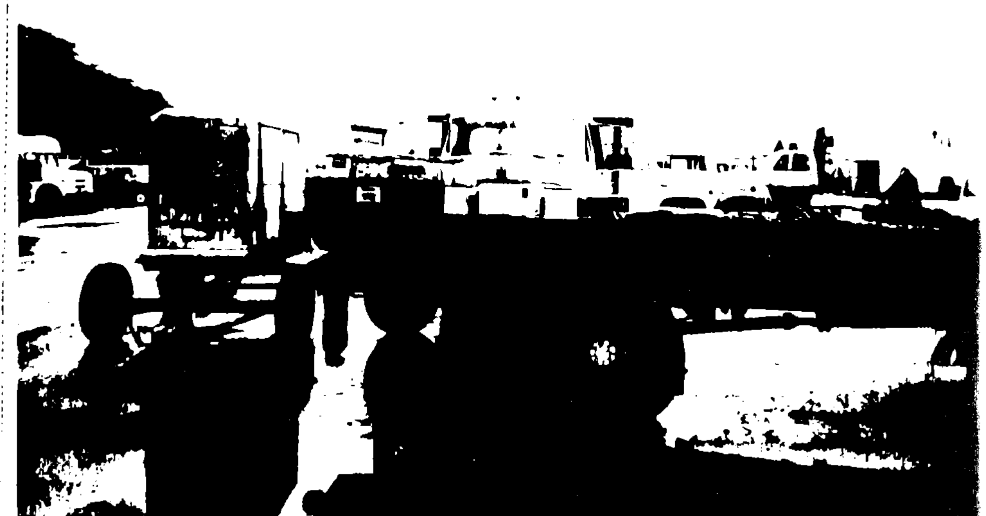

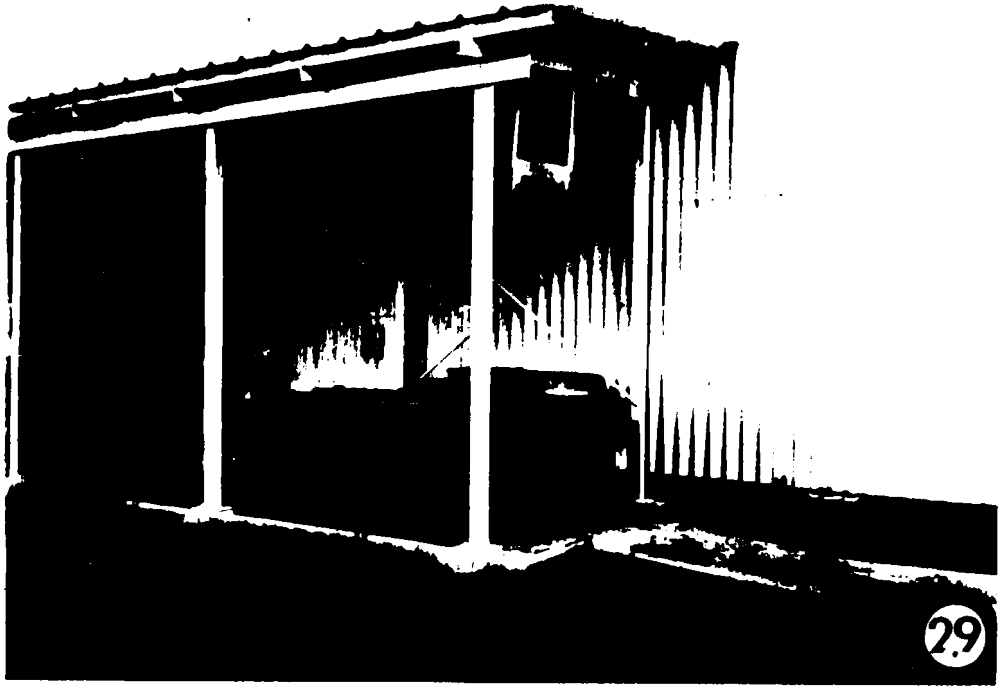
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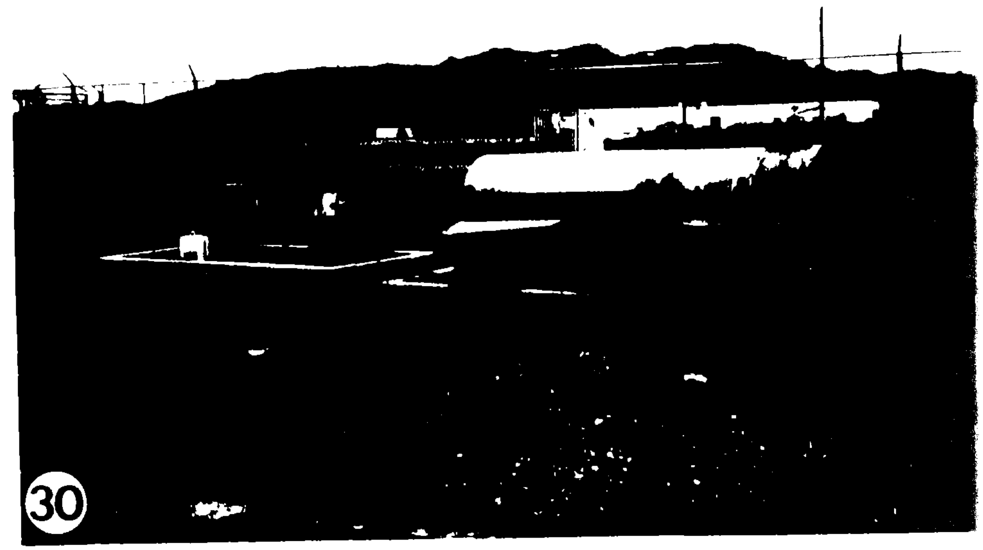
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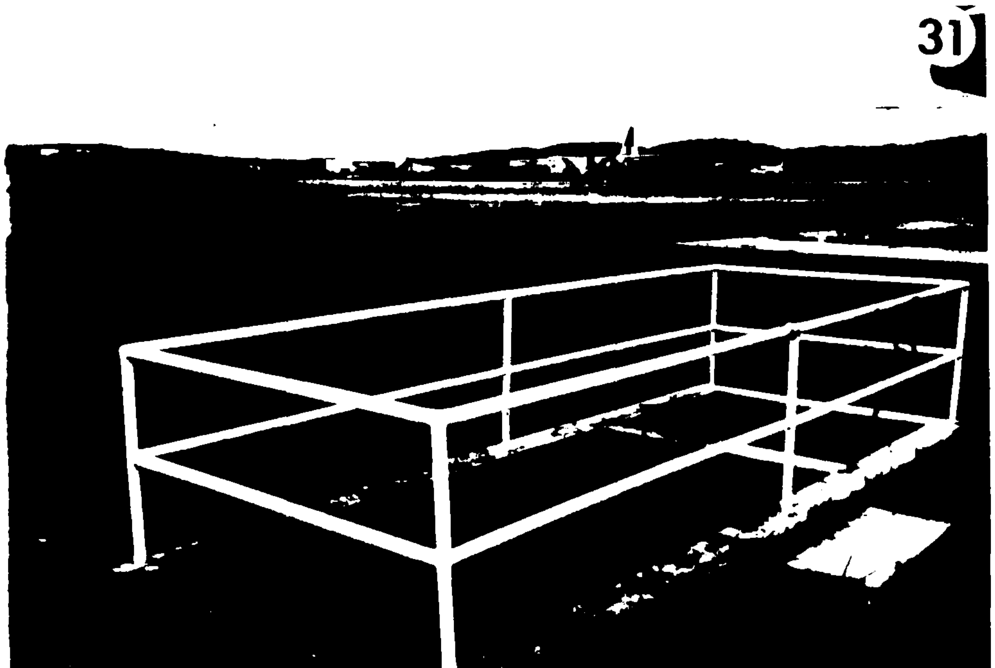
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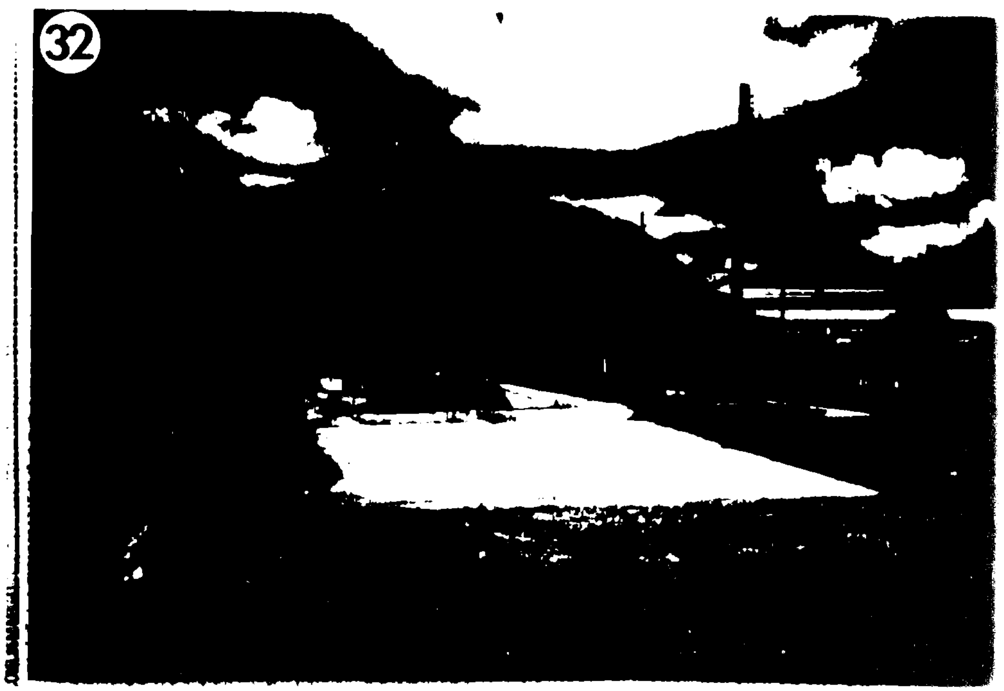
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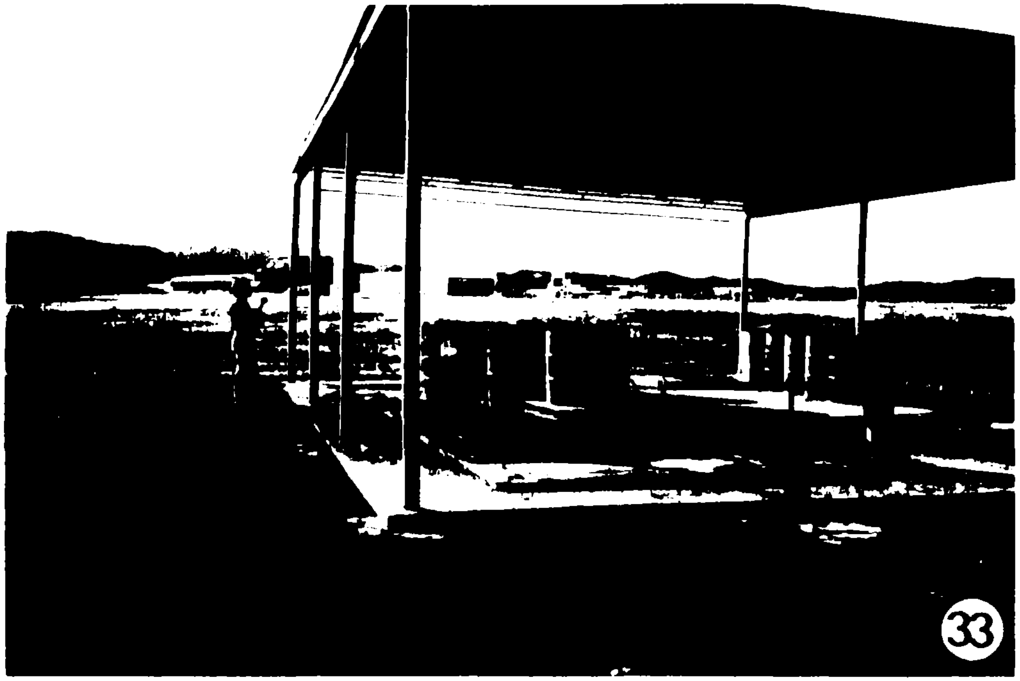
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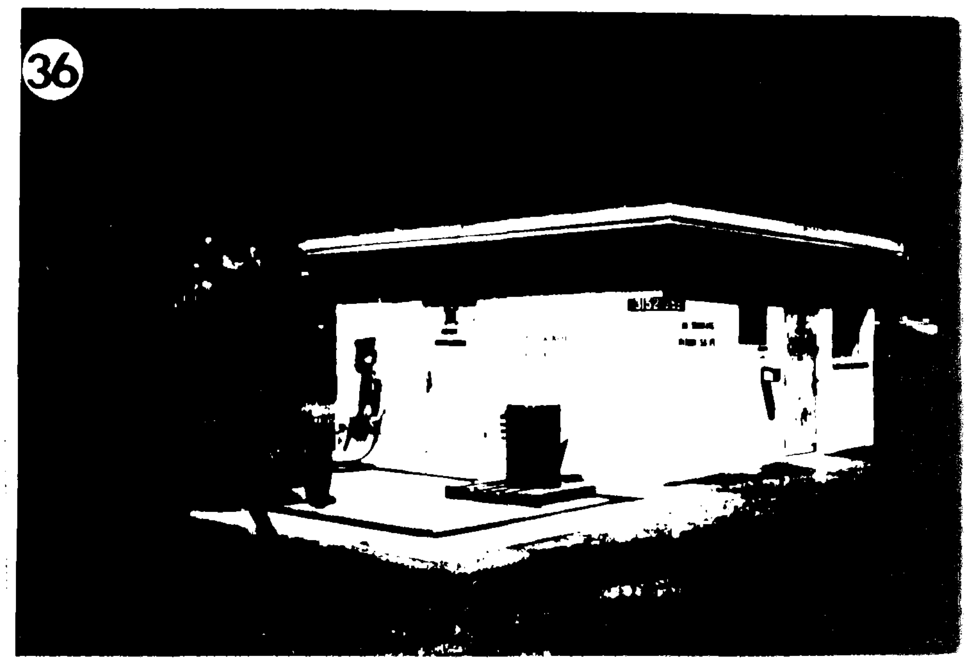
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SECTION K

