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Final Draft (FINAL VERSION)  
**Preliminary Range Assessment Report**  
**Vieques Naval Training Range**  
**Vieques Island, Puerto Rico**



*Prepared for*

**Commander, U.S. Atlantic Fleet**  
**U.S. Navy**

*Prepared by*

**Naval Facilities Engineering Command**  
**Atlantic Division**  
**1510 Gilbert Street**  
**Norfolk, VA 23451-2699**

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# Abbreviations and Acronyms

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°F	Degrees Fahrenheit
AFWTF	Atlantic Fleet Weapons Training Facility
AOC	Area of Concern
ARS	Archives Record Search
BZO	Battle Zero
CAL	Caliber
CD	Compact Disc
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COMLANTFLT	Commander, U.S. Atlantic Fleet
CSM	Conceptual Model
CRP	Community Relations Plan
DDT	Deflagration-to-Detonation Transition
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DOI	Department of Interior
DTC	Desert Test Center
EBS	Environmental Baseline Survey
ECA	Eastern Conservation Area
EIS	Environmental Impact Statement
EMA	Eastern Maneuver Area
EOD	Explosive Ordnance Disposal
ERI	Environmental Resources, Inc.
ERM	Environmental Resources Management, Inc.
FMFLANT	Fleet Marine Force, Atlantic
Ft	Feet/Foot
GIS	Geographic Information System
HEAT	High Explosive/Anti- Tank
GPS	Global Positioning System
IAS	Initial Assessment Study
LANTDIV	Atlantic Division
LAW	Light Anti-Craft Weapon
LDGP	Low Drag General Purpose Bomb
LIA	Live Impact Area
LUMP	Land Use Management Plan
MC	Munitions Constituents
MEC	Munitions and Explosives of Concern
MPPEH	Munitions that Present a Potential Explosive Hazard
MSL	Mean Sea Level
NSRR	Naval Station Roosevelt Roads
NAVFACENGCOM	Naval Facilities Engineering Command

Navy	U.S. Navy
NEW	Net Explosive Weight
NGFS	Naval Gunfire Support
NRHP	National Register of Historic Places
NTR	Navy Technical Representative
NWS	National Wildlife Service
OB	Open Burn
OD	Open Detonation
ODUSD	Office of the Deputy Under Secretary of Defense
OP	Observation Post
PA	Preliminary Assessment
PAOC	Potential Area of Concern
PI	Photo-Identified
PPE	Personal Protective Equipment
PRA	Preliminary Range Assessment
PRASA	Puerto Rico Aqueduct and Sewer Authority
PREQB	Puerto Rico Environmental Quality Board
QA	Quality Assurance
QC	Quality Control
RAC	Risk Assessment Code
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RCRA	Resource Conservation and Recovery Act
SIA	Surface Impact Area
SWMU	Solid Waste Management Unit
TM	Technical Memorandum
UNITAS	United International Antisubmarine Warfare (Exercise)
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
UXO	Unexploded Ordnance
VNTR	Vieques Naval Training Range

# Executive Summary

---

This report presents the results of the Preliminary Range Assessment (PRA) prepared for the Vieques Naval Training Range (VNTR), Puerto Rico. The objectives of the PRA are multi-pronged and include:

- Provide information about the types, quantities, constituents, and other factors related to the military munitions employed; and identify the type(s) and location(s) of any targets that may have been used on the MEC areas on the facility. The assessment is limited to the collection of information on the land-based areas, no underwater assessments are provided;
- Identify range operations or management practices, past or present, which have the potential to result in adverse environmental impacts to the MEC areas or surrounding areas;
- Identify MEC areas requiring further investigation prior to arriving at decisions on the need (or lack of need) for remedial actions;
- Identify the need for an accelerated remedial action or removal action, if required, due to an imminent threat to human health or the environment;
- Provide information on previous range refurbishing activities, reported incidents involving military munitions [including unexploded ordnance (UXO)], or previous remedial actions on the MEC areas;
- Based on the field reconnaissance and risk assessment eliminate from further consideration suspect Munitions and Explosives of Concern (MEC) areas that pose no threat to public health or the environment;
- Based upon the information gathered and the explosives risk, propose an initial explosives safety risk assessment to identify areas for further action. Each investigated area was scored and ranked in accordance with guidance provided in the Defense Environmental Restoration Program (DERP) Guidance Manual.

The scope of the PRA was based on Department of Defense (DoD) guidance for performing response actions on military ranges, as well as U.S. Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency's (USEPA) guidance on ordnance and explosive response actions. The PRA utilized available information gathered through a combination of national and local archive/file searches, interviews, desktop information collection and analysis; including field investigations for limited visual observations at the areas. A preliminary assessment of the risk posed by any MEC and munitions constituents (MC) was completed at the MEC areas.

Vieques Island has a land area of approximately 33,000 acres, and is located in the Caribbean Sea approximately 7 miles southeast of the eastern coast of the island of Puerto Rico. The VNTR is located on the eastern one-third of the island mostly under the command of the Atlantic Fleet Weapons Training Facility (AFWTF) who in turn reports to Commander, U.S.

Atlantic Fleet (COMLANTFLT). The VNTR includes the following operational areas extending from east to west: the Eastern Conservation Area (ECA), comprised of an area of 200 acres; the Live Impact Area (LIA), comprised of 900 acres; the Surface Impact Area (SIA), comprised of 2,500 acres; and the adjacent and wholly contiguous Eastern Maneuver Area (EMA), comprised of around 11,070 acres. The locations of these areas are shown on Figure 2-2. The Navy utilized these areas as impact areas for COMLANTFLT training in the operational areas of Naval Gunfire Support (NGFS) or ship-to-shore firing; Air-to-Ground (ATG) ordnance delivery; ground forces artillery/tank firing/small arms firing; and amphibious operations landings.

Of the 62 MEC areas discussed in this PRA, the area with the largest ordnance usage is the LIA of the VNTR, encompassing an area of 900 acres. This area was established by the Navy in 1964 when a gunnery range was constructed. This range consisted of point and area targets for ships to practice NGFS. In 1965, the LIA added an air impact area where numerous mock-ups such as old tanks and vehicles were used as targets for aerial bombing and strafing with live and inert ordnance. The activity at the LIA increased significantly after July 1975 when training activities stopped on nearby Culebra Island. From 1974 through 1998, an average of more than 7,600 rounds per year of naval gunfire (NGF) was directed at the LIA. The naval gunfire MEC typically ranged from 3-inch/50 to 5-inch/54 type projectiles each weighting from 13 to 70 pounds. For the same period of time, the ATG MEC expended averaged more than 3,000 rounds per year. The ATG MEC typically ranged from MK-24s (parachute flares) through MK-84 bombs (2,000 lb. bombs). The total weight of the NGF and ATG from 1974-1998 exceeded 27,000 tons.

The SIA, encompassing 2,500 acres, was established during the 1950s when several marine artillery targets were constructed. Marine artillery, ranging from 76mm rounds to 175mm rounds, were directed toward these targets from artillery gun positions within the SIA and EMA. During the mid-1970s, bulls-eye targets were established in the SIA for ATG bombing with MK-76 and MK-106 practice bombs and inert rockets. An aerial photo analysis of this area identified that the entire SIA is covered by numerous craters caused by bomb mortar and artillery fire. The craters were most visible on the 1962 photography. The aerial photo analysis also identified 18 artillery gun positions or observation posts within the SIA.

The EMA, encompassing 11,070 acres, was established in 1947 and provided maneuvering areas and ranges for the training of marine amphibious units and battalion landing teams in exercises of amphibious landings, small arms fire, artillery and tank fire, shore fire control, and combat engineering tasks. The heaviest training events occurred from the mid-1950s to the early 1960s. However, no ordnance data was available for these years. In 1966, six ranges were established along the northern coast of the EMA. Three of the ranges were used for small arms fire, one was used for rifle grenade fire, one was a rocket range, and one was a demolition-blast range. Large-scale artillery exercises were completed in the EMA using live artillery (105mm, 175mm, 8-inch, tank (90mm) and other weapons including: pistols, rifles, machine guns, grenades, tanks, artillery, recoilless rifles, and mortars. An average of 4,459 artillery rounds per year were fired during these exercises from the period from 1974 through 1998. The total weight of the artillery for this period was more than 2,100 tons.

A field reconnaissance, archive records search, and aerial photographic analysis were conducted at the EMA and SIA to characterize the extent and the types of MEC present at six

ranges, 10 artillery gun positions, one ATG target area, and one ordnance loading/off-loading area. Based on this information, MEC usage was confirmed. Additional field investigations would be needed to further quantify the amount of MEC present within these areas.

In addition to the 19 MEC areas investigated within the VNTR, an analysis of historical aerial photographs and interviews of personnel identified 43 additional potential MEC areas within the VNTR boundaries. These areas include five potential ranges, 32 mortar or artillery gun positions, four observation posts and two MEC storage areas. Additional field investigations will be required to assess if MEC was used at these areas and to determine whether further action would be required.

The information from the field reconnaissance, archive search and the aerial photo analysis was evaluated to develop a MEC Conceptual Model (CSM) for the VNTR Facility. The CSM indicates that the entire 900 acres of the LIA has been impacted from MEC from air-ground ordnance delivery and naval gunfire. The activities of the LIA have also impacted the 200 acres of the adjacent Eastern Conservation Area. The aerial photo analysis identified numerous craters within the entire 2,500 acres of the SIA which were caused by mortar and artillery fire, naval gunfire and aerial bombing. Safety fans developed for the six ranges and several artillery fans within the EMA show that approximately 5,200 acres of the 11,070 acres within the EMA potentially contain MEC.