OTHER FEDERAL LAWS

Information has been provided in accordance with the requirements of 40 CFR 270.114(b)(20) in the Environmental Assessment of Vieques. At this time, however, the OB/OD facility is in compliance with the following Federal laws: Wild and Scenic Rivers Act, National Historic Preservation Act of 1966, Endangered Species Act, Coastal Zone Management Act, and the Fish and Wildlife Act.

A brief synopsis of Navy activities on pertinent issues is provided as follows:

K-1 Ecological Conservation Zones

Various conservation zones have been established on Navy lands on Vieques. These areas encompass various plant and wildlife species habitats designated as rare and endangered, as well as ecosystems unique to the Caribbean. The designated conservation zones are:

Punta Este

This area includes unique vegetation of upland forest scrub and evergreen scrub. The evergreen scrub community, consisting of drought-resistant shrubs, is located on dry coastal limestone uplifts and is only found on Vieques. Punta Este is also home to an orchid (*Epidendrum bifidum*) identified as rare by the Commonwealth of Puerto Rico and is a candidate for the threatened and/or endangered species list as per the Endangered Species Act.

Cayo Conejo

This small island is Bahia Salina del Sur is an endangered brown pelican nesting habitat. The breeding colony is one of the largest in Puerto Rico. Access to this island is restricted and must be authorized by the U.S. Fish and Wildlife Service.

Ensenada Honda

This area includes extensive mangroves and is the best example of a lowland forest on Vieques. It contains one of the island's last remaining strands of Ucar (*Bacida buceras*) intermixed with Cobana Negra (*Stahlia monosperma*) which was listed as a threatened plant species in 1990.

South Coast Bays

This conservation zone encompasses extensive mangroves adjacent to Puerto Mosquito, Puerto Ferro, Bahia Corcho, and Bahia Tapon. Bahia Tapon and Puerto Mosquito bays have bioluminescent qualities. Bioluminescence is a unique phenomenon occasionally found in protected tropical bays with unique physical, chemical, and biological characteristics. The bioluminescence is caused by an accumulation of large numbers of dinoflagellate *Pyrodinum bahemense*. This species of phytoplankton normally occurs in near-shore tropical waters and emits light when disturbed by boats, swimmers, fish, etc. Only 14 bioluminescent bays have been identified worldwide.

Playa Grande

This lagoon, located on the NAF south coast, provides important fishery and wildlife habitat.

Monte Pirata

Monte Pirata's slopes support the most diverse upland forest on the island. This forest contains some of the oldest, largest, rarest, and most unusual trees on Vieques Island. Several plants identified as Puerto Rican species of concern are in the area. This conservation zone includes coastal areas which serve as brown pelican roosting sites and sea turtle nesting and feeding habitat.

Laguna Kiani Complex

This zone, composed of extensive mangrove forest areas, is located at the northwestern tip of Vieques. These mangroves provide important fishery and wildlife habitat and include vegetation remnants that formerly characterized the island. Located in this zone is Green Beach, used for recreational purposes by both military and civilian personnel. This beach provides turtle nesting and pelican roosting habitat.

In addition to these seven conservation areas, the Navy is protecting other areas of ecological importance. An example is the Northwest Coast Sea Grass Beds Conservation Zone which is used by manatees and sea turtles for feeding. Boaters must avoid anchoring in this or any other areas of vegetated sea grass because anchors remove portions of sea grass which require a long time to recover. Boat speed limits are also imposed to avoid collisions with manatees or sea turtles.

The OB and OD areas of the AIA are not located within any of these conservation zones.

K-2 Mangrove Forests

Mangrove forests are important ecological systems serving as habitat for terrestrial and aquatic species, as well as sediment traps or filters that help create and stabilize shorelines. A total of 31 mangrove forests, occupying 854 acres, are within Navy property. These forests are composed of one or a combination of black, white, red, and button mangrove species. Most mangrove areas are within the designated conservation zones mentioned in Section K-1.

Except for traffic on existing roads, military maneuvers and operations within mangrove forests are prohibited. No mangrove forests are located in the area of the OB and OD units.

Wildlife and Endangered Species Protection

Vieques is home to 120 species of bird, four species of amphibians, 14 species of terrestrial reptiles, and seven species of terrestrial mammals. Additionally, the island's coastal areas support diverse marine species, including approximately 350 species of fish, the bottlenose dolphin, the West Indian manatee, and sea turtles.

Vieques is within the range of various terrestrial and marine species listed by the Federal and Commonwealth governments as threatened and/or endangered. These species include sea turtles, brown pelican, peregrine falcon, Puerto Rican plain pigeon, piping plover, snowy plover, West Indian whistling duck, Caribbean coot, ruddy duck, least tern, West Indian manatee, and humpback whales. The Navy, in coordination with Federal and Commonwealth government agencies, has established programs to manage and ensure species existence and protection of their habitat. For example, beaches are surveys for sea turtle nests before landing maneuvers are conducted. If a sea turtle nest in found, it is marked off-limits.

All threatened and endangered species are protected and any disturbance is penalized with up to $25,000 fine and/or five years in prison.

No habitats of threatened or endangered species are known to exist within the area of the AIA containing the OB and OD units.

Cultural Resources

From 1978 through 1984, comprehensive cultural resource reconnaissance surveys were conducted on Navy lands. The surveys covered 85 percent of Navy landholdings on Vieques and is the largest and most extensive systematic survey conducted to date for any of the Caribbean islands. The studies located 218 prehistoric and historic sites with 33 determined to be eligible for inclusion in the National Register of Historic Places. All materials extracted during the study were donated to the University of Puerto Rico.

These sites are protected against disturbance and military maneuvers are not allowed on or near them. To avoid vandalism, cultural resources sites are not identified to the public at large. Collection and/or digging artifacts on federal lands is prohibited with a penalty of $10,000 and/or five years in prison.

No identified cultural resource sites are located in the vicinity of the OB and OD areas.

SECTION L

ENVIRONMENTAL PERFORMANCE STANDARDS

The Environmental Performance Standards section of this permit application provides a discussion of the natural and environmental aspects of the AFWTF OB/OD treatment units and the surrounding area within the Inner Range Air Impact Area. In completing this section of the application, AFWTF Vieques evaluated the following factors:

- Unit characterization: Design and operating parameters of the OB and OD unit.
- Waste characterization: Volume, toxicological properties, mobility, physical/chemical data and OB/OD by-product information.
- Site characterization: Meteorology, hydrology, geology, climatology, topography, etc.

L-1 ENVIRONMENTAL PERFORMANCE STANDARDS [40 CFR 270.23(b)]

L-1(a) NATURAL ENVIRONMENT

All available information which characterizes the environment of the AIA is summarized in this section in order to provide a concise description of the area rather than to disperse the information throughout individual sections. The information in this section is either directly quoted or paraphrased from several documents, including USGS reference materials and Naval site-specific environmental studies. The Naval Initial Assessment Study and RCRA Facility Assessment for the facility are shown in Appendices J-1 and J-2. Copies of all other pertinent documents are included as appendices to this section, as follows:

Appendix L-1 USGS Open-File Report 87-0749
Puerto Rico Groundwater Quality.

Appendix L-2 USGS Water-Resources Investigation Report 86-4100
Reconnaissance of the Groundwater Resources of Vieques Island, Puerto Rico.

Appendix L-3 USGS Water-Resources Investigation Report 86-4074
Planning Report for the Caribbean Islands Regional Aquifer System Analysis Project.

Appendix L-4	Geological Survey Professional Paper 813-U Summary Appraisals of the Nation's Groundwater Resources — Caribbean Region.
Appendix L-5	USDA Soil Conservation Service Soil Survey Report Soil Survey of Humacao Area of Eastern Puerto Rico (selected maps only).
Appendix L-6	USGS and Puerto Rico Department of Natural Resources Geochemical Reconnaissance of the Island of Vieques, Puerto Rico.

Topography

The topography of Vieques is characterized by a series of low hills and small valleys (see Figures B-2, B-2(a), and B-2(b)). The areas of highest elevation are generally found along the east-west longitudinal axis of the island, and exhibit a more angular block structure than the adjacent lower hills lying north and south of the main axis. The hills on the western end of the island generally differ in form and character from those on the eastern end of the island. The hills in the west are gentler and more rolling with a deeper soil profile than those on the east end, which are angular and rugged in appearance and have a greater amount of exposed rock surface. The highest point on the western end of the island is Monte Pirata (elevation 1,000 feet); on the eastern end, the highest point is Cerro Matias (elevation 420 feet).

In addition to the hilly central portion of the island, there are several low-lying coastal zones. The largest zones are located in the northwest corner of the island, on the east end north of Bahia Salina del Sur, and in the southern valley between Esperanza and Bahia Tapon. These coastal zones are generally level and contain extensive lagoons and mangrove swamps.

The topography of the OB and OD units is basically level. There are no specific drainage patters due to the presence of a series of small irregular drainage basins which are continuously be altered by the bombing activities. The area generally slopes in a southwesterly direction toward Laguna Anones.

Geology

The geology of Vieques is characterized by three major rock types in the upland areas, and unconsolidated sedimentary deposits in the lowlands. The three main rock types are Upper Cretaceous volcanic rocks, Upper Cretaceous or Lower Tertiary intrusive rocks, and Upper Tertiary and Quaternary sedimentary rocks. The consolidated sedimentary deposits of Vieques are of Quaternary age and consist of alluvial deposits, beach and dune deposits, and swamp and marsh deposits. The locations of these rock and sedimentary types are shown on Figure L-1.

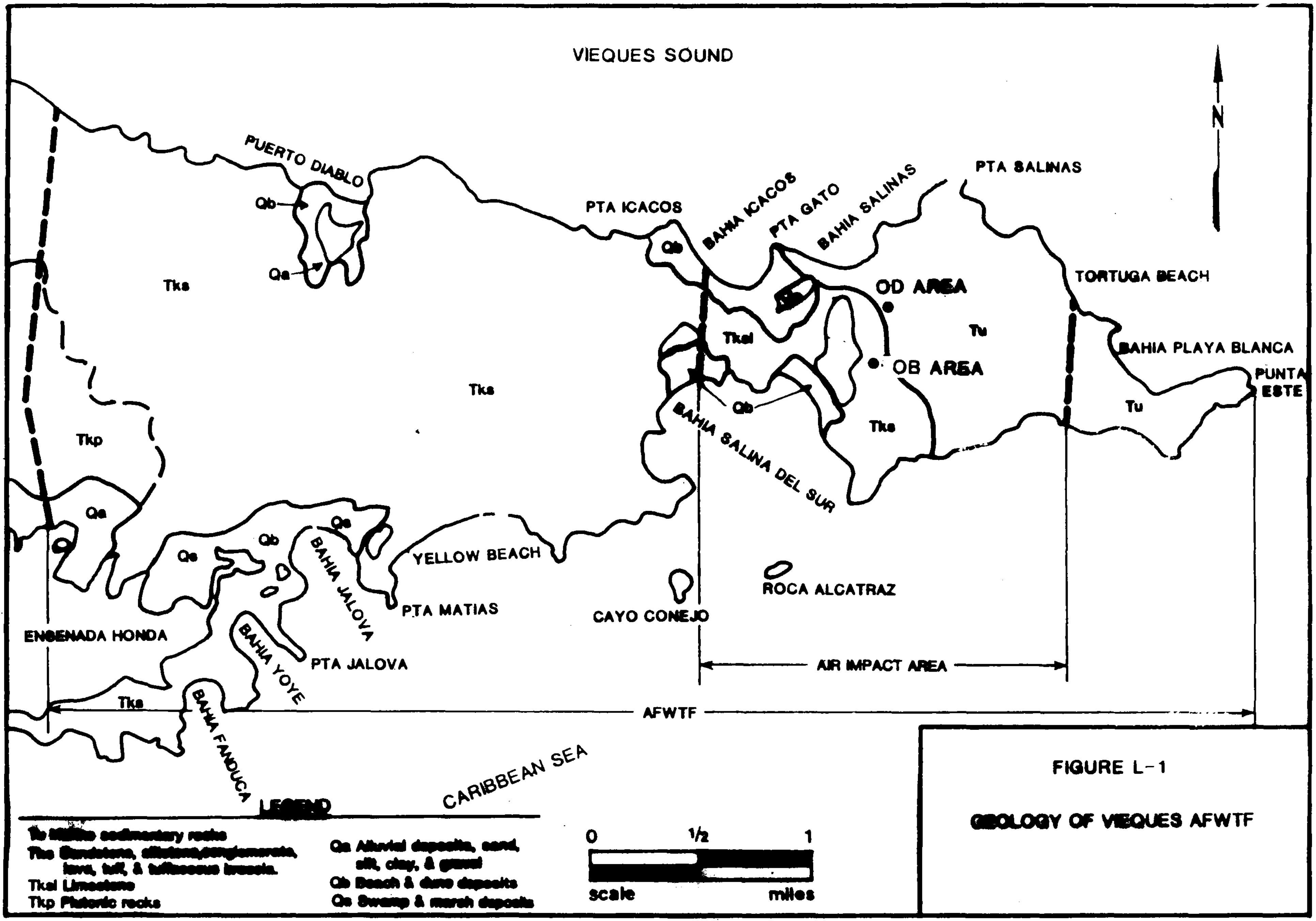

FIGURE L-1

GEOLOGY OF VIEQUES AFWTF

The oldest rocks exposed on Vieques are presumed to be of Upper Cretaceous age and are mostly andesites, tuffs, and conglomerates. It is generally believed that these rocks were deposited in a marine environment, and that they are similar to rocks of this age found on Puerto Rico and the Virgin Islands. The bedding thickness of these deposits is believed to vary across the island; total thickness is difficult to determine because of metamorphism of the rocks and generally poor surface exposure. These volcanic rocks are most common on the eastern end of the island.

During the Upper Cretaceous or Lower Tertiary period, the emplacement of a quartz diorite complex pluton resulted in the deformation and metamorphosis of the Cretaceous volcanic rocks. The quartz diorite plutonic rocks outcrop over a large percentage of the island, particularly in the western and central portions. The pluton is divided into two major bodies by a narrow belt of metamorphosed andesites and andesite tuffs running from Isabel Sequnda to Bahia de la Chiva. The western pluton is generally coarse-grained and equiangular in texture, while the eastern pluton is generally finer grained with a micrograniitic texture.

There are also well distributed local occurrences of mafic intrusives throughout the island. Dark-colored, fine-grained dike rocks outcrop at various locations throughout the island, while coarse-grained rocks of varying color and texture outcrop at the western end of the island in the quartz diorite complex.

Limestones of Upper Tertiary age outcrop at three major areas on the island. There are limestone headlands located on the south coast opposite Camp Garcia and also on the extreme eastern tip of Vieques. A third outcrop of limestone, approximately 50 feet thick, covers two acres of Punta Caballo on the north coast. Limestone was once a widespread deposit around the coast of Vieques, but has since been eroded. The limestone is locally known as the Puerto Ferro limestone and is of Tertiary-Miocene age. The thickness is 125 to 140 feet on the south coast and 160 to 175 feet on the eastern tip of the island. On the south coast, the limestone rests on granodiorite basement rock.

Quaternary deposits include beach, swamp, and alluvial deposits. Alluvial deposits of Quaternary age blanket most of the valleys of Vieques. On the south coast these areas include: the area from Esperanza to Camp Garcia, the area around Ensenada Honda, and the area around Laguna Playa Grande. On the north coast they include the Valle de Resolucion and Hacienda Arcadia area. Alluvial deposits are stream-laid silt, clay, and gravel derived from the disintegration of diorite or volcanic rock. Fringing the drowned shoreline of Vieques are assorted deposits of beach and windblown sand and lagoon and salt marsh muds. These deposits are Pleistocene to Holocene in age.

There are two potentially important geologic resources on the island of Vieques: sand, and crushed or quarried stone. In addition, various studies have revealed copper mineralization occurrences over several areas of the quartz diorite intrusives, and the various limestone deposits have been investigated as possible sources for cement and crushed stone. However, little potential exists for profitable exploitation of the copper minerals because of a lack of concentrations extensive enough to warrant development; and most of the limestone has been found to be too soft to be used for crushed stone and of insufficient purity to be used for cement.

There are two major types of sand deposits found on Vieques. The first type is an alluvial deposit found in valleys filled with the material formed from the weathering of the quartz diorite intrusive. These deposits, which are found primarily on the western end of the island, consist of coarse siliceous sand. Several alluvial sand deposits are currently being exploited; however, all of these are relatively small operations. The sand from these deposits is used primarily for construction purposes including concrete, mortar, and fine aggregate for building block construction. A large deposit of alluvial sand, offering good potential for development, is present along Quebrada La Mina.

The second type of sand deposit is a marine-deposited calcareous sand located on the fringe beaches. These deposits are not of sufficient quantity to warrant long-term development.

The quartz diorite of the west-central part of the island offers excellent potential for crushed or quarried stone operations. Several small sites in this area are presently being worked by hand methods. In addition, the Navy operates a quarry in metamorphosed volcanics near Desembarcadero Mosquito which produces substantial amounts of stone for military construction. Several other inactive quarries are also present on the island. Sufficient quarry stone appears to be available for the island's construction needs.

More detailed geological information is included in Appendices L-1 through L-6.

Soils

The majority of the soils on Vieques are residual in nature. Because of the tropical wet and dry type climate and the relatively impermeable intact volcanic rock, soil development has been severely limited on the eastern portion of the island, resulting in a very shallow soil profile. Generally, the soils on the eastern end of the island are fine-grained with a high clay content. The soil profiles on the western end of the island, which are somewhat better developed, have been formed by the weathering of the underlying granite diorite intrusive. These solids are primarily coarse-grained and contain primarily arkosic material with subordinate amounts of clay.

The larger valleys of Vieques are blanked and filled by alluvial deposits of Quaternary age. These stream-laid deposits consist of clay, silt, sand, and gravel derived from the parent volcanic or intrusive rock. The larger valleys include Valle de Resolucion on the northwest side of the island and the large valley stretching from Esperanza to Camp Garcia on the south coast. Although the alluvial deposits in these valleys vary in thickness, they are generally greater than

40 feet thick. In addition to the major soil areas mentioned above, the areas along the shoreline are covered with deposits of beach, alluvial and windblown sand, lagoon and salt marsh muds.

The island of Vieques, due to its small size and relatively uniform climate, has a limited range of soils series (see Figure L-2). The Descalabrado soils are the most common in Vieques,covering more than 30% of the total land area. They are moderately steep to steep (5% to 60%), shallow, well-drained solid which are found above consolidated volcanic rocks. They were formed in a medium to fine-textured residuum derived from this same rock. The surface layer is typically very dark brown to dark grayish-brown, 3 to 7 inches thick. The type of vegetation which usually occurs on this soil type largely consists of grasses and shrubs. All types or phases of this soil series on Vieques have severe limitations for both agricultural and non-agricultural land uses due to low rainfall, steep slopes, shallow soils, and in come cases the presence of rocks. All these soils are easily eroded. Virtually all are classified with a land capability that restricts use to grazing, woodland, or wildlife.

The Vieques series is found on another 26% of the island's total land area. Vieques soils occur on moderate to steep slopes (5% to 40%) in the dry uplands. They are formed from partially weathered granitic rocks. They are shallow, and in a typical profile the dark brown surface layer is 4 to 8 inches thick. Drainage is good, runoff medium, and permeability moderate. Texture ranges from loam to clay loam. Associated series are the Descalabrado, Coamo, and Guayama, all of which also form significant portions of the island's surface area.

The Coamo series constitutes almost another 16% of the total land area of the island. Coamo soils are gently sloped, deep, fairly rich soils which have a variety of uses if properly managed. Characteristically, they are deep and well-drained, occurring over deep layers of stratified coarse-textured materials. They formed in sediments derived from volcanic and limestone rocks. Usually, the surface layer is very dark brown, and slightly acidic to neutral. Subsoils are mildly to moderately alkaline. Typical natural vegetation consists of xerophytic trees and brush. This soil series is considered good for agriculture.