Based on the information that has been obtained from the PRA, an initial explosives safety risk assessment was conducted for the MEC areas in the VNTR. The risk assessment procedure used, the Risk Assessment Code (RAC), is an interim internal DoD wide approach for providing a single consistent preliminary evaluation of explosives hazards posed by MEC areas. The risk assessment calculates two risk components, hazard severity and hazard probability. Hazard severity takes into account the types of MEC present at each area. The hazard probability considers: distance of the MEC to the nearest receptor, access to the MEC area and the area dynamics. Based on the results of an explosives safety risk assessment, the MEC areas have been categorized as follows:

- **Serious Risk - Priority for Further Action:** The entire LIA including the Bombing Range and the OB/OD area
- **Moderate Risk - Recommended Further Action:** The SIA target areas, 15 gun positions in the SIA and EMA, and 3 ranges within the EMA (Range 3, Range 4, Range 5)
- **Low Risk - Recommended Further Action:** 3 ranges within the EMA (Range 1, Range 2 and Range 6)

The low to moderate risk areas are primarily attributed to the restricted access and the long distance to the nearest inhabited location. Should the security be breached at VNTR by trespassers, similar to what has occurred on several occasions during the last few years, the explosive safety risk will increase to a high-risk category for these MEC areas.

It is recommended that the explosives safety risk assessment be re-evaluated following the implementation of the security measures associated with the transfer of the property from the Navy to DOI. These security measures will be outlined in the Memorandum Of Agreement (MOA) that is under negotiation between both parties As an interim safety

precaution, it is recommended that the access be further restricted to the following locations: the LIA, SIA, the marine artillery firing positions, and three ranges within the EMA (Ranges 3, 4, 5). Access restrictions could include the installation of Jersey barriers or gates across the access roads to these areas, the installation of fencing to restrict walking access and the installation of signage.

To better quantify this preliminary RAC risk assessment and to assess the need for additional investigations and remedial actions, it is recommended that completion of a more detailed Preliminary Assessment/Site Investigation (PA/SI) at the potential MEC areas which have been identified in this PRA. Geophysical surveys are recommended at the areas known to contain MEC to initially evaluate the nature and extent of MEC present. Based on the results of these investigations, a more detailed screening of areas can be developed to prioritize the areas for further investigation and action if appropriate. The prioritization should take into account the RAC components, as well as factors such as anticipated land use, human health and ecological receptors, vegetative cover, public access, and technological and economic feasibility.

## SECTION 1

# Introduction

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This Draft Preliminary Range Assessment (PRA) Report for the Vieques Naval Training Range (VNTR) has been prepared for the Naval Facilities Engineering Command (NAVFACENGCOM) Atlantic Division (LANTDIV) under Navy Contract N62470-95-D-6007, Navy Comprehensive Long-Term Environmental Action Navy (CLEAN), District III, Contract Task Order 272. This report presents results of the PRA and the Archives Record Search (ARS) that were completed concurrently from mid-October 2002 through early February 2003. The information obtained from the PRA (munitions-related Archives Search and Inspection) will be combined with knowledge and information gathered the Environmental Baseline Survey (EBS) for the VNTR, which was completed concurrently with the PRA. The two reports will give the Navy a completed review of both potential environmental and MEC contamination within the VNTR.

By May 1, 2003, the U.S. Navy plans to cease training exercises on the eastern end of Vieques. On January 10, 2003, the Secretary of the Navy certified to the President and Congress that an alternative training facility or facilities that provide equivalent or superior training exist and are available, thereby confirming that the Navy will cease operations at Vieques.

Following termination of training operations on Vieques, the VNTR will be transferred to the jurisdiction of the Secretary of the Interior. Interior would administer the Live Impact Area (LIA), a 900-acre area for targeting by live ordnance in training by the Navy and Marine Corps, as a "Wilderness Area" with no public access. The remaining 13,770 acres of the VNTR would be administered by the Interior as a Wildlife Refuge.

## 1.1 Purpose and Scope

The PRA conducted for the VNTR was designed to identify those munitions and explosives of concern (MEC) areas that may pose no threat to the public or the environment; to identify those MEC areas that warrant further investigation prior to arriving at decisions on the need (or lack of need) for remedial actions; and to identify the need for an accelerated remedial action or removal action because of an imminent threat to human health or the environment. In addition, objectives also included an initial preliminary prioritization for sequencing areas for further action. To meet these objectives, a number of tasks detailed in Section 3 were developed to gather the required information from field reconnaissance and ARS efforts to help form conclusions on the potential risks posed by MEC hazards within the study area.

**These tasks:**

- Provide information on previous range clearance activities, reported incidents involving military munitions (including unexploded ordnance [UXO]), or previous remedial actions on the MEC areas.
- Provide information about the types, quantities, constituents, and other factors related to the military munitions employed.
- Identify range operations or management practices, past or present, which have the potential to result in adverse environmental impacts to the MEC areas or surrounding areas.
- Address safety issues related to military munitions on the MEC areas.
- Identify human health or environmental effects of other constituents known or believed to be present on the MEC areas.
- Identify the type(s) and location(s) of any targets that may have been used on the MEC areas.
- Identify other past and present uses of the MEC areas.
- Provide any reasonably anticipated future land use or imposing land use restrictions. If not available, provide current and reasonably anticipated future land uses.
- Present data elements required to complete prioritization and cost to complete analysis using approved Department of the Navy Methodology.
- The scope of the PRA was based on Department of Defense (DoD) guidance for performing response actions on military ranges and U.S. Environmental Protection Agency (USEPA) guidance for conducting Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Preliminary Assessments (PAs), as well as on U.S. Army Corps of Engineers (USACE) guidance on ordnance and explosive response actions.
- The field truthing element of the PRA utilized accessible ARS information and field reconnaissance methods, based on visual observations, to evaluate risks posed by any MEC noted within individual areas.

Due to restrictions based on the safety requirements for the 900-acre LIA, the field truthing component of the PRA scope was not executed in this area. Information gathered from the ARS and personnel interviews about the types, quantities, constituents, and other factors related to the munitions employed in the LIA is noted throughout this report. A data sample for selected operational periods at the LIA is presented in both narrative and tabular form in Section 2.2. Summaries of the types and quantities of ordnance historically used at the LIA are provided as Appendix A to this draft report, and should be used along with information presented here for a more thorough understanding of the historical activity at the LIA.

Section 3 lists the specific types of ordnance employed, explosive and hazardous constituents associated with ordnance used, types of ordnance management practices (i.e., storage,

handling, open burning, open detonation, firing point, impact areas), and general environmental settings for areas included in ground truthing efforts under this PRA.

## 1.2 Report Organization

This Draft PRA Report contains six sections, the remainder of which are organized as follows:

**Section 2, VNTR Background, History, and Physical Setting** - Describes the area and military history of the VNTR and the physical setting of those areas including climate, vegetation, geology, hydrology, groundwater. This section also provides a narrative on natural and cultural resources within the VNTR, and a summary of previous investigations completed within these lands.

**Section 3, Summary of Field Investigations** - This section introduces areas chosen for the field truthing component of the PRA and also describes the approach, methods, and operational procedures employed to perform these efforts. This section also presents findings of the field investigation and discusses the data management and quality control measures utilized during collection of PRA-related data.

**Section 4, Pathway and Hazard Analysis and Preliminary MEC Hazard Assessments** - Introduces the conceptual model (CSM) for the VNTR. The CSM illustrates the primary MEC sources, release mechanisms, pathways and potential receptors. This section also presents results of the preliminary qualitative MEC hazard evaluation, which includes an assessment of hazard severity, probability, and subsequent MEC safety risk assessment that result in Risk Assessment Code (RAC) scores for areas included under this study.

**Section 5, Conclusions and Recommendations** - This section builds on results of the preliminary MEC hazard evaluations in Section 4 and presents conclusions that rank and prioritize areas in terms of MEC safety hazard risks. From this preliminary ranking and prioritization of area risks, recommendations for further evaluation and actions where warranted are presented for consideration, as is a recommendation to limit access to a number of areas within the VNTR.

**Section 6, References** - Lists other documents and sources cited or used in the development of this Draft PRA Report.

Appendixes to this Draft PRA Report include the Draft ARS Report, Level 1 Reconnaissance Forms, a photo-documentation log of areas visited during PRA activities, personnel interview sheets, and a copy of the ERI December 2002 Draft Addendum Report on the analysis of historical aerial photographs.

## SECTION 2

# VNTR Background, History, and Physical Setting

---

This section discusses the background, history (including historical military operations), and the physical setting of the VNTR. The physical setting of these lands is an important consideration when discussing outcomes of the PRA and future characterization and/or remedial actions for MEC, if any. The numerous terrain and vegetation challenges that would be faced during further investigations of these lands must be considered.

This section also briefly discusses the natural and cultural resources within the VNTR and summarizes previous investigations and the regulatory status of the study area.

## 2.1 VNTR Location

Vieques is located in the Caribbean Sea approximately 7 miles southeast of the eastern tip of the island of Puerto Rico and 20 miles southwest of St. Thomas, U.S. Virgin Islands. Vieques is the largest offshore island that is part of the Commonwealth of Puerto Rico. It is approximately 20 miles long and 3 miles wide, and has an area of approximately 33,088 acres (51 square miles). Figure 2-1 shows the location of Vieques and the supporting base at Naval Station Roosevelt Roads (NSRR). Vieques lies between 18°10'N and 18°05'N latitude and between 65°35'W and 65°16'W longitude.

The VNTR is situated in the eastern third of the island, and is bordered to the west by the community of Isabel Segunda, to the north by the Vieques Sound, and to the south by the Caribbean Sea. The entire VNTR consist of approximately 14,670 acres and is divided operationally into four areas that from west to east include: the Eastern Maneuver Area (EMA), which comprises an area of 11,070 acres; the Surface Impact Area (SIA); comprised of 2,500 acres; the 900 acre LIA and the 200-acre Eastern Conservation Area (ECA) which is situated on the easternmost tip of Vieques. Figure 2-2 presents a site map of VNTR.

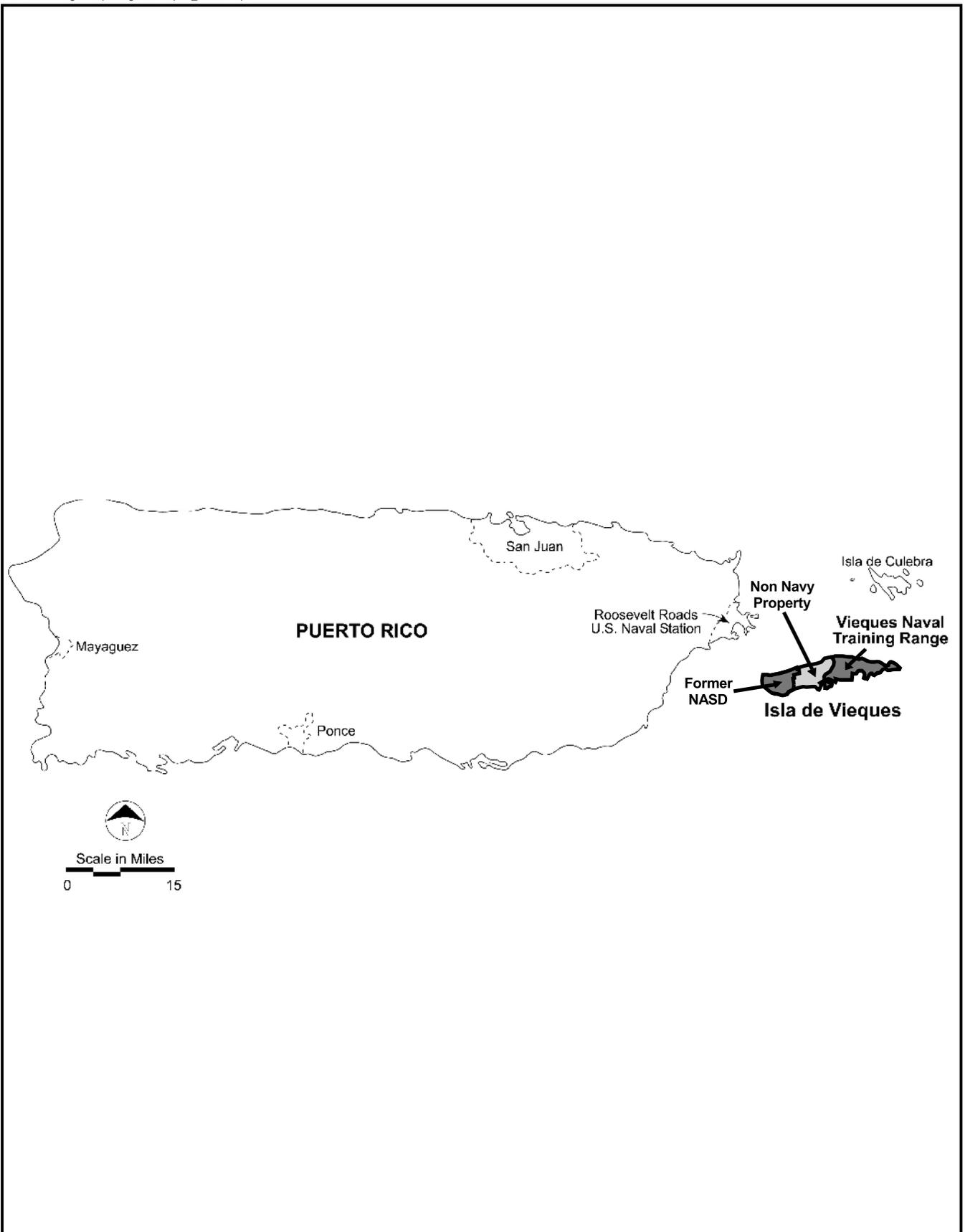


Figure 2-1  
Site Location Map  
Vieques Naval Training Range  
Vieques, Puerto Rico

## 2.2 VNTR History and MEC Usage

### 2.2.1 VNTR History

The Navy has owned portions of Vieques since 1941, when land was purchased on the west end of Vieques for use as ammunitions storage facility in support of World War II training requirements. Construction of the facilities for ammunition storage was completed in 1943.

In 1947 the Navy purchased land on the eastern end of Vieques and shortly thereafter began training for amphibious and ground warfare within the EMA. To support a marine regiment the Fleet Marine Force (FMF) constructed a tent camp (Camp Garcia) in 1954 and 1955. Between 1960 and 1965 the tents were replaced with metal buildings and Camp Garcia was designated as a separate organization to provide logistical and training support. During the height of activity at camp Garcia in the mid-1950s to early 1960s over 300 military personell and 60 civilians were employed at the camp. During that period, regimental and battalion landing teams utilized the VNTR for roughly 330 days per year. Marine artillery gun positions were established throughout the EMA and SIA where live artillery fire was directed toward artillery targets, such as old vehicles, within the SIA and at the LIA. During the mid-1960s a series of small arms ranges were established along the northern coast of EMA.

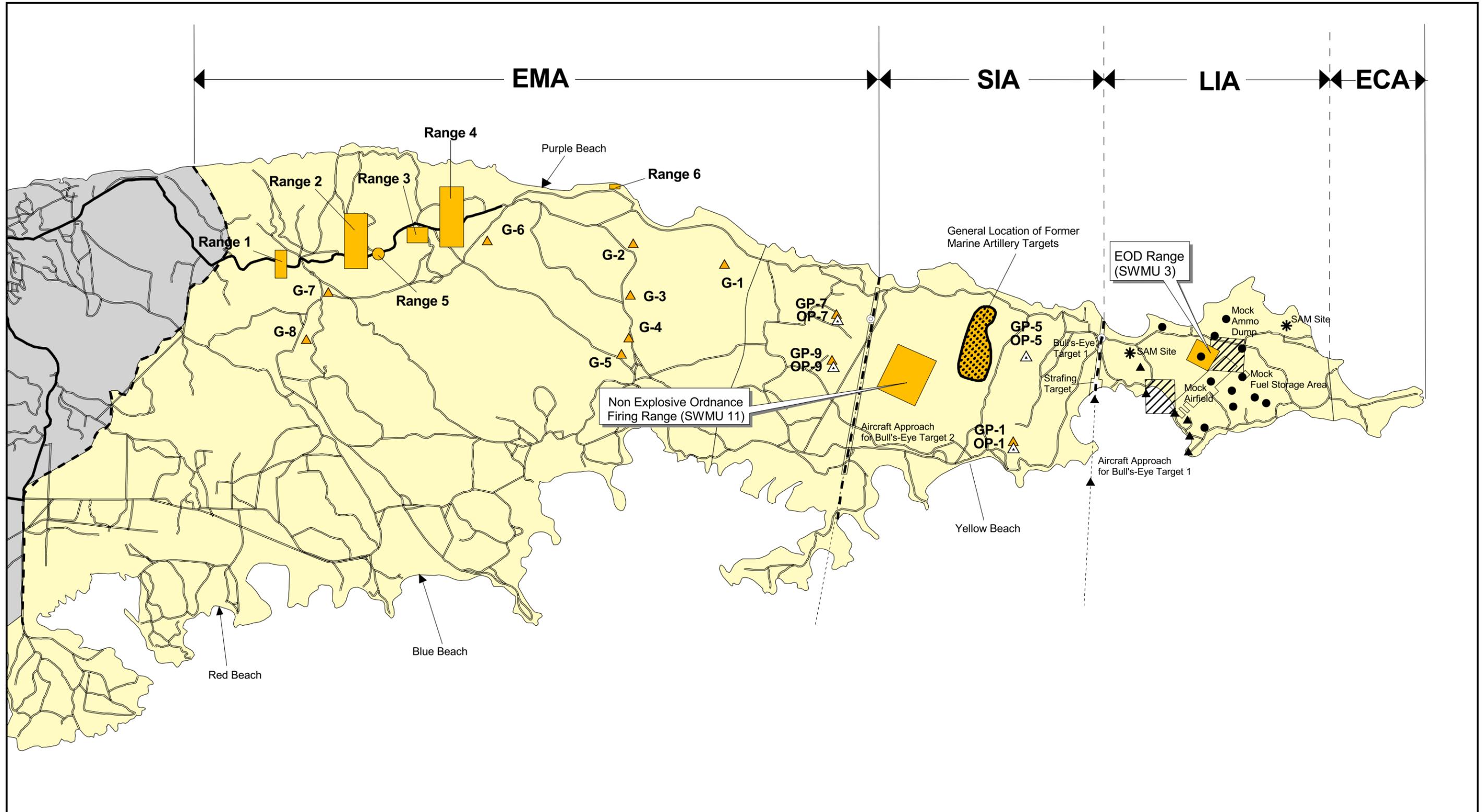
The Navy began developing facilities within the LIA during 1964 when a gunnery range was established where point and area targets were established for ships to practice naval gunfire support (NGFS) The naval gunfire was in support of amphibious landings or troops already ashore (Ecology and Environment, 1986). The following year the air to ground (ATG) training was initiated in the LIA where several mock-ups such as old tanks and vehicles were used as targets for aerial bombing. The location of the naval gunfire and aerial bombing targets are shown on Figure 2-2.