At least 8% of Vieques' surface is covered by a land type called simply *rock land*, where rock outcrops cover 50% to 70% of the surface area, or where loose stones and boulders are common. The shallow soil between and around the rocks is insufficient to be classified by soil series. The slope gradient ranges from 60% to 70%. Natural vegetative cover is usually brush and wild grasses, though on Vieques some of the higher undisturbed peaks are still forested. There are two subcategories of the rock land type on Vieques: volcanic rock land and limestone rock land. Neither has any agricultural or engineering uses. The capability unit classification restricts use to wildlife habitat, recreation, and aesthetic purposes. The OB and OD units are located in an area of the AIA primarily characterized as rock land.

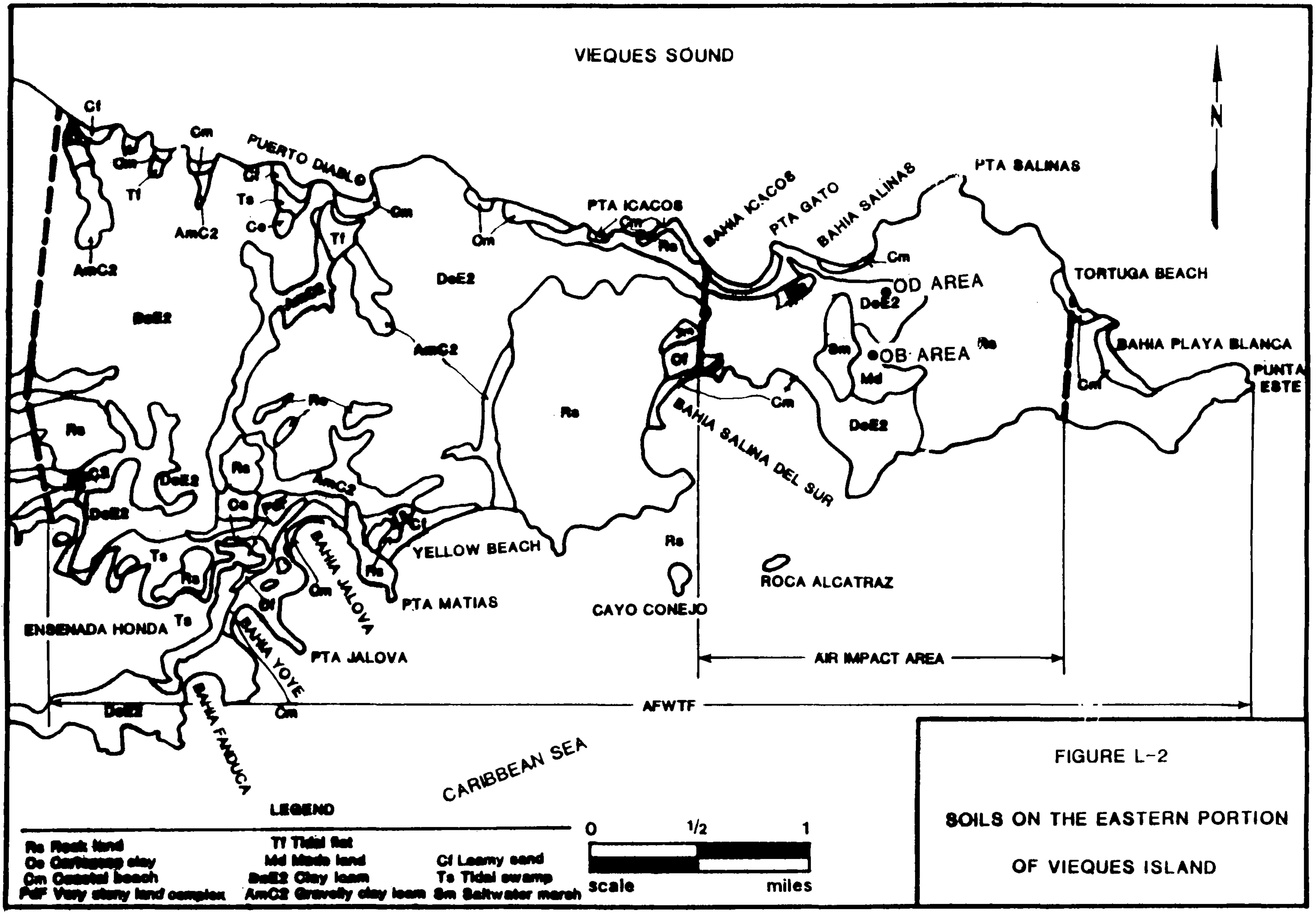

FIGURE L-2

SOILS ON THE EASTERN PORTION OF VIEQUES ISLAND

The remaining 15% of the island's area is distributed in nine additional series of varying quality. They are Ametia, Cartgena, Catano, Coastal Beaches, Descalabrado, Fraternidad, Jacana, Pandura, Paso Seco, Pancena and Pozo Blanco.

Air-to-Ground Ordnance (ATG) delivery and Naval Gunfire Support (NGFS) training activities in the AFWTF result in disturbance to vegetation and surface and subsurface soils which could lead to accelerated soil erosion. However, natural conditions of topography, soils, precipitation, vegetation, and drainage patterns in the AFWTF minimize the soil erosion potential. In general, the topography in the Air Impact Area (AIA) is relatively flat, and the drainage basins are small with no defined drainage channels. The soils are very porous, and rainfall is suspected to be lower than for the western portions of the island. With the exception of the target areas themselves, the access roads and the Eastern and Western Friendly Front Lines, the AIA is well-vegetated. Most of the targets are located on hilltops and are surrounded by well-vegetated slopes which trap and hold sediment eroded from target areas. The bombing also creates a cratered landscape which helps to retard surface runoff and minimize erosion. Some mitigation measures have been implemented which also have reduced soil erosion and sedimentation. These measures include berms and sediment basins constructed around the mock air strip which help minimize erosion to Laguna Anones.

More detailed soils information is contained within Appendices L-5 and L-6.

Surface Water

The topography of Vieques consists of a series of low hills and shallow valleys with an average elevation of about 200 feet above sea level. The highest point on the eastern end of the island is Cerro Matias; on the western end of the island, the highest point is Monte Pirata. The higher elevations are generally along the east-west axis of the island. From the high points, small, normally dry streambeds or quebradas flow either north or south toward the sea. This division of the drainage results in many small drainage basins, most of which are less than a mile in length, only a fraction of a square mile in drainage area, and have no well-defined drainage channel.

Vieques has no perennial surface drainage. Rainfall on Vieques ranges from 25 to 45 inches annually. Thirty-six inches is considered the average annually precipitation for the island as a whole. Based on figures for the U.S. Virgin Islands, the amount of water that evaporates and is transpired back into the atmosphere is about 90% of the rainfall. An additional 5% is infiltrated and recharges groundwater aquifers. Thus the amount of rainfall that is accounted for by runoff is only 5%. In the rainy season, channels in many of the valleys contain runoff; however, in the dry season, the streams tend to pond or dry up entirely. Groundwater discharge sustains several springs in the quebradas during the dry season. One of two streams are said to have flowed continuously at some time in the past, probably before well fields lowered the water table.

The nearest surface water bodies to the OB/OD units are the Laguna Anones and the Caribbean Sea. Laguna Anones, located approximately 1/8 mile from the OB unit and 1/4 mile from the OD unit, is the nearest water body. The majority of runoff from the two units would drain into this lagoon. Samples taken under the NPDES program from this lagoon revealed no indications of contamination. This is addressed further in Section L-3.

Groundwater

Vieques has two major aquifers: the Valle de Resolucion aquifer located beneath the western portion of the island within the NAF, and the Valle de Esperanza aquifer located within a 4-square-mile area between the village of Esperanza and Camp Garcia on the southern portion of the island. Of these, the Valle de Esperanza is more productive. Prior to the installation of the water line from the main island of Puerto Rico in 1978, the Calle de Esperanza aquifer supplied most of the potable water for the island. This aquifer currently serves as the water supply source for Camp Garcia and OP-1 only.

To supply the island with potable water before the installation of the water pipeline, the Puerto Rico Autoridad de Acueductos y Alcantarillados (Aqueduct and Sewer Authority, or PRASA) maintained a network of 16 wells which cumulatively pumped 450,000 gallons per day (gpd). The PRASA well field, located in Esperanza, is currently not in use.

The U.S. Geological Survey (USGS) recently completed a two-year study of groundwater resources in Vieques in general and in the Valle de Resolucion and Valle de Esperanza in particular (Torres 1985). The study showed rainfall to be the primary source of local groundwater, recharging aquifers through infiltration and stream incisement.

Analyses of samples from wells near Esperanza revealed that groundwater is a sodium-bicarbonate type generally characterized as hard and suitable for uses other than irrigation. Because of high sodium levels, untreated groundwater used for irrigation on a long-term basis would result in the accumulation of salts in the soils (Torres 1985). The relatively high concentrations of chloride previously recorded (i.e., in 1977) in groundwater from the Valle de Espernaza aquifer are attributed to seawater encroachment as a result of excessive groundwater withdrawals, and to the accumulation of salts from infiltration of sea spray, a condition typical of islands with low rainfall. Since withdrawals from the PRASA wells have been discontinued, chloride concentrations in the groundwater have decreased substantially, from 205 milligrams per liter (mg/l) to 94 mg/l (Torres 1985).

Additional information on Vieques island groundwater is shown in Appendices L-1 through L-6.

Marine Water Quality

The coastal waters of Vieques are subject to and classified in accordance with the Puerto Rico Water Quality Standards. For the most part, the island's marine waters are of acceptable quality and are classified as suitable for direct human contact and for use in the propagation of preservation of desirable marine species. The only offshore waters classified as limited to indirect human contact or for use in propagation and maintenance of desirable species are those near Isabel Segunda and Puerto Real between Cayo de Tierra and Cayo Real. This limitation is the result of sanitary wastewater discharges from the two major civilian areas, Isabel Segunda and Esperanza. In contrast, Puerto Mosquito, located on the southern coast, exhibits exceptional water quality characteristics which should not be altered in order to preserve the existing natural bioluminescence.

The only Naval activities on Vieques that have the potential to affect marine water quality are those which promote soil erosion and sedimentation, including those involving the use of the AIA. There are no discharges of sanitary wastewater from the NAF and Camp Garcia to coastal waters. As a result, this section focuses on the coastal waters off the AIA.

In accordance with the provisions of a U.S. Environmental Protection Agency (USEPA) NPDES permit issued in November 1984, the Navy is currently monitoring and conducting extensive analyses of the quality of the coastal waters off the AIA. The NPDES permit authorizes the occasional release of unexploded ordnance in the waters off the AIA. Because of several factors related to the Navy's use of the AIA since 1978, the existing quality of the marine waters off the eastern portion of Vieques is not expected to have changed significantly since 1978, when the coastal waters were determined to be in compliance with applicable Puerto Rican marine quality standards. These factors include:

- The overall level of operations has not increased since 1977-1978, when ATG and NGFS activities peaked and the amount of explosive by-products in marine waters off the AIA were expected to peak correspondingly. Since the coastal waters off the eastern part of the island were in compliance with water quality standards in 1978, when ATG and NGFS operations peaked, current water quality can similarly be expected to conform to applicable standards.

- The Navy has moved various targets inland and, as a result, significantly fewer live ATG bombs and NGFS rounds have landed in the water than originally estimated.

- The Navy has implemented various erosion control techniques in the AIA aimed at the reduction of runoff that carries sediment and increases the suspended solids concentrations in the waters off the AIA. These measures include the placement of berms around the mock airstrip and initiation of the resurfacing of the OP-1 road.

The following summarizes the results of the studies that were performed to characterize the quality of the marine waters off the AIA in 1978, and describes in greater detail why the present quality of the waters off the AIA is expected to be similar or better.

The physio-chemical and nutrient data collected in 1978 showed that the coastal waters were in compliance with Puerto Rico water quality standards and exhibited characteristics typical of natural seawater. The total phosphate concentration was found to exceed the 1974 water quality standards of 25 micrograms per liter (ug/l) only at Puerto Mosquite; this cariance was attributable to the bay's unique naturally occurring bioluminescent characteristics. This numerical standard for phosphorous waters was eliminated in March 1983 when Puerto Rico's standards were amended.

The metals data collected in 1978 showed that, with the exception of zinc and lead, the average concentration of metals tested in waters around Vieques was in compliance with the water quality standards or within the approximate concentrations found in natural seawater. Although the maximum concentrations of several of the metals were greater than normally anticipated in natural seawater, and in some cases exceeded the water quality standards, there was no consistent pattern between the stations located in the waters adjacent to the AIA compared to those elsewhere on the island, and it was determined that Naval training activities were not responsible.

In conjunction with the marine water quality program in 1978, the Naval Surface Weapons Center surveyed the island's waters for explosive products and by-products. Samples were collected from crater runoff, lagoon water, and seawater near large bomb craters; these samples were compared with samples from waters outside the AIA and were analyzed for TNT, RDX, and tetryl. Results from thin-layer chromatography (TLC) and vapor phase chromatography (VPC) analyses indicated no accumulation of explosive products and by-products and no essential differences between the water samples taken outside of the AIA and those taken within the AIA (Hoffsomer and Glover 1978). Also, no detectable concentrations of perchlorate or white phosphorous were found in any of the water samples, including those collected in target areas where ammunition containing white phosphorous was used.

During 1978, 36.8 tons of NGFS explosives and 532.8 tons of ATG explosives were expended. Based on Naval operations analysis, it was estimated that approximately 40% of the NGFS ordnance and 4% of the ATG ordnance would land in the water. As a result, the annual loading to the water was estimated at approximately 14.7 tons of NGFS explosives and 21.3 tons of ATG explosives. Naval operations had predicted that by 1985 the annual expenditure of explosives would be about 54 tons for NGFS and 736 tons for ATG, of which roughly 22 tons of NGFS explosives and 29 tons of ATG explosives would land in the water.

However, a review of naval operations data from 1979-1985 shows that the actual percentage of ordnance landing the water has been significantly less than predicted. In particular, recent data indicate that approximately 6.4% of the NGFS explosives and less than 1% of the ATG explosives actually landed in the water. This reduction in water rounds may be due to the relocation of targets farther inland.

In addition, operations at the AIA have not reached the levels originally predicted (i.e., 54 tons of NGFS and 736 tons of ATG expended annually by 1985). Instead, the average amount of explosives expended annually from 1979 to 1985 was 31 tons of NGFS and 730 tons of ATG. Using these actual averages and the recent observed water round percentages of 6.4% for NGFS and less than 1% for ATG, the amount of explosives actually landing the water is projected to be 2 tons of NGFS explosives and 7.3 tons of ATG explosives annually. These loadings are seven and three times less than those observed in 1978, when the marine waters were found to be of acceptable quality for designated uses.

Because of the reduction in the annual explosives loading from 1979 to 1985, the significantly fewer actual water rounds than projected, and the elimination of any sanitary wastewater discharges in conjunction with Navy operations on Vieques, the existing marine water quality conditions were expected to be similar or better than those observed in 1978. This was confirmed in a detailed water quality study completed by the Navy in 1990.

The 1990 study was performed to evaluate the water quality database compiled under the NPDES program during the 1980s. A brief history of the NPDES/water quality history of the AFWTF is provided in the following paragraphs, along with the conclusions of the water quality study. A copy of the water quality study, along with all appendices, is shown in Appendix L-7.

In March 1978, the governor of the Commonwealth of Puerto Rico and other concerned groups (including Vieques fishermen's groups) instituted a court suit (Romero-Barcelo´ vs. Brown) against the U.S. Navy concerning alleged violation of environmental laws. The suit contended that Naval shelling and bombing training activities had been illegally transferred to Vieques Island from Culebra and its cays in violation of congressional and executive directives. It also contended that the Navy's activities polluted the island's air and coastal waters, threatened irreplaceable historical sites, and diminished the productivity of fishing and agricultural resources. The suit contended that these activities had led to irreparable damage to the island's ecology and inhabitants. Among the alleged impacts was a violation of federal and commonwealth water quality standards for the waters on and around the Inner Range of the AFWTF at Vieques. The objective of the suit was to enjoin the Navy from using any portion of its land on Vieques or surrounding waters for Naval training operations. The basis of the suit was an alleged violation of the Clean Water Act of 1977.

After lengthy legal proceedings, the resulting District Court decision stated that the continued use of Vieques by the Navy was essential to national defense and injunction of Naval training activities was not appropriate relief for violations the Navy might be found responsible for. However, the Court found the Navy in violation of the Federal Water Pollution Control Act, Executive Order 11593, and the National Environmental Policy Act. All other claims were dismissed. To correct these violations, the Navy was required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for the release or firing of ordnance into the waters of Vieques, to conduct cultural resources surveys to locate sites eligible for the National Registry of Historic Places (NRHP), and to file an Environmental Impact Statement (EIS) in connection with its activities in and around Vieques. The EIS was prepared, and the determination of historic and prehistoric places was listed in compliance with the court directives. However, obtaining an NPDES permit became a complex legal issue.

In May 1981, the Environmental Protection Agency (EPA) drafted and proposed to issue an NPDES permit for the Navy's activities at the AFWTF Inner Range. However, the Commonwealth of Puerto Rico had appealed the decision of Romero-Barceló vs. Brown in January 1981. The appeal was heard in the First Circuit Court of Appeals, and no major changes were made to the decision. Puerto Rico again appealed, and the case was heard before the U.S. Supreme Court in October 1981. Again, no major changes were made in the decision. When the draft NPDES permit came before the Puerto Rico Environmental Quality Board (EQB) for final issuance of a Section 401 Water Quality Certificate (WQC), the EQB denied the permit (December 1981). The Navy then filed a Petition for Reconsideration for the WQC with the EQB.

In February 1982, the U.S. Supreme Court reheard the case. No major changes were made in the court ruling. However, the EQB denied the Petition for Reconsideration. The Navy appealed this denial of the WQC in April 1982. Also, beginning in May 1982, the EPA requested an amendment to the Clean Water Act to exempt facilities such as Vieques because of their unusual operations and pollutants (stray ordnance); this request is still awaiting appeal.

In compliance with the draft EPA NPDES permit requirements, the Navy began monitoring water quality at several sites around Vieques in September 1983. In October 1983, the EQB issued a certification requiring more monitoring than the EPA had required. EQB's certification also required submittal of an Erosion Control Plan, completed in October 1985 and since implemented by the Navy. The final NPDES permit was posted in *The Federal Register* in October 1984.

Water quality monitoring of both coastal and inland surface water bodies has been conducted since 1983. The monitoring results have indicated that:

- No significant correlations were found to exist between ordnance usage and parameter concentration for any of the parameters analyzed.
- Studies indicate that the overall water quality is neither improving or decreasing.

- No relationship can be established between limited data or rainfall runoff (via discharge runoff from the inner range) and the water quality parameters.

- Ordnance studies indicated that explosives and their detonation byproducts should not produce water quality degradation.

As a result, it has been concluded that the water quality monitoring standards are not appropriate or applicable to the oceanic waters surrounding Vieques, and it was therefore recommended that the water monitoring program specified by the NPDES permit be terminated. No action has yet been taken concerning this recommendation.

Based upon these past surface water studies, there are no indications that ordnance training activities on Vieques Island have impacted the surrounding oceanic surface waters.

Climate

Vieques' climate is tropical-marine, with minimal fluctuations in temperature. Easterly trade winds, which blow directly across the island year-round, moderate the tropical heat considerably.

The U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), has established two weather stations on Vieques since 1982; one located near the main gate at Camp Garcia, and one located in the main area of the camp. However, data from these station have been erratic, with only one station (the one near the main gate) reporting sufficient daily values to warrant publication. This station records only precipitation and temperature.

The mean annual temperature on Vieques is approximately 79°F to 80°F, with little variation in mean monthly temperatures. Historical data show August as the warmest month, at 81.8°F, and February the coldest, at 76.0°F. The minimal variation in monthly temperature ranges is attributed to two factors. First, the island is surrounded by water, the temperature of which changes little from the warmest to the coolest season; and second, the island is near the equator, which accounts for the relatively small differences in energy received from the sun from season to season. Monthly extreme temperatures at Esperanza ranged from 98°F to 60°F for a 14-year period of record. The mean daily temperature range (the difference between the daytime maximum and the nighttime minimum) is estimated to be between 15° and 25°.

There is little information on rainfall patterns on Vieques. Available data from the western end of the island indicate that an average of approximately 45 inches of rainfall occur annually. However, it is reported that rainfall varies from east to west across the island, ranging from an estimated annual average of 25 inches in the east to between 45 and 50 inches in the west, and on an island-wide basis, average rainfall is estimated to be 36 inches per year. However, there are no data to support this conclusion. The island's rainy season is typically characterized as August to November, although rain showers occur frequently throughout the year. For the most part, these showers are of short duration, usually less than 30 minutes. The island's dry season extends from December through April.

The outstanding feature with regard to wind patterns around Vieques is the steadiness of the trade winds, which are from an easterly direction almost without exception, varying from north-northeast to south-southeast. The trade winds move inland, where they are lifted over the terrain or pushed aside by the hills and form micro-circulation patterns. Wind speeds tend to change from calmer night winds to stronger day winds at daybreak and change back again at approximately 4 p.m. The day winds generally reach a peak in late morning or early afternoon.

Tropical cyclones (hurricanes and tropical storms) are most likely to occur during the summer and early fall. A cyclone is a closed circulation in which the winds rotate counterclockwise in the Northern Hemisphere or clockwise in the Southern Hemisphere; any such nonfrontal, low-pressure, synoptic-scale circulation that forms over tropical waters is referred to as a tropical cyclone. Tropical cyclones characteristically range from 100 to 600 nautical miles in diameter; have a central *eye*, or an area of light winds, minimum cloud cover, and minimum pressure; have sustained wind speeds (i.e., over a period of one minute) that often reach 100 knots near the center and higher gusts; and are accompanied by torrential rains.

Tropical cyclones are further classified as tropical depressions, tropical storms, or hurricanes according to the sustained wind speed at the center of the storm. A tropical depression has sustained wind speeds of less than or equal to 33 knots, while tropical storms and hurricanes are characterized by winds of 34 to 63 knots (inclusive) and greater than or equal to 64 knots, respectively.

Air Quality

Vieques is within the Puerto Rico Air Quality Control Region (AQCR), which encompasses the entire Commonwealth including Culebra. Puerto Rico has adopted the National Ambient Air Quality Standards (NAAQS) as the maximum permissible average and peak concentrations for criteria pollutants. The Puerto Rico Environmental Quality Board (EQB) administers the ambient air quality program in conjunction with the USEPA, Region II. In particular, EQB is responsible for permitting minor air pollution sources, while USEPA administers the Prevention of Significant Deterioration (PSD) program and authorizes major source permits. USEPA has no immediate plans to delegate PSD or major source permitting authority to EQB.

USEPA and EQB do not presently maintain any air quality monitoring station on Vieques. However, the air quality on Vieques is generally expected to be in attainment for all criteria pollutants since air quality for the entire Puerto Rico AQCR is generally considered to be good. Occasional violations of particulate standards in Puerto Rico as a whole have been recorded as a result of unusual wind conditions which transport sand and dust from the Sahara Desert into the Caribbean area. The last such episode occurred in October 1984, when high particulate levels were reported in the Virgin Islands.