Between 1969 and 1971 a strafing target was constructed and two bull's eye targets were set up at the east and west ends of the SIA. These targets were used for ATG training using inert practice bombs and inert rockets. Although ATG training was initiated in 1965, live ordnance was not used on a regular basis until December 1974. This does not mean that live bombs were not dropped prior to this date, but there was no significant trend (Tippets, et al., 1979).

In 1973 Public Law 93-166 directed the U.S. Navy to terminate the use of Culebra which resulted in a significant increase in naval gunfire within the LIA. As an example, 96 US ships and 30 NATO ships trained on Vieques from 1973 to 1977.

During the late 1970s the amphibious training in the EMA declined and Camp Garcia was closed in 1978. Also at this time, use of the SIA for live fire was discontinued and live artillery fire afterwards was directed to the northwest portion of the LIA. Since that time , ATG activities have remained the same levels or declined.

The 1983 Memorandum Of Understanding between the Navy and the Commonwealth of Puerto Rico established provisions for the reduction in the use of live ordnance at VNTR and for the protection of the environment. This resulted in the establishment of conservation zones to protect tropical ecosystems within the VNTR. One of the conservation zones was the Eastern Conservation Area (ECA), located at the easternmost 200 acres of the VNTR.



**LEGEND**

- |  |  |
|--|--|
| Naval Gunfire Support (NGFS) Area Target | Property Line                                |
| Navy Property                            | Small Arms/Artillery Ranges                  |
| Non-Navy Property                        | General Location of Marine Artillery Targets |
| Air-To-Ground (ATG) Target               | Observation Point                            |
| Naval Gunfire Support (NGFS) Target      | Gun Position                                 |

ECA - Eastern Conservation Area  
 LIA - Live Impact Area  
 SIA - Surface Impact Area



Figure 2-2  
 MEC Areas  
 Preliminary Range Assessment  
 Vieques Naval Training Range  
 Vieques, Puerto Rico

Since April 2000 all the ordnance fired on Vieques was limited to inert ordnance based on an Agreement between President Clinton and the Puerto Rico Governor. On January 10, 2003, the Secretary of the Navy certified to the President and Congress that an alternative training facility or facilities that provide equivalent or superior training exist and are available, thereby confirming that the Navy will cease operations at Vieques on May 1, 2003. Following termination of training operations on Vieques, the VNTR will be transferred to the jurisdiction of the Secretary of the Interior.

## 2.2.2 Military Uses of the Vieques Naval Training Range

Portions of the training areas within the VNTR have been in continuous use since World War II, when the Navy acquired title to the land. The Atlantic Fleet's ships, aircraft and marine forces carried out training in all aspects of naval gunfire support (NGFS), ATG ordnance delivery, amphibious landings, small arms fire, artillery and tank fire, and combat engineering. As part of normal operations, unexploded ordnance is cleared periodically from the LIA and destroyed.

Historically, unserviceable military munitions declared as hazardous waste were periodically received from NSRR and from the NASD on the West End of Vieques, for demolition at the OB/OD area (SWMU 3) at the LIA under an interim Subpart X permit.

Table 2-1 summarizes available data on historical ordnance uses on the VNTR for the period from 1983 through early 2003. This information was collated from records accumulated during the records search and interviews conducted during the week of February 10, 2003, with AFWTF personnel at NSRR. Table 2-1 also presents a description of select ordnance items including net explosive weights (NEW).

TABLE 2-1  
 Types of Ordnance Most Frequently Used at VNTR

Area Of Primary Use	Ordnance Type	Total Weight Of Projectile (lbs)	Weight Of Explosives (lbs)
<b>Live Impact Area</b>	<b>Air to Ground</b>		
	MK-14 (live, high explosive)	411-514	250
	MK-16 (practice bomb)	870-1000	50-150
	MK-24 (parachute flare)	26	18
	MK-77 (napalm fire bomb)	479-539	75
	MK-78 (fire bomb)	650	94
	MK-81/BDU (live, high explosive)	250	100
	MK-82 (live, high explosive)	500	192
	MK-82 (inert)	500	0
	MK-83 (live, high explosive)	1000	445
	MK-83 (inert)	1000	0
	MK-84 (live, high explosive)	2000	945
	MK-84 (inert)	2000	0
	5-inch Zuni rocket	56	0
	<b>Naval Gunfire Support</b>		
	5-inch/54 (live)	70	9.53
5-inch/38 (live)	55	9.23	
4.5-inch/50 (live)	30	4.79	
16-inch (inert)	2,795	0	
<b>Surface Impact Area</b>	MK-76 (practice bomb)	25	0.03
	BDU-33 (practice bomb)	25	0.03

TABLE 2-1  
 Types of Ordnance Most Frequently Used at VNTR

Area Of Primary Use	Ordnance Type	Total Weight Of Projectile (lbs)	Weight Of Explosives (lbs)
	MK-106 (practice bomb)	10	0
	2.75 inch rocket (inert)	6.5	0
<b>Eastern Maneuver Area</b>	<b>Artillery</b>		
	76-mm	28	1.2
	81-mm	9.7	2.2
	90-mm	23	2.1
	105-mm	33	5.1
	106-mm	41	8
	155-mm	95	15.3
	175-mm	130	22
	<b>Range</b>		
	20-mm	0.243	0.015
	25-mm	0.293	0.002
	27-mm	1.11	0.04
	30-mm	1.63	.005
	40-mm	2.0	0.235
	Grenades	1.0	0.361

Appendix A (Draft ARS report) presents a comprehensive summary of fiscal year range utilization data for the periods 1974 through 1998. In addition to information on quantities and types of ordnance items listed in Table 2-1, the ARS Report in Appendix A provides data on the following:

- Number of range users including number of aircraft and ship runs
- Quantities of ordnance dropped (live and inert percentages and totals by year)
- Total weight of ordnance dropped (live and inert percentages and totals by year)
- Net explosive weight (NEW) of each ordnance item dropped
- Total weight of high explosive (HE) in dropped ordnance (live and inert percentages and total by year)
- Days range utilized (by NGFS, ATG, , MLT, ETA, and Small Arms Ranges operations)
- Number of troops trained

#### 2.2.2.1 Live Impact Area

The Navy began developing air-to-ground training (ATG) and naval gunfire support (NGFS) activities within the LIA during 1965 when a gunnery range was established and several targets were constructed. However, live ordnance was not used on a regular basis until 1974.

Table 2-2 summarizes the NGFS rounds that were fired annually by type, for the period from 1974 through 1998. The data shows that the NGFS activity was fairly consistent from 1974 to 1986 when the number of rounds ranged from 6,700 to 9,800 rounds per year. The Activity increased during the period from 1987 to 1990 when the number of rounds averaged approximately 15,000 round per year. Since that time, the activity has been cyclical ranging

from 577 rounds per year in 1993 to 7,609 rounds in 1998. The total weight of the NGFS expended from 1974 to 1998 was 6,732 tons.

TABLE 2-2  
 Number of NGFS Rounds Expended Annually by Type  
*VNTR, Vieques, Puerto Rico*

Year	16"/50	5"/54	5"/38	4.5"/38	3"/50	Total
1974	NA	3,051	1,362	1,235	1,308	6,956
1975	NA	3,498	3,289	324	691	7,802
1976	NA	5,547	1,414	290	679	7,930
1977	NA	6,591	1,667	530	1,066	9,854
1978	NA	6,116	738	233	179	7,266
1979	NA	5,789	892	91	1,203	7,975
1980	NA	7,499	1,081	267	77	8,924
1981	NA	7,749	439	105	1,094	9,387
1982	NA	5869	721	41	106	6,737
1983	NA	6938	491	0	1044	8,473
1984	0	5940	849	75	274	7,138
1985	0	7136	756	31	331	8,254
1986	19	5931	1209	104	42	7,305
1987	384	11596	2552	1143	563	16,238
1988	0	13012	1013	301	1246	15,572
1989	229	11938	1193	1041	862	15,263
1990	58	11121	920	243	563	12,905
1991	0	3902	0	131	196	4,229
1992	0	3873	0	397	413	4,683
1993	0	523	0	54	0	577
1994	0	774	0	15	0	789
1995	0	519	0	361	0	880
1996	0	3065	36	150	0	3,251
1997	0	4261	0	188	0	4,449
1998	0	7301	0	308	0	7,609
Total Rounds	690	149,539	20,622	7,658	11,937	190,446
Weight of each round (lbs)	2795	63	55	50	50	
Total Wt. (lbs)	1928550	9,420,947	1,134,210	382,900	596,850	13,463,467
Average Rounds per year	28	5,981	825	306	478	7,617
Percent of Total Rounds	0.3	78.5	10.8	4.0	6.3	100

Data for the period prior to 1974 was not recovered during the records search. Records indicate that in 1973 a request was made by the AFWTF operations officer that more detailed range utilization reports were necessary to include information on AFWTF operations including dates, customer, type operation, and type/amount of ordnance used (Tippets, et al., 1979). The accuracy of data from 1974 up to the 1983 MOA has not been confirmed as the Navy was under no legal obligation to track ordnance amounts up until that period when provisions of the MOA required the Navy to maintain statistics regarding the types and amounts of ordnance used which were to be made available to the appropriate Commonwealth of Puerto Rico representatives if requested. Information reviewed in the 1979 EIS indicates that range utilization records from the period 1973 through 1976 were only 60 percent accurate, and that records from the period 1976 through 1979 were approximately 90 percent accurate.

The ordnance usage accuracy figures reported above would have been a result of the difficulty in accurately documenting ordnance usage data as military units would typically

go out with a certain amount of ordnance which may not all have been expended or returned as unused. Data from 1983 forward should be considered accurate based on the more detailed documentation of ordnance usage records as required by the MOA provisions.