Noise

Noise levels associated with Navy activities on Vieques were extensively investigated in 1978 by a team of Navy specialists as well as by several private consultants. As a part of these investigations, environmental noise levels were monitored at various locations on Vieques and predictions were made of the noise levels caused by various AFWTF activities. In addition, 260 Vieques residents were surveyed to determine whether noise was perceived as a nuisance. Because neither civilian land uses nor Naval activities on Vieques have changed substantially since 1978, the data from these investigations, as summarized below, are generally expected to be indicative of the existing noise environment.

Sound levels on the civilian portions of the island are generally typical of the noise environment on many Caribbean islands, with an average day-night sound level (LDN) approaching 60 decibels. LDN is defined as the energy-averaged sound level (or equivalent continuous sound level, LEQ) obtained for a given day over 24 hours, with the addition of 10 decibels to all sound from 10 p.m. to 7 a.m. to account for the sensitivity of humans to noise during normal sleeping hours. The Puerto Rico EQB Noise Regulations specify an LEQ of 65 dB(A) during the daytime hours and 45 dB(A) for the nighttime; calculated on a daily basis, these levels equate to an LDN of approximately 60 decibels.

Rural farming and grazing sections of the island have low background sound level defined by natural conditions such as wind, rain, animals, windblown movement of vegetation, and thunderstorms. In the villages of Isabel Segunda and Esperanza, the sound environment is much louder as a result of noises associated with human habitation (i.e., automobiles, radios, machinery, pets, conversation).

Overall, Vieques is not considered to be particularly noisy, and the various investigations found no evidence to indicate that Navy activities significantly affect sound levels in the civilian areas or cause sound levels in the populated areas to exceed reasonably acceptable criteria. The noise survey of Vieques residents revealed that only 4.6% had ever been annoyed by noise. In comparison, 24% of the respondents in a noise survey conducted in the continental United States pinpointed noise as the leading undesirable condition in their neighborhood.

The OB/OD units are located approximately 10 miles from the nearest civilian areas. Therefore, noise levels from OB/OD activities do not impact civilian areas. OP-1 is located approximately 1.8 miles from the OB/OD units; their relative location is shown on Figure B-3. Personnel at OP-1 have reported no adverse noise effects from activities at the treatment units.

Ground Vibration

No ground vibration data exists regarding the detonation activities which occur at the OD unit. The closest structure to the units is OP-1, located approximately 1.8 miles from the individual units. No ground vibration effects have been detected by OP-1 personnel during the operating period of the facility. It is therefore unlikely that ground vibration effects are significant. However, a monitoring program will be conducted during the next treatment event per the criteria stated in 30 CFR 816.67 (Department of Interior — Use of Explosives; Control of Adverse Effects).

L-2 GROUNDWATER AND SUBSURFACE MIGRATION

Waste Analysis Plan

The volume and physical and chemical characteristics of the waste explosive which may be treated at the OB/OD facility have been addressed in Section C of this permit application. The plan requires that all ash generated during open burning operations be collected and analyzed to determine if it meets the characteristics of a hazardous waste. If it does, it will be disposed/treated at a properly permitted hazardous waste facility.

Since the primary use of the area is to serve as a bombing range, the overwhelming source of any potential contamination would be from this non-regulated activity. The Navy conducted a study in 1991, in response to the EQB comments concerning the Part B application, to evaluate whether a significant difference between soil contamination within the units and outside the units existed. The final report from this study, including all appendices, is shown in Appendix L-9.

The soil study consisted of a statistical evaluation of the soil samples obtained from the open burning area, the open detonation area, and the primary impact area. At the OB unit, two organic constituents (benzene, chloroform) in one TCLP extract (out of eleven) exhibited concentrations exceeding the 95 percent upper confidence level (UCL_{95}) for the primary impact area. However, selenium exceeded the UCL_{95} in more than 60 percent of the extract. At the OD unit, benzene concentrations exceeded the UCL_{95} in 30 percent of the extracts, and selenium concentrations exceeded the UCL_{95} in 25 percent of the extracts. The absence of quantifiable selenium concentrations at the impact area resulted in a computed UCL_{95} equal to the quantification limit of 0.49 ug/l. The OD concentrations were actually only 0.57, 0.62, and 0.64 ug/l.

This would tend to suggest that hazardous constituents from OB/OD activities exceed those from bombing operations. However, these compounds are not normal constituents of the ordnance treated by OB/OD at this facility and there is no apparent reason for these constituents to be present. Therefore, it does not appear likely that the current OB/OD activities are the source of these contaminants. It is more probable that, in the past, materials other than ordnance were treated at the facility by burning and/or detonation, such as waste solvents or fuels. However, since the results of the analyses from the impact area was considered to constitute *background*, and these compounds were detected at statistically higher concentrations in the OB and OD areas, the soils at the OB and OD areas were characterized as containing residual contamination of the three constituents. However, the concentrations of the constituents in the extracts are sufficiently low (ug/L range) that assessments of the risk of those residual concentrations to human health and the environment may be appropriate prior to performing elaborate removal, in-situ treatment, or containment alternatives. Also, according to published sources, there is no major aquifer in the area of the facility, and any groundwater would probably be in the form of small lenses. The soil in that area is primarily clay and rock with a low permeability.

The U.S. Army conducted a series of studies of over twenty open burning/open detonation sites, in which it was determined that groundwater contamination existed only at sites where open burning was conducted on the ground surface. This was primarily due to the use of supplemental fuels such as diesel or kerosene. This study, which was conducted by the U.S. Army Environmental Hygiene Agency, is included as Appendix L-8.

Hydrologic and Geologic Characteristics

The known hydrologic and geologic characteristics of the facility were described in Section L-1 of this application.

Existing Quality of Groundwater

No groundwater monitoring wells exist at the OB/OD area and groundwater quality cannot be verified. However, the explosives detonations occurring in the area as part of the training exercises is another source of potential contamination which would be the more significant contributor to any adverse impacts on groundwater quality. Any contamination from training operations would be indistinguishable from contamination from treatment operations. Further, the potential amount of contaminants from training is many times greater than that from treatment. Finally, there may not be any groundwater aquifer in the area.

Section L-9 describes a preliminary risk assessment which will be performed utilizing existing data in an attempt to determine possible impacts, if any, upon groundwater in the vicinity of the OB and OD units. This process will be followed in lieu of direct groundwater monitoring for the following reasons:

- Installation of monitoring wells would create an unacceptably high risk for onsite personnel. There is a strong possibility that drilling activities would inadvertently impact and detonate unexploded ordnance. This could also occur in transporting the drilling equipment onto and off the range.

- Integrity of wells cannot be maintained due to routine bombing activities. Even a near hit could damage or destroy the well structure.

- The presence of wells within the impact range would more than likely contribute to groundwater contamination, since, if damaged, the wells would act as a direct pathway from the surface to groundwater. In the event a well is damaged, any surficial contaminants present would potentially be transported directly into any underlying aquifer via this conduit. Therefore, the presence of wells could exacerbate rather than prevent any potential groundwater problem.

- If groundwater contamination is detected, it would be impossible to positively determine whether the source of the contamination is the OB/OD activities or the normal range activities. It is possible that wells could be installed on the perimeter of the range to avoid the above problems; however, this would tend to accentuate the problem of source determination.

On this basis, the most reasonable solution is to evaluate the situation based on a correlation of available surficial soil and water data to known OB/OD migration and health data.

Volume and Direction of Groundwater Flow

The volume of groundwater at the site has not been determined. If groundwater exists in the area, it is expected to be a very small aquifer.

Withdrawal Rates of Groundwater

There are no groundwater withdrawal wells in the immediate vicinity of the OB/OD facility. The closest withdrawal wells are located at Camp Garcia, located approximately 8 miles from the facility. Groundwater on Vieques Island is not used by civilian populations. All civilian drinking water is pumped from Puerto Rico by a submarine pipeline. There are no plans for further uses of groundwater on Vieques Island.

Patterns of Land Use

This information has already been provided in Figure B-3 of this permit application. The AFWTF is bounded on three sides by the Caribbean Sea. It is bounded by the Eastern Maneuver Area (EMA) which is used by the Fleet Marine Force, Atlantic (FMFLANT) for training exercises.

Migration of Contaminants to Subsurface Structures and the Root Zone of Food Chain Crops

There are no food chain crops or subsurface structures in the vicinity of the OB/OD facility. No subsurface structures are located in the area of the OB/OD facility.

Further, all ash associated with open burning is collected and removed from the site. It is then sampled and analyzed to determine if it is a hazardous waste. If so, the materials are disposed/treated at a properly permitted hazardous waste facility. Finally, an evaluation of soil contamination has been conducted; the final work plan and report of this study are shown in Appendix L-9.

Health Risks

No evidence exists that any increase in health risks will result from operation of this facility since the chances are minimal that significant amounts of hazardous constituents will reach groundwater and since there are no groundwater withdrawal wells in the area. Further, the area is abandoned except for a few days during the year when the targets are being repaired.

The Lawrence Livermore National Laboratory, in conjunction with the U.S. Army Medical Research and Development Command, conducted a Health and Environmental Effects Data Base Assessment concerning conventional weapons demilitarization. The final report was issued in 1987. Rather than duplicate this information, the report is included in its entirety in Appendix L-10.

Damage to Domestic Animals, Wildlife, Crops, Vegetation, and Physical Structures Caused by Exposure to Waste Constituents

No evidence exists that there is any damage to domestic animals, wildlife, crops, vegetation, or physical structures by way of the groundwater and subsurface due to operation of this facility. There is a 1750 ft. safety radius that is cleared during all OB/OD operations. Further, the area is being used for similar actions on a much greater scale for more than 200 days each year.

Groundwater Summary

AFWTF Vieques no longer open burns hazardous waste ordnance on the ground. Instead, burn trays, as described in Section D of this permit application, are utilized. Using burn trays for open burning operations prevents burn materials from contacting the ground during the treatment process, thereby preventing potential soil contamination and potential subsequent groundwater contamination. This engineering control along with the implementation of ash/debris removal (discussed later in Section L-8) ensures that operations conducted at this facility are sufficient to protect human health and the environment in regards to groundwater contamination and subsurface migration.

Further discussion on the engineering controls implemented by AFWTF Vieques can be found in Section L-8.

L-3 SURFACE WATER, WETLANDS AND SOIL SURFACES

Waste Analysis Plan

The volume and physical and chemical characteristics of the waste explosive which may be treated at the OB/OD facility have been addressed in Section C of this permit application. The plan requires that all ash generated during open burning will be collected and analyzed to determine if it meets the characteristics of a hazardous waste. If it does, it will be disposed/treated at a properly permitted hazardous waste facility.

Since the primary use of the area is serve as a bombing range, the overwhelming source of any potential contamination would be from this non-regulated activity. No waste water is generated from the process. The possible route for contaminated run-off water would be via soil contamination.

The Navy has conducted an investigation to determine whether there is a significant difference between soil contamination within the units and outside the units. This was described in detail in Section L-2 of this application.

Containment Structures

The waste is a bulk solid which is not given to spills with liquid runoff or absorption into the soil. Waste is stored at the facility only on the day of treatment. No definite drainage paths exist at the AIA, as described in Section L-1. The Navy installed sediment fences in the AIA aimed at the reduction of runoff that carries sediment and increases the suspended solids concentrations in Laguna Anones and the waters off the AIA. This measure also tends to inhibit runoff from the OB/OD units from exiting the facility. Since treatment will never occur during adverse weather, the potential for releases from the facility by surface runoff are negligible.