Table 2-3 illustrates the type and amount of ATG ordnance fired on the LIA from 1974 to 1998. The amount of ATG ordnance items fired on VNTR ranged from 656 rounds in 1974 to a peak usage of 13,379 rounds in 1977. The average for the 25-year period from 1974 to 1998 was 3,014 rounds per year. The total weight of the rounds for these years was 21,252 tons.

TABLE 2-3  
 Number of ATG Ordnance Rounds Expended at Live Impact Area Annually by Type  
 VNTR, Vieques, Puerto Rico

Year	MK-81	MK-82	MK-83	MK-84	MK-77	MK-78	MK-16	Total
1974	12	612	0	0	24	8	8	656
1975	134	2,164	34	40	203	0	4	2,579
1976	186	1,281	127	0	0	0	0	1,594
1977	242	4,771	715	144	41	30	0	5,943
1978	3	12,538	826	15	0	0	0	13,382
1979	2	7,855	265	117	0	0	0	8239
1980	52	3,749	61	70	0	0	0	3932
1981	0	8,467	288	80	0	0	0	8835
1982	0	762	14	58	0	0	0	834
1983	0	2547	92	22	0	0	0	2,661
1984	0	857	45	69	0	0	0	971
1985	0	575	72	20	0	0	0	667
1986	0	780	289	75	0	0	0	1,144
1987	0	1108	160	0	0	0	0	1,268
1988	12	1486	251	20	0	0	0	1,769
1989	27	1737	805	66	0	0	0	2,635
1990	23	1884	494	75	0	0	0	2,476
1991	106	2441	340	37	0	0	0	2,924
1992	8	1904	213	145	0	0	0	2,270
1993	0	1687	192	0	0	0	0	1,879
1994	0	1458	287	19	0	0	0	1,764
1995	0	939	246	14	0	0	0	1,199
1996	0	1899	393	14	0	0	0	2,306
1997	121	1865	329	3	0	0	0	2,318
1998	0	857	246	2	0	0	0	1,105
<b>Total Rounds</b>	<b>928</b>	<b>66,223</b>	<b>6784</b>	<b>1105</b>	<b>268</b>	<b>38</b>	<b>12</b>	<b>75,350</b>
<b>Weight of Each round (lbs)</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>509</b>	<b>650</b>	<b>463</b>	
<b>Total Wt. (lbs)</b>	<b>232,000</b>	<b>33,111,500</b>	<b>6,784,000</b>	<b>2,210,000</b>	<b>136,412</b>	<b>24,700</b>	<b>5,556</b>	<b>42,504,168</b>
<b>Average Rounds per year</b>	<b>41</b>	<b>1601</b>	<b>254</b>	<b>36</b>	<b>13</b>	<b>0.38</b>	<b>0.57</b>	<b>1,947</b>
<b>Percent of total</b>	<b>2.1</b>	<b>82.2</b>	<b>13.1</b>	<b>1.9</b>	<b>0.66</b>	<b>0.02</b>	<b>0.02</b>	<b>100</b>

Figures 2-3 and 2-4 illustrate live ATG densities and NGFS impact densities within the LIA respectively for live bombs dropped in 1978 (Tippetts, et al., 1979). The figures illustrate that the ATG hits are more concentrated than the NGFS and they are also not evenly distributed around the target. Although most of the hits are within 50 yards of the target, the remaining hits tend to concentrate along the aircraft approach paths (Ecology and Environment, 1986).

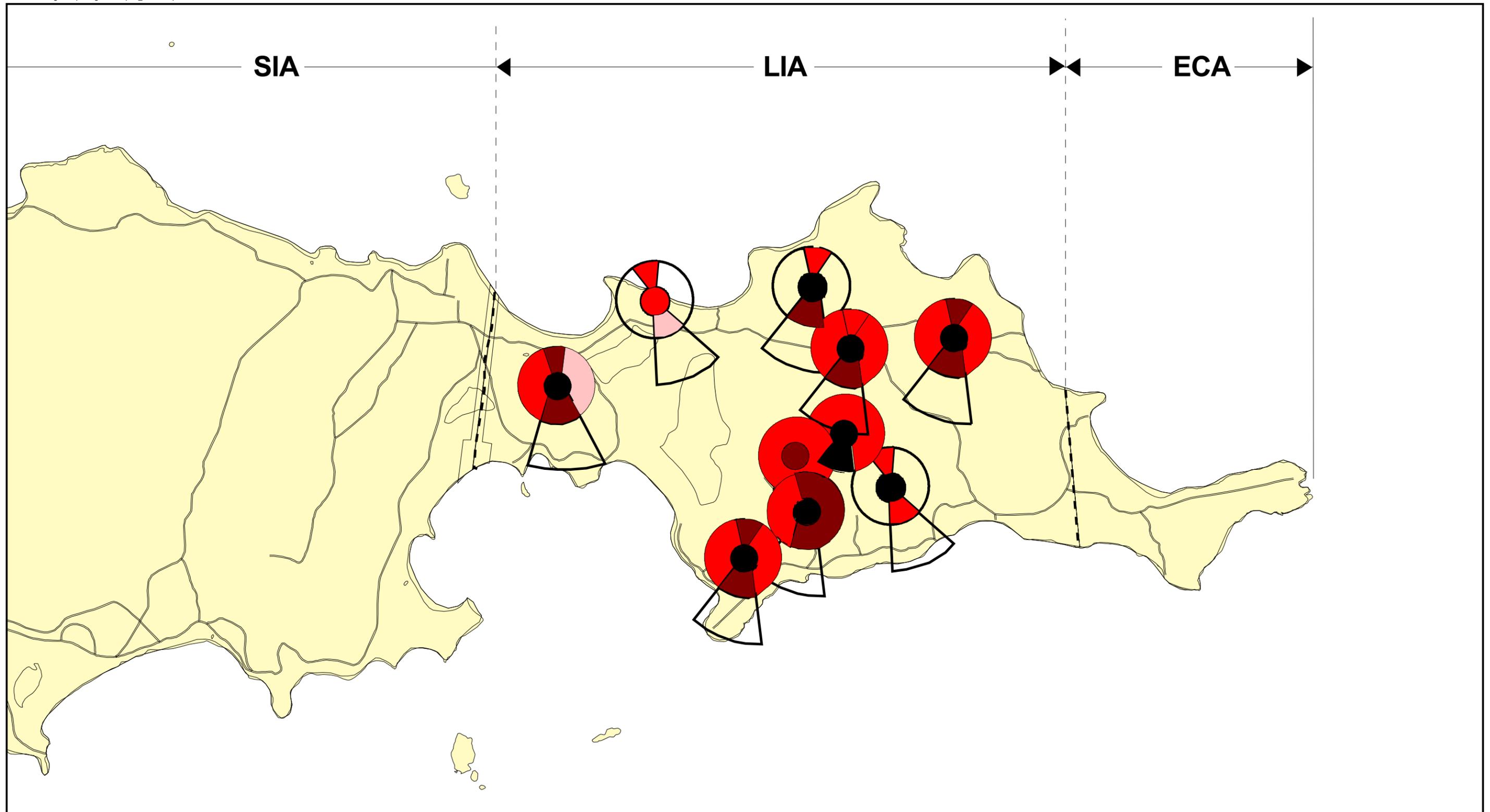
Since 1977, four documented cases of Napalm use have been recorded in the VNTR (U.S. Navy, October 1999). The most recent event occurred in October 1992 when Marine aircrews dropped 24 canisters of Napalm in the LIA during routine training. The other three documented cases involved ATG bombing with MK-77 Napalm in the LIA in February 1977, July 1977, and March 1979. The October 1999 Navy document indicates that the use of Napalm during these events was consistent with regulations and use permits for that time frame.

Information related specifically to the LIA, including range refurbishment records, after-action reports from training activities, and a variety of miscellaneous information such as Inner Range dimensions and operational functions is discussed in the Draft Final ARS Report (Appendix A).

#### 2.2.2.2 Surface Impact Area

Marine artillery targets were established in the SIA during the 1960s where marine artillery fire was directed from several gun positions located throughout the EMA and SIA. In 1978 use of the SIA for live fire was discontinued and live artillery fire afterwards was directed to the northwest portion of the LIA.

During the early 1970s two bull's eye targets were installed at the east and west ends of the SIA for ATG practice with inert MK-76 and MK106 practice bombs and inert 2.75 inch and 5 inch zuni rockets. To the south of bull's eye target 1 (Figure 2-2) a strafing range was installed for practice with 20mm machine gun rounds. Table 2-4 summarizes the type and amount of practice ATG ordnance that was fired from 1974 to 1998.



**LEGEND**

- 0.05 - 0.99 Live Bombs / Acre / Year
- 1.00 - 4.49 Live Bombs / Acre / Year
- 4.50 - 27.9 Live Bombs / Acre / Year
- 28.0 - 189.9 Live Bombs / Acre / Year
- 190.0 - 350.0 Live Bombs / Acre / Year

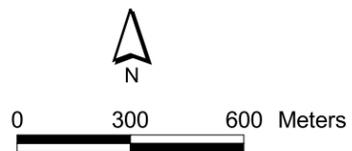
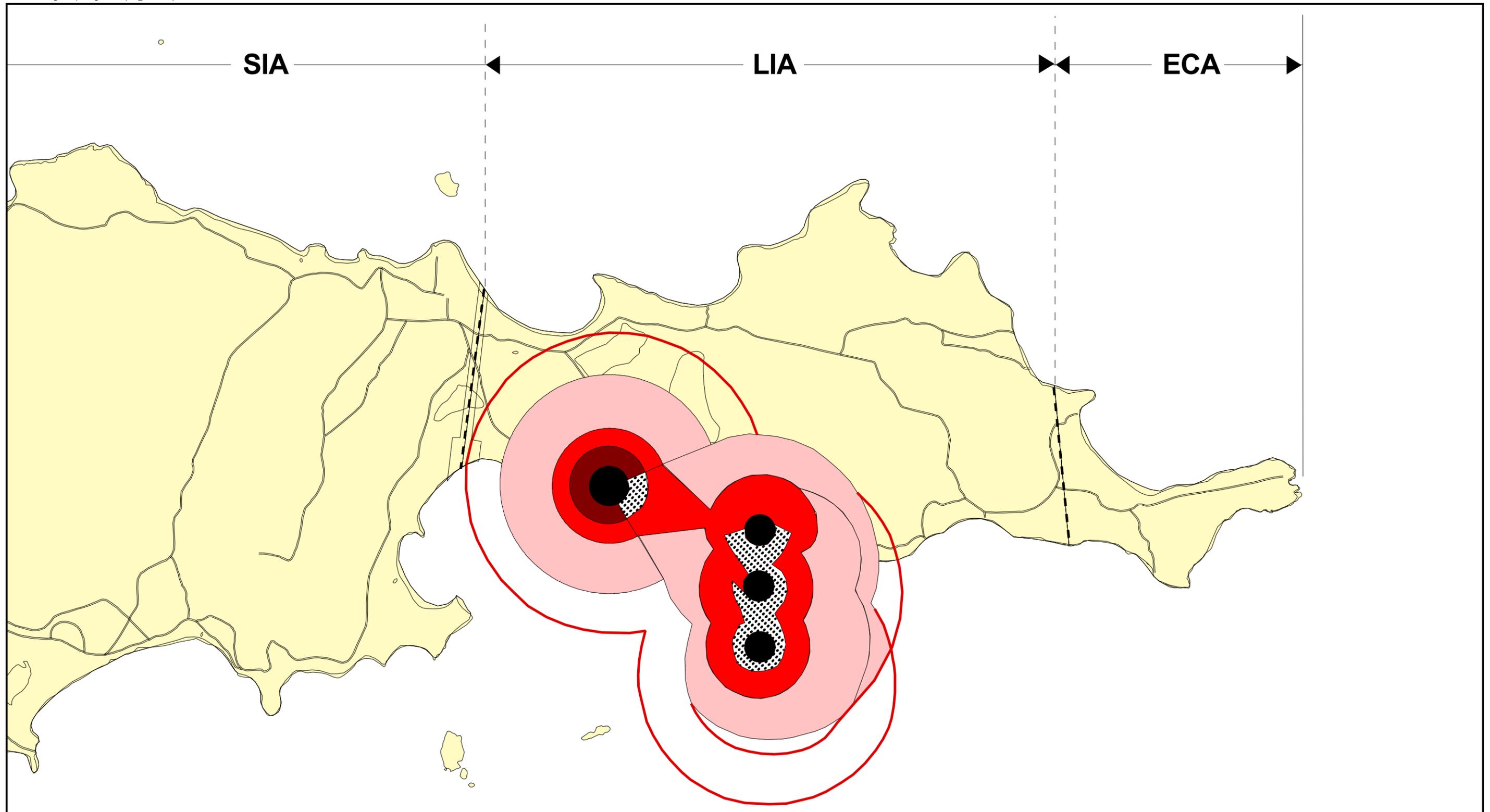


Figure 2-3  
Density of Live Air-to-Ground Ordnance  
Vieques Naval Training Range  
Vieques, Puerto Rico  
From: TAMS, 1979  
Densities Based on Records From 1978



**LEGEND**

- 0.50 - 1.49 Rounds / Acre / Year
- 1.50 - 4.49 Rounds / Acre / Year
- 4.50 - 8.99 Rounds / Acre / Year
- 9.00 - 22.99 Rounds / Acre / Year
- 23.00 - 50.00 Rounds / Acre / Year
- 75.00 - 180.00 Rounds / Acre / Year

Figure 2-4  
Density of Impacts of Naval Gunfire Support  
Vieques Naval Training Range  
Vieques, Puerto Rico  
From: TAMS, 1979  
Densities Based on Records From 1978

**TABLE 2-4**  
 Practice Bombs Expended in the SIA, 1974-1998  
*VNTR, Vieques, Puerto Rico*

Year	MK-76 and BDU 33	MK-106	2.75" Rocket	Total
1974	1,566	NA	2,036	3,602
1975	4,965	NA	3,097	8,062
1976	3,574	NA	4,975	8,549
1977	12,675	NA	3,246	15,921
1978	23,438	NA	1,227	24,665
1979	14,898	NA	1,555	16,453
1980	15,766	NA	237	16,003
1981	16,574	NA	398	16,972
1982	20,973	NA	943	21,916
1983	14,094	534	481	15,109
1984	7,422	611	48	8,081
1985	5,798	684	75	6,557
1986	3,719	130	628	4,477
1987	6,318	641	1,094	8,053
1988	4,547	516	105	5,168
1989	6,861	759	1,321	8,941
1990	5,985	422	1,786	8,193
1991	4,363	633	299	5,295
1992	5,089	384	1,305	6,778
1993	5,781	229	504	6,514
1994	7,030	300	1,110	8,440
1995	4,414	24	NA	4,438
1996	8,615	NA	110	8,725
1997	5,637	NA	1,210	6,847
1998	4,628	NA	115	4,743
<b>Total</b>	<b>214,730</b>	<b>5,867</b>	<b>27,905</b>	<b>248,502</b>

Source: CINCLANFLEET, 1985 and Pace-Fallon Report, 1999  
 NA - Data not available for this period

### 2.2.2.3 Eastern Maneuver Area

During the height of activity at camp Garcia in the mid-1950s to early 1960s marine artillery gun positions were established throughout the EMA where live artillery fire was directed toward artillery targets, such as old vehicles, located within the SIA and LIA. An aerial photograph analysis (ERI, 2003) indicates that as many as 30 gun emplacements and positions may have existed historically at the EMA.

Table 2-5 summarizes the type and amount of Marine artillery ordnance fired, mostly from the EMA, for the period of 1974 to 1998. During this time 998 the amount of Marine ordnance items fired ranged from a high of 34,255 rounds in 1974 to a low of 896 rounds in 1985. The average for the 25 years was 4,459 rounds per year. The total weight for these rounds over the years was 2,135 tons.

**TABLE 2-5**  
 Number of Rounds of Marine Ordnance Expended Annually by Type  
*VNTR, Vieques, Puerto Rico*

<b>Year</b>	<b>175mm</b>	<b>155mm</b>	<b>106mm</b>	<b>105mm</b>	<b>90mm</b>	<b>81mm</b>	<b>76mm</b>	<b>Total</b>
1974	4,933	3,508	2,741	15,100	1,996	5,947	0	34,255
1975	0	2,388	305	8,162	440	1,422	78	12,795
1976	1,066	3,124	0	5,525	0	244	1,957	11,916
1977	0	0	0	212	0	16	3,928	4,156
1978	NA	NA	NA	NA	NA	NA	NA	3,214
1979	NA	NA	NA	NA	NA	NA	NA	2,100
1980	NA	NA	NA	NA	NA	NA	NA	2,356
1981	NA	NA	NA	NA	NA	NA	NA	3,500
1982	NA	100	NA	1,343	NA	2,599	12	4,054
1983	NA	177	NA	NA	NA	1,007	NA	1,184
1984	NA	146	NA	186	NA	1,049	223	1,604
1985	NA	311	NA	253	NA	288	44	896
1986	NA	165	NA	538	NA	855	70	1,628
1987	NA	817	NA	144	NA	869	139	1,969
1988	NA	1,336	NA	698	NA	2,342	891	5,267
1989	NA	667	NA	464	NA	1,333	442	2,906
1990	NA	1,505	NA	1,088	NA	620	306	3,519
1991	NA	515	NA	NA	NA	1,073	155	1,743
1992	NA	NA	NA	49	NA	471	470	990
1993	NA	156	NA	351	NA	1,002	625	2,134
1994	NA	NA	NA	NA	NA	639	355	994
1995	NA	517	NA	NA	NA	273	468	1,258
1996	NA	223	NA	397	NA	1,199	757	2,576
1997	NA	NA	NA	320	NA	625	700	1,645
1998	NA	816	NA	NA	NA	1,364	641	2,821
<b>Total Number of Rounds</b>	<b>5,999</b>	<b>16,471</b>	<b>3,046</b>	<b>34,830</b>	<b>2,436</b>	<b>25,237</b>	<b>12261</b>	<b>111,480</b>
<b>Weight (lbs)</b>	<b>130</b>	<b>95</b>	<b>41</b>	<b>33</b>	<b>23</b>	<b>10</b>	<b>28</b>	
<b>Total Wt. (lbs)</b>	<b>779,870</b>	<b>1,564,745</b>	<b>124,886</b>	<b>1,149,390</b>	<b>56,028</b>	<b>252,370</b>	<b>343,308</b>	<b>4,270,597</b>

NA - Data not available

The heaviest amphibious and ground warfare training in the EMA occurred from the mid-1950s until early 1960s (Tippetts, et al., 1979). During that period, regimental and battalion landing teams utilized the VNTR for roughly 330 days per year. The frequency of these maneuvers was reduced between 1974 and 1976. Up until April 1999, the Navy used the VNTR approximately 180 days per year. Activity since April 1999 has been reduced drastically, with an average of less than 90 days of activity since that time.