Hydrologic Characteristics of the Unit Including Topography

The hydrologic characteristics were described in Section L-1. Topographic maps (Figures B-2, B-2(a) and B-2(b)) have been submitted with this permit application which delineates the topography at the OB/OD facility and surrounding area.

Patterns of Precipitation

The mean annual precipitation in the area is approximately 36 inches. The patterns of precipitation should have no adverse effect on surface water. Further, operations are not conducted during storm conditions for safety reasons. Runoff from the range into lagoons and the surrounding ocean waters was monitored extensively during the 1980s under the facility NPDES permit. The results of this monitoring is summarized in the 1990 Water Quality Study in Appendix L-7. No explosives compounds were detected in any monitoring events.

Further precipitation information is included in Appendix L-7.

Quantity, Quality, and Direction of Groundwater Flow

The area is a bombing range and is therefore uninhabited. No appreciable groundwater aquifers are known to exist at the facility, so surface water contamination from groundwater is unlikely. As discussed previously, there is little or no groundwater in this area, and the quality of any groundwater is unknown. However, contaminated groundwater (from either OB/OD treatment or ordnance training operations) could transport contaminants into either the Laguna Anones or the Caribbean. The surface water monitoring program detected no indications of such migration.

Proximity of the Unit to Surface Waters

The closest bodies of surface water are the Laguna Anones and the Caribbean Ocean. Laguna Anones, located approximately 1/8 mile from the OB unit and 1/4 mile from the OD unit, is the nearest water body. The majority of runoff from the two units would drain into this lagoon. Samples taken under the NPDES program from this lagoon revealed no indications of contamination. This is addressed further in Section L-3.

Uses of Nearby Surface Waters

The Laguna Anones has no use at this time. The nearby Caribbean waters are reserved for military training. Civilian personnel are only allowed in the area with military escort and the approval of the range officer.

Existing Quality of Surface Waters and Soils

The quality of surface water in the area is discussed in Section L-1, where surface water quality is described as good. Further, it is closely monitored by the Navy per the facility NPDES permit.

Detailed information on water quality standards, designated use standards, and sampling/analytical results are contained within Appendix L-7.

Patterns of Land Use

The patterns of land use in the vicinity were addressed in Section B of this application. The entire eastern third of the island is used for military exercises. The OB/OD units are located adjacent to the target areas in a bombing range. The treatment activities are minor compared to the ordnance training activities which occur approximately 200 days per year.

Health Risks

No evidence of increased health risks from the operation of this facility exists through contamination of the surface water. As discussed in other sections, the OB/OD activity is similar in nature to the existing use of the property. However, the OB/OD activities occur for a few minutes per year as opposed to the use of the site as a bombing range for over 200 days per year. Therefore, the effects, if any, of the OB/OD activities are minuscule in comparison with the primary use of the property.

Further information concerning health effects are included in Section L-2 of this application. A preliminary risk assessment is planned in which potential health effects will be evaluated. This assessment is discussed further in Section L-9.

Damage to Domestic Animals, Wildlife, Crops, Vegetation, and Physical Structures Caused by Exposure to Waste Constituents

No evidence of damage is known to exist. As discussed in other sections, the OB/OD activity is similar in nature to the existing use of the property. However, the OB/OD activities occur for a few minutes per year as opposed to the use of the site as a bombing range for over 200 days per year. Therefore, the effects, if any, of the OB/OD activities are minuscule in comparison with the primary use of the property.

No food-chain crops are located within several miles of the facility. No man-made or natural subsurface physical structures are known to be located within several miles of the facility. The only vegetation within the AIA are rough grasses and shrubs; these materials are periodically cleared for target operations and range clearance.

Surface Water, Wetlands, and Soil Summary

As discussed within Section L-2, contamination to all environmental media is minimal, especially through the use of the engineering controls discussed in Section L-8.

The primary means of minimizing potential contamination of environmental media is through the effectiveness of the treatment process. This is described in detail in Section C-1 of this application.

L-4 AIR

Waste Analysis Plan

The volume and physical and chemical characteristics of the waste PEPs and explosives have been described in Section C.

Appendix C-4 describes the decomposition products from open burning and open detonation of PEPs. The extent of reaction is essentially complete. Air pollutants, such as carbon monoxide and NO_x are present in relatively small quantities due to the low annual quantity of wastes treated.

Since the primary use of the area is serve as a bombing range, the overwhelming source of any potential contamination would be from this non-regulated activity. The area is defined as an attainment area by EQB and EPA. The emissions from the normal range activities are insufficient to cause it to be classified as a PSD facility.

Information from pertinent DoD studies as well as appropriate air modelling will be utilized to obtain or estimate this information during the risk assessment described in Section L-9. The data will be compared with pertinent federal and EQB standards. The modelling activities will attempt to determine emissions both on an annual basis and on a per-event basis. The results of the assessment, along with pertinent regulatory standards, will be submitted as an addendum to this application when completed.

Effectiveness and Reliability of Structures to Reduce or Prevent Emissions of Hazardous Constituents to the Air

Due to the inherent nature of treatment, it is not technically feasible to utilize emission control devices for open burning and/or open detonation operations. The possibility of such equipment being destroyed during interim periods is high, and the virtually instantaneous nature of the treatment events makes it unlikely that any useful information could be developed. However, as shown in Appendix C-4, the treatment results in virtually all compounds being converted. Further, the amount of material treated is relatively small compared to the other activities which occur year-round. Emissions from OB/OD activities occur for only a few minutes each year. Therefore, the very nature of the process minimizes emissions.

The Department of Defense has performed extensive studies into the effectiveness of open burning and detonation in terms of effectiveness and impact upon human health and the environment. The most recent has been performed by the U.S. Army Armament, Munitions and Chemical Command under both laboratory and field conditions. The final reports, including all conclusions and recommendations, of this testing program are shown in Appendix L-11. The report suggests that the bulk explosives and propellants examined during the field testing will produce and release acceptable levels of emittants to the environment by surface OB/OD methods. However, further item- and site-specific testing is needed to provide data to support risk assessments. Only after these risk assessments are completed can a definitive statement be made concerning the effect (if any) OB/OD operation may have on human health and the environment. Based upon the testing performed so far, OB/OD thermal treatment operations appear to be an environmentally safe, as well as cost effective, means of treatment.

Operating Characteristics of the Unit

The operational characteristics of the facility have been fully addressed in Section D. Normal operation of the unit results in all wastes losing their reactive properties because they react to completion. Further, the treatment activities occur for only a few minutes out of the year as opposed to the similar activities which occur year round. Therefore, the OB/OD units should have no adverse impact on air quality. One goal of the preliminary risk assessment described in Section L-9 is to attempt to determine the effects of the OB/OD activities on air quality.

Appendix L-11 provides representative descriptions of the releases, such as plume descriptions, reaction temperatures, contaminant levels, etc.

Atmospheric, Meteorologic, and Topographic Characteristics of the Unit and Surrounding Area

The available climatic information requested in this section was described in Section L-1. In addition, topographic maps of the OB/OD facility and the surrounding area are provided in Figures B-2, B-2(a), and B-2(b). These factors will have no adverse effect on air quality.

Existing Quality of the Air, Including Other Sources of Contamination and the Cumulative Impact on the Air

The results of computer modeling simulations of OB/OD activities are provided in Appendix C-4. These simulations demonstrate that only small amounts of air pollutants are emitted to the atmosphere on an annual basis, and should not adversely affect the existing quality of the air. EQB already monitors the air quality in the area and has classified it as an attainment area. Further, the combined activities of the target range and the OB/OD units have been insufficient to cause the area to be classified as a PSD. The only other air emissions source within five miles is the impact range itself; any emissions from this area would be similar, if not identical, to those from the OB/OD activities.

Potential for Health Risks

Since the area is a bombing range, it is uninhabited. In fact, the entire eastern end of the island is reserved for military operations. There are no potential receptors for miles around the units.

Also, the unit discharges only small amounts of total emissions during a year. Most of these emissions are typical of by-products of residential and industrial combustion activities.

A more detailed narrative on potential health risks is presented in Section L-2 of this application. Waste characterization and volumes are contained within Sections C and D of this application.

Damage to Animals, Wildlife, Crops, Vegetation and Physical Structures Caused by Exposure to Waste Constituents

The area is uninhabited because it is a bombing range. In fact the entire eastern end of the island is reserved for military operations. During treatment, a safety radius of 1750 ft. is cleared from around the units which limits exposure to these activities. Also, the unit discharges only small amounts of total emissions during a year. Most of these emissions are typical of by-products of residential and industrial combustion activities.

Air Monitoring Summary

As mentioned above, open detonation activities do not emit sufficient quantities of hazardous constituents to require air monitoring. Numerous studies and simulations have been conducted by the U.S. Army Armament, Munitions, and Chemical Command which reviewed the processes of open burning and open detonation and their effects on environmental media. The conclusion to these studies illustrated little to no contamination of environmental media. The studies did not consider the use of engineering controls as mentioned within this permit application section.

L-5 MONITORING AND TESTING DURING THE OPERATIONAL, CLOSURE AND POST-CLOSURE PERIODS [40 CFR 264.602]

The U.S. Army conducted a study of over twenty military sites which open burn/open detonate explosive waste. In addition, the Army Armament, Munitions, and Chemical Command is currently conducting studies to identify and quantify emissions from OB/OD thermal treatment facilities. These studies provide a substantial body of information which characterizes the environmental impact of these units. The information compiled from these studies, along with site specific sampling data, will be utilized to perform a preliminary risk assessment into any potential environmental impacts from OB/OD. This will be performed in lieu of monitoring due to the obstacles associated with such monitoring activities, as described below.

The nature of this type of facility makes monitoring impractical, if not impossible, due to; 1) the explosions associated with treatment and/or ordnance training would either destroy or render inoperable the monitoring equipment, 2) it would be impossible to disassociate the effects of treatment from the effects of the training operations which occur in the same area, 3) the aquifer at the facility site is assumed to be either very thin or nonexistent which makes groundwater monitoring impossible, and 4) the effects of four or five days of treatment per year are minuscule compared to the effects of ordnance training. For these reasons, no monitoring is planned. It is anticipated that the preliminary risk assessment will provide an adequate representation of conditions at the facility.

L-6 POTENTIAL PATHWAYS OF EXPOSURE

The treatment of explosive hazardous waste by open detonation and open burning have some small potential to enter the soils, surface waters, groundwater, and air. However, the various studies conducted by DoD indicate no significant effects to these media when operations are limited to open detonation on the ground surface and open burning in trays. AFWTF Vieques will utilize additional engineering controls such as precipitation covers, berms, and burn tray screens. Also, administrative controls including ash/debris removal management are utilized at the facility.

The preliminary risk assessment will attempt to assess the various pathways to determine whether these controls are effective at limiting exposure.

L-7 DEMONSTRATION OF EFFECTIVENESS OF TREATMENT

Materials which are thermally treated at Vieques include conventional munitions, propellants, pyrotechnics, and explosives. As part of the manufacturing process, these items are specifically designed to combust or explode completely. Undetonated and unburned materials are retreated until they have lost their reactive properties.

The effectiveness of the OB/OD treatment process is further demonstrated in the OB/OD simulation results shown in Appendix C-4, as well as the test series results included in Appendices L-8 and L-11.

L-8 FACILITY ENGINEERING CONTROLS

AFWTF Vieques' open burning operations are conducted within burn trays/containers with an engineered filter screen to minimize particulate emissions and to prevent direct contact of soil and hazardous waste ordnance constituents. Open detonation operations are conducted on the ground with no direct (i.e. trays, shields, filter screens, etc.) engineering controls to prevent potential environmental media contamination. Because of the tremendous reaction associated with the open detonation process, direct environmental pollution control equipment would be unable to withstand the pressures and forces applied to them during each open detonation treatment activity.