Marine forces simulated amphibious assault operations over suitable beachheads that included Blue, Green, Purple, Red, and Yellow beaches. These simulated assaults involved pre-assault operations, ship-to-shore movement, assault, consolidation, and withdrawal. Battalion teams would spend on average of three weeks operating in the EMA, and the exercise would involve two to four amphibious landings on Red, Blue, and Purple Beaches that could last 3 to 5 days. While amphibious assaults were conducted with blank ammunition, Marine forces would conduct live firing on ranges in the EMA for 8 to 11 days with all weapons including pistols, rifles, machine guns, grenades, tanks, artillery, recoilless rifles, and mortars. The EMA met the training requirements for a Marine amphibious unit

(1,200 to 1,500 marines) or a battalion landing team (1,200 to 1,500 marines) (Department of The Navy, 1979).

During 1966, six ranges were established in the EMA along the Northern Coast Road where Engineers Road ends. These ranges remained operational through February 1999 when they were deactivated until further notice by the Commanding Officer of AFWTF (Department of the Navy, September 1999). The ranges were used as follows:

- Range 1: Small Arms Range using service rifles, pistols, and machine guns
- Range 2: Small Arms Range using pistols and shotguns
- Range 3: Rifle Grenade Range (40mm) and small arms
- Range 4: Anti-armor/Antipersonnel Live Fire Tracking Range using 3.5 inch rockets and light anti-craft weapons (LAWs)
- Range 5: Hand Grenade Range using various types of grenades
- Range 6: Demolition and small arms range

Using the records from calendar years 1983- 1998, Table 2-6 presents an example of the small arms ammunition fired at the EMA ranges.

TABLE 2-6  
 Rounds of Small Arms Ammunition Fired within the EMA Ranges by Type, 1983-1998  
 VNTR, Vieques, Puerto Rico

Year	5.56mm	7.62mm	9mm	.38 CAL	.50 CAL	12 Gage	Grenades	Total Rounds
1983	NA	NA	NA	NA	NA	NA	NA	NA
1984	NA	NA	NA	NA	630	NA	NA	630
1985	NA	NA	NA	NA	NA	NA	NA	NA
1986	NA	NA	NA	NA	NA	NA	NA	NA
1987	NA	5,900	NA	NA	18,000	NA	NA	23,900
1988	NA	24,000	NA	NA	24,793	NA	NA	48,793
1989	NA	124,130	NA	NA	116,510	NA	NA	240,640
1990	NA	224,250	NA	NA	102,350	NA	NA	326,600
1991	NA	48,580	NA	NA	27,885	NA	NA	76,465
1992	1,500	282,200	NA	NA	48,881	NA	NA	332,581
1993	7,600	176,299	NA	NA	53,805	NA	NA	237,704
1994	144,235	384,370	NA	NA	46,131	NA	NA	574, 736
1995	139,964	207,680	17,951	2,450	38,364	174	739	409,31722
1996	99,424	147,692	3,480	2,592	50,846	2,000	292	308,3226
1997	161,070	491,534	9,205	NA	54,605	200	240	55,0458
1998	207,605	147,712	30,390	3,825	80,759	3,427	720	476,4368

NA – Data not available

The ARS Report (Appendix A) also provides additional information related to areas of the EMA and beach areas.

An aerial photograph analysis of the EMA and SIA (ERI, 2003) indicates that as many as nine ranges and up to 30 gun emplacements and positions may have existed historically at the EMA, and that up to nine gun positions and eight observation post areas, which potentially may have been used for mortar or artillery gun training, exist at the SIA component of the VNTR. These locations are illustrated in Figure 2-5.

#### 2.2.2.4 Range Clearance and Refurbishment

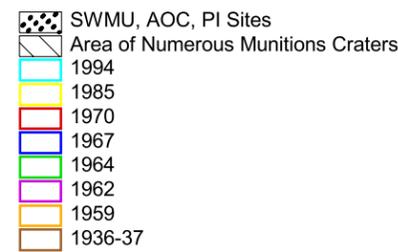
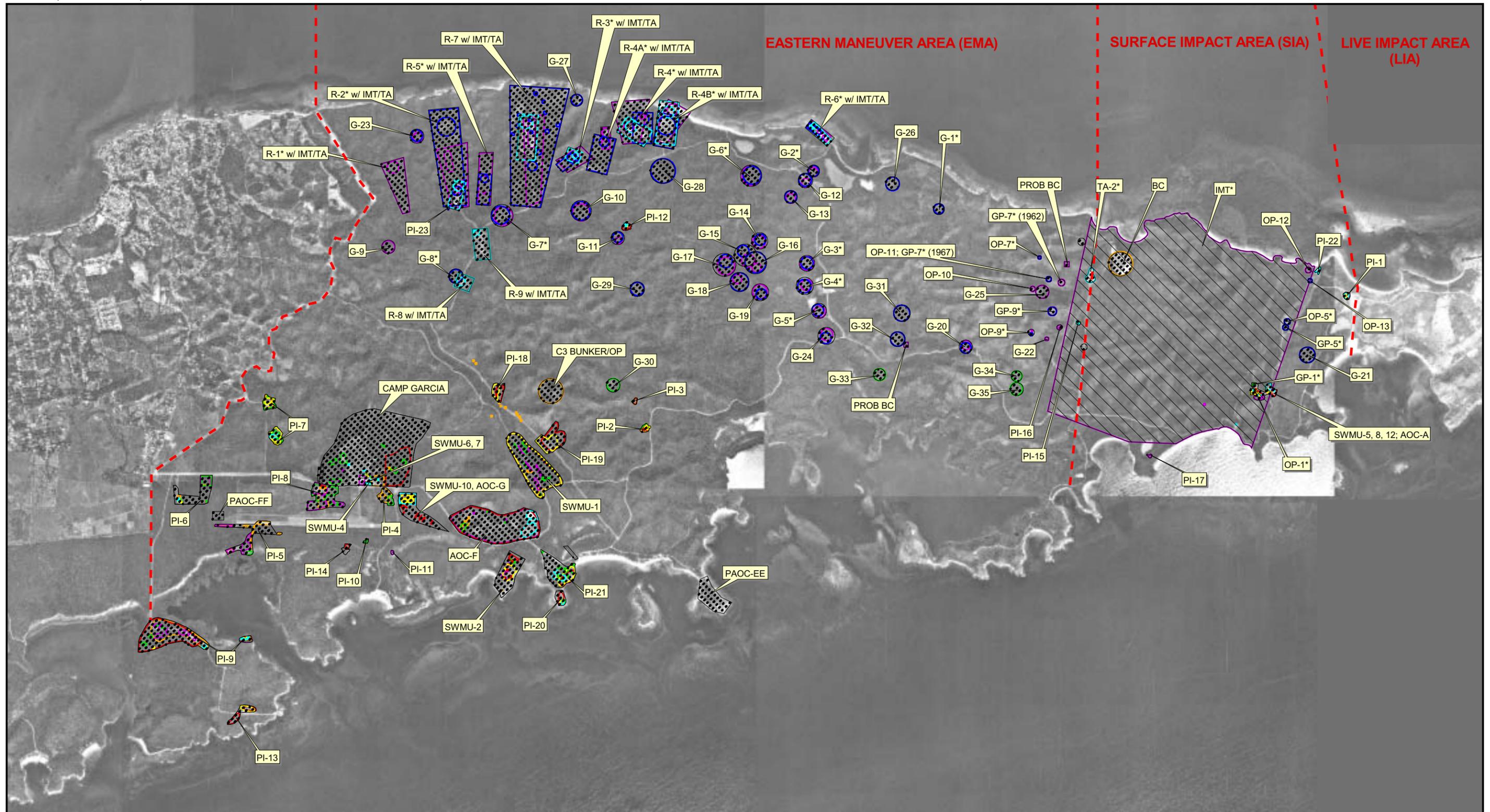
MEC clearance and target refurbishment of the LIA was conducted semi-annually in accordance with MEC neutralization provisions of the October 11, 1983 Vieques Memorandum of Understanding. The EOD Mobile Unit from NAVSTA Roosevelt Roads had the responsibility for conducting the range clearance and refurbishment activities, and the AFWTF Command was the scheduling authority for these operations. Approximately 30 percent of the 900 acre LIA was cleared of surface MEC during each of these semi-annual events (Department of the Navy, 1992) which includes individual targets and a 100 foot radius around target complexes, access and transit roads, beaches and other designated points on the range in which personnel was present. Smaller scale efforts were also conducted on occasion as required. Twenty-five full working days were typically required to complete a normal range clearance using eight EOD technicians and support staff. (Department of the Navy, February 1999; After Action Reports from November 1992 – 2003).

Controlled vegetation burning was conducted on occasion as required during range clearance efforts to reduce vegetative cover in areas where the EOD Mobile teams were operating. Brush clearing efforts were conducted for safety reasons due to the thickness of the canopy and to minimize the potential for disrupting ordnance items during reconnaissance activities. Recovered items were treated by open detonation within the EPA permitted OB/OD pits located in the LIA.

To provide an examples of the MEC items recovered during range refurbishment, Tables 2-7 and 2-8 present a summary of items recovered and detonated on the LIA during the winter 1994 and during the winter of 2002 range clearance and refurbishment events, respectively. No target reposition was required during the 2002 clearance effort.

On occasion, delivered ordnance did not reach the intended target within the LIA and may have landed in either the SIA or EMA. When this occurred, the incident was reported to the EOD Mobile Unit teams from NSSR so that efforts can be made to re-acquire these items from the SIA or EMA, if possible, during normal range clearance activities.

Since training commenced in the 1940s, more than 700,000 items of live and inert munitions have been expended without a single round falling outside the limits of the Inner Range Complex (Pace-Fallon, 1999).