Open Burn Tray/Container

The open burn tray/container is illustrated in Figure D-1. The purpose of the burn tray is to contain the burn process and the ash and debris by-products to prevent these materials from contacting environmental media. The trays also allow for easy removal of residue for subsequent sampling and disposal. The burn tray is equipped with a burn screen designed to prevent escape of burn ash and particulates into the air. For more information regarding the design and purpose of the burn tray and its filter screen, see Section D.

Precipitation Management

Precipitation management includes preventing precipitation, through engineering and administrative controls, from contacting and potentially contaminating environmental media (i.e. soil, surface waters, and groundwater). Precipitation management at AFWTF Vieques includes the employment of a precipitation cover for the open burn trays to prevent the direct contact between precipitation and the potentially contaminated portions of each unit. The precipitation cover is designed for runon contamination control.

No precipitation control is possible at the open detonation area due to the function of the unit. Any roofed structures would be destroyed during the treatment event; also, such structures would be destroyed during routine ordnance training operations. However, the erosion control measures discussed in Section L-1 also assist in minimizing releases via surface drainage.

More information on the design and use of the burn trays and precipitation covers is located in Section D.

Periodic monitoring conducted during the 1980s per the NPDES permit confirmed that no appreciable levels of contaminants were entering the surface water bodies in the vicinity of the treatment units.

Air Emissions Management

Due to the type of treatment involved, no real engineering controls can be installed to minimize air emissions from the respective units. However, the DoD studies and simulations have indicated that air emissions from these types of units are minimal. This is described further is Section L-4.

Noise Management

AFWTF Vieques realizes that open detonation operations produce noise levels above the Occupational Safety and Health Administration's required limits. To eliminate the harmful affects these operations may pose to military and civilian populations, AFWTF Vieques has chosen a remote location for these treatment units. The Noise Management program incorporates natural buffers by using distance, landscape, and topography to eliminate the affects of these operations.

Ash/Debris Management

Ash and debris management consists of collecting all visible ash and debris produced from the open burning and/or open detonation of military ordnance at the permitted OB/OD treatment unit.

Open burning operations produce ash and debris, the majority of which is contained within the burn tray. After the burn operation is completed (minimum of 24 hours), EOD collects all ash and debris from the burn tray and surrounding area into metal drums for subsequent sampling and disposal.

Following open detonation operations, a 24 hour waiting period is required prior to inspection. Due to the nature of the treatment, it is rare that any debris from the explosion is detected. Also, since the area is bombed approximately 200 days per year, it is impossible to determine the source of any debris encountered. An unexploded ordnance detected is treated/retreated upon detection. Additional debris, which would primarily consist of metal fragments, are not collected due to the preponderance of such material on the range. Such materials will be addressed during the closure of the range itself.

Sampling and disposal of the ash and debris produced during open burning and open detonation operations is coordinated through the Demilitarization and Reutilization Marketing Office (DRMO) located at Naval Station Roosevelt Roads. Procedures for sampling ash and debris collected after OB/OD operations are completed are located within Section C — Waste Analysis Plan of this permit application. Also, more information on ash and debris collection is located within Section D — Process Information.

L-9 PRELIMINARY RISK ASSESSMENT

Due to the inherent risks associated with drilling within active impact ranges as well as the likelihood that monitoring equipment such as wells or air monitors will be damaged or destroyed, groundwater and air monitoring is not considered feasible at this facility. In order to determine whether such monitoring in necessary, a preliminary risk assessment will be performed to evaluate the facility based upon existing data.

The objective of the preliminary risk assessment will be to determine the health hazard and risk to humans and the environmental impacts of hazardous materials from the OB/OD activities at AFWTF Vieques. The assessment will consider environmental media and exposure pathways that could result in unacceptable levels of exposure now or in the future. In a full baseline risk assessment, the value of the risk assessment as a basis for making operational or remedial decisions is contingent upon an adequate characterization of chemical contamination. However, due to the safety hazards associated with subsurface investigations within active impact ranges, this preliminary assessment will attempt to evaluate the facility utilizing existing soil and surface water data as well as generic DoD data from OB/OD research activities. The documentation to be used for the preliminary risk assessment is included in Appendices L-7, L-8, L-9, L-10 and L-11. The results of this assessment will be forwarded upon completion.

Specific guidance on conducting a baseline risk assessment, including a full quantitative risk assessment for likely exposure pathways, is provided in USEPA guidance (USEPA, 1986; USEPA, 1988a; USEPA, 1988b; USEPA, 1989; and USEPA, 1990). This preliminary assessment will be conducted in accordance with these guidance materials, a partial list of which is shown at the end of this section.

The risk assessment process can be divided into four components:

Contaminant identification: The objectives of contaminant identification are to screen the information that is available on hazardous substances present at the site and to identify contaminants of concern in order to focus subsequent efforts in the risk assessment process. Contaminants of concern are selected in consideration of their intrinsic toxicological properties, their presence in large quantities, their frequency of occurrence and/or their presence in potentially critical exposure pathways (e.g., drinking water supply).

Exposure assessment: The objectives of an exposure assessment are to identify actual or potential exposure pathways, to characterize the potentially exposed populations, and to determine the extent of the exposure. For exposure to occur, four essential elements must exist, i.e. (a) a source and mechanisms of chemical release to the environment, (b) an environmental transport medium (e.g., air, groundwater released chemical), (c) a point of potential contact (exposure point) with the contaminated medium and (d) an exposure route (e.g., inhalation, ingestion) at the contact point.

Toxicity assessment: The objective of the toxicity assessment is to further determine the potential hazard posed by the chemicals of concern for which exposure pathways have been identified. The predicted exposure levels are evaluated relative to internal dose and toxicological responses. Data for each reasonable route of exposure are compared with generally accepted safe levels. Contaminant-specific standards that are applicable or relevant and appropriate (ARARs) are used when available to determine acceptable levels. When ARARs are not available or sufficiently protective for specific compounds or exposure media, health-based levels are determined by using USEPA reference doses (RfDs) for noncarcinogens and USEPA potency factors (q_1*s) for carcinogens.

Risk characterization: The objective of this final step of the risk assessment is to estimate the overall potential adverse effect by utilizing the exposure information and dose-response data for each exposure scenario. The risk characterization provides numerical estimates of risk and a framework to help judge the significance of the risk and convey the related uncertainties.

The AIA is located within a secured military facility. No civilian personnel are allowed within the unit, and the OB/OD facility is located such that there is a approximately eight miles to the nearest civilian activity. Ordnance is not classified as waste until the time when the decision is made to discard the waste. From this point, the waste is accumulated within secured Naval magazines on either Roosevelt Roads Naval Station or the Naval Ammunition Facility (NAF) on Vieques Island. Ground transportation occurs entirely within these installations. The waste is transported by sea from Roosevelt Roads to the NAF, and then from the NAF to the AIA. Therefore, it is unlikely that exposures to the public will occur prior to treatment. This risk assessment, however, will be performed in order to verify this.

Contaminants of Concern

The primary contaminants of concern are those described in Section C of this application. However, three additional contaminants were detected during the 1991 soil sampling activity, and DoD utilizes a wide variety of parameters in conducting OB/OD effectiveness testing. Therefore, professional judgement will be used in conjunction with USEPA guidance to select the chemicals for evaluation in the risk assessment. The selection will be made based upon the primary objective of the baseline risk assessment, i.e. to determine if the site and its respective operations pose a significant hazard now or in the future from any pathway such that no additional monitoring or remedial activities will be required. This selection process will include the following criteria:

- The chemical has demonstrated significant toxicity to animal life in published reports.
- USEPA health-based numbers can be obtained for the chemical.
- The occurrence of the chemical is significant, based on frequency, concentration and exposure potential, in regard to the total risk posed by the site or activity.

Other factors to be considered in selection of the chemicals of concern are historical information (site related), mobility, persistence, and bioaccumulation in the environment. A partial list of guidance documentation to be utilized is shown below:

- Sims, R.C. et al, 1988. Soil Transport and Fate Computer Database, Utah State University, Logan, Utah.

- USEPA, 1986. Superfund Public Health Evaluation Manual, EPA/540/1-86/060, EPA Office of Solid Waste and Emergency Response, Washington, D.C.

- Criteria for Selection of Groundwater Exposure Assessment Models, OHEA-E-219, USEPA, 2/1987.

- Endangerment Assessment Handbook USEPA/OWPE, TR-693-24B, 10/1985.

- General Quantitative Risk Assessment Guidelines for Noncarcinogenic and Nonmutagenic Health Effects, USEPA/RAF, Third Draft, 2/1988.

- Guidance for Establishing Target Clean-up Levels for Soils at Hazardous Waste Sites, USEPA/ORD, 1989.

- Hazard Evaluation Division Standard Evaluation Procedures: Ecological Risk Assessment, USEPA/OPP, EPA 540/9-85-001, 6/1986.

- Health and Environmental Effects Profiles and Documents, USEPA/OHEA/ECAO, 1984-1990.

- Health Effects Assessments, USEPA/OHEA/ECAO, 1984-1988.

- Integrated Risk Information System, On-Line, USEPA Risk Data Base (updated monthly).

- U.S. Environmental Protection Agency, 1986. 2 Guidelines for Risk and Health Assessments (in 5 areas). Federal Register 51:185, pg. 33994-34054.

- U.S. Environmental Protection Agency, 1988a. Superfund Exposure Assessment Manual. OSWER Directive 9285.5-1, EPA/540/1-88.001, April 1988.

- U.S. Environmental Protection Agency, 1988b. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final. OSWER Directive 9355.3-01. EPA/540/G-89/004, October 1988.

- U.S. Environmental Protection Agency, 1989. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual Part A, Interim Final. EPA/540/1-89/002. December 1989.

- U.S. Environmental Protection Agency, 1990. National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule. EPA/540/1-89/002. December 1989. Federal Register V55:46 pg 8666-8865, March 8, 1990.

- National Science Foundation, Division of Policy Research and Analysis. Risk Assessment and Risk Assessment Methods: The State-of-the-Art. NSF/PRA 84016, 1985.

- Nonexposure Aspects of Risk Assessment, EPA Contract #68-02-4254-75, OTS, 1988.

- Office of Science and Technology Policy, Interagency Staff Group on Chemical Carcinogenesis, Executive Office of the President. Chemical Carcinogens: A Review of the Science and its Associated Principles. Federal Register 50:10372-10442, 1985.

- Rapid Assessment of Potential Groundwater Contamination under Emergency Response Conditions, EPA 600/8-83-030, 11/1983.

- Toxicology Handbook USEPA/OWPE, Tr-603-21A, 10/1985.

- USEPA. Proposed Guidelines for Mutagenicity Risk Assessment. Federal Register 49:46313-46321, 1984c.

- USEPA. Proposed Guidelines for the Health Assessment of Suspect Developmental Toxicants. Federal Register 49:46323-46331, 1984d.

- USEPA. Water Related Environmental Fate of 129 Priority Pollutants, Vol. 1, EPA 440/4-79-029a, Dec. 1979.

- Byard, J.L., 1989. The Risk Assessment of Environmental and Human Health Hazards: A Textbook of Case Studies. John Wiley and Sons, pp. 334-337.

ALL SECTION L APPENDICES ARE LOCATED IN VOLUMES II, III, IV, and V OF THIS APPLICATION

SECTION M

LETTER OF CERTIFICATION

The following is the required letter of certification to be signed by the owner or operator as required by 40 CFR 270.270.11(d).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted.

Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the application submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

____
Signature

____
Date