AOC - Area Of Concern  
 BC - Bomb Crater(s)  
 G/GP - Gun Position  
 IMT - Impact Area(s)  
 OP - Observation Point  
 PI - Photo-Identified Site  
 R - Range  
 SWMU - Solid Waste Management Unit  
 TA - Target Area(s)  
 \* - Previously-Identified G/GP, IMT, OP, R, & TA

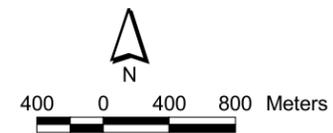


Figure 2-5  
 Aerial Photographic Analysis,  
 Preliminary Range Assessment  
 Eastern Maneuver Area and Surface Impact Area  
 Vieques Naval Training Range  
 Vieques, Puerto Rico  
 Figure Adapted From ERI, 2002

**TABLE 2-7**  
 Winter 1994 Refurbishment Ordnance Report, LIA, Department of the Navy  
 VNTR, Vieques, Puerto Rico  
 December 1994

<b>Item</b>	<b>Quantity</b>
<b>Convoy Area</b>	
BLU-77 Bomblet	10
MK-82 LDGP Bomb	9
MK-118 Bomblet	4
5" 54 Projectile	1
2.75" Warhead	1
<b>Sam East</b>	
MK-118 Bomblets	2,587
BLU-77 Bomblets	1,364
BLU-63/86 Bomblets	101
BLU-97 Bomblets	20
3" HE Projectile	3
5" HE Projectile	2
2.75" HE Warhead	1
2.75" WP Warhead	1
<b>Runway</b>	
MK-82 LDGP Bomb	5
5" HE Projectile	5
81mm HE Mortar	1
<b>Sam West</b>	
MK-82 LDGP Bomb	6
81mm HE Mortar	2
40mm HE Grenade	2
83mm Heat Warhead	1
MK-83 LDGP Bomb	1
60mm Illumination Round	1
<b>Fuel Farm</b>	
5" HE Projectile	5
MK-82 LDGP Bomb	2
2.75" HE Warhead	1
60mm Illumination Round	1
<b>NGFT 1</b>	
5" HE Projectile	1
60mm HE Mortar	1
<b>NGFT 2</b>	
MK-82 LDGP Bomb	2
81mm HE Mortar	2
MK-83 LDGP Bomb	1
69mm HE Mortar	1
<b>NGFT 3</b>	
MK-83 LDGP Bomb	3
<b>NGFT 4</b>	
MK-82 LDGP Bomb	1
40mm HE Grenade	1
<b>NGFT 5</b>	
MK-82 LDGP Bomb	2
40mm HE Grenade	1
<b>NGFT 6</b>	
Clear	0
<b>NGFT 7</b>	
MK-82 LDGP Bomb	1
40mm HE Grenade	1

TABLE 2-8

Winter 2002 Refurbishment Ordnance Report, Department of the Navy, January 2003  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Quantity	Item	NEW TNT Equivalent
<b>Sam East</b>		
24	MK-118 Submunitions	10.8 lbs.
13	BIU-77 Submunitions	1.95 lbs.
3	MK 82 LDGP Bomb (Inert)	0
2	M 74 Submunitions	0.65 lbs.
1	5" 54 Projectile	3.5 lbs.
1	BLU-97 Submunition	1.0 lbs.
1	MK-1 Submunition	1.0 lbs.
<b>Sam West</b>		
1	60mm Mortar	0.75 lbs.
1	3" Projectile	1.5 lbs.
<b>Airfield</b>		
1	MK-82 LDGP Bomb	265 lbs.
1	UK 540 LB MC Bomb	256 lbs.
<b>Ammo Dump</b>		
1	MK-82 LDGP Bomb (Inert)	0
1	81mm Mortar	2.0 lbs.
<b>Railroad Tunnel</b>		
1	MK-82 LDGP Bomb	265 lbs.
<b>Fuel Farm</b>		
1	MK-82 LDGP Bomb (Inert)	0

## 2.2.3 Summary of MEC Areas

Based on the results of the archive search and interviews with personnel and the aerial photograph analysis, a preliminary location map of MEC areas was developed and was presented previously as Figure 2-2. The aerial photo analysis report is included as Appendix E of this report, and the photo-identified areas are shown on Figure 2-5.

### 2.2.3.1 Live Impact Area

In 1965, ATG training activity began in the LIA where several mock-ups such as old tanks and vehicles were used as targets for aerial bombing. Since the mid-1970s, naval gunfire was practiced at the LIA, where several point and area targets for ships were constructed. Locations of the ATG bombing targets and the naval gunfire targets in the LIA were shown on Figure 2-2 (presented previously). Illustrations of the lateral extent and density of naval and air-ground gunfire that was completed in the 1970s were shown on Figures 2-3 and 2-4 (presented previously). Based on the naval gunfire and ATG gunfire that has occurred from the 1970s through 2003, the entire 900 acres of the LIA has been impacted by MEC.

### 2.2.3.2 Surface Impact Area

The SIA was established in the 1950s, when several Marine targets were constructed in the SIA. Marine artillery ranging from 76mm to 175mm rounds was directed toward these targets from artillery gun positions within the SIA and EMA. During 1969, the construction of bulls-eye targets 1 and 2, used for inert bombing, established the east and west boundaries of the SIA. At that time, a permanent OP with a helicopter pad was also constructed on Cerro Matais. In 1971, a strafing target was installed adjacent to one of the targets. The aerial photo

analysis identified numerous craters within the eastern two-thirds of the SIA, which were caused by mortar and artillery fire, naval gunfire and aerial bombing. The craters were most visible on the 1962 aerial photographs. In addition, the ARS identified several artillery gun positions and Observation Posts within the SIA that may have been used for artillery fire. The locations of artillery gun positions and the artillery targets are shown on Figure 2-2. The locations of the additional gun positions and observation posts identified from the analysis of the aerial photos were shown on Figure 2-5 (previously presented).

#### 2.2.3.3 Eastern Maneuver Area

The EMA encompassing 11,070 acres was established in 1947 and provided maneuvering areas and ranges for the training of Marine amphibious units and battalion landing teams in exercises that included amphibious landings, small arms fire, artillery and tank fire, shoe fire control, and combat engineering tasks. The heaviest training events occurred from the mid-1950s until the early 1960s.

In 1966, six ranges were established along the northern coast of the EMA. Section 3 of this report describes each of these ranges in detail. The descriptions include the current field conditions of the ranges, as well as a summary of the archive data and aerial photo analysis for each range. The aerial photo analysis also identified three additional ranges, the locations of which were shown on Figure 2-5.

The ARS identified eight artillery gun positions within the EMA from which Marine artillery gunfire was directed toward the SIA and LIA. The artillery MEC fired ranged from 60mm to 175mm rounds. A detailed field reconnaissance for each of these gun positions was completed. Section 3 of this report summarizes these field visits. The aerial photo analysis identified 19 additional gun positions that were used for either mortar or artillery gunfire. The locations of these gun positions are shown on Figure 2-5.

#### 2.2.3.4 Eastern Conservation Area

The Eastern Conservation Zone, encompassing 200 acres on the eastern tip of Vieques, was not an operational area for munitions use. However, its close proximity to the LIA, where extensive naval gunfire and AT bombing took place, identifies the ECA a potential area for MEC impacts. In addition, the OB/OD area within the LIA generated an explosive safety arc that extended well into the ECA.

### 2.2.4 Use of Biological, Chemical, and Radiological Warfare

The use of biological, chemical, and radiological weapons on Vieques was evaluated during the ARS and personnel interview component of this project.

In May 1969, Desert Test Center (DTC) Test 69-10 was conducted on the beaches of the VNTR (beaches not identified) to determine the operational effects of a persistent, toxic, chemical agent spray attack on U.S. amphibious forces and to evaluate performance of protective clothing worn by troops involved in the exercise. The testing organization was the U.S. Army DTC, and the participating services were the U.S. Navy, U.S. Marine Corps, and DTC personnel. Marine A-4 aircraft equipped with Aero 14B spray tanks were utilized for the dispersal of Tri (2-ethylhexyl) phosphate (a non-toxic simulation substitute for the VX nerve agent that can irritate the eyes, skin, and respiratory tract on contact).

Although the use of depleted uranium is not authorized on the Vieques ranges, a one-time accidental use of armor piercing incendiary depleted uranium ammunition has been documented. This incident occurred in February 1999, when a Marine Corps jet accidentally fired 263 rounds of armor piercing incendiary depleted uranium ammunition in the LIA. Records indicate that 116 of the 263 rounds were recovered by ground teams following this event (U.S. Navy, 2003). Depleted uranium rounds possess very low levels of radioactivity, and individually pose very little radioactive threat to human health.

In June 2000 the Nuclear Regulatory Commission (NRC) conducted a radiological survey to determine if the DU rounds had potentially contaminated the surrounding environment. The survey concluded there was no radioactive contamination to areas outside the LIA and the contamination inside the LIA was limited to the soil immediately surrounding the DU penetrators (U.S. Navy Office of Radiological Controls and Health Branch, 2002).

No other incidences on the use of biological, chemical, or radiological warfare were identified during the record searches for the VNTR.

### 2.2.5 Foreign Military Use

Use of the VNTR by armed forces of foreign nations has historically been limited to less than 10 days per year that included joint use of the range by U.S. forces. Five of these days are typically for the U.S. phase of the annual United International Antisubmarine Warfare (UNITAS) exercises with South American navies, while remaining days were reserved for training exercises with European allies. South American participants in the UNITAS exercises have included navies from Argentina, Brazil, Chile, Columbia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela. The U.S. Air Force and the Puerto Rican National Guard also participate in UNITAS exercises on occasion.

The Puerto Rico Army Reserves has also used the VNTR on occasion with data for 1998 indicating over 500 hours of training on the inner range by the combined National Guard and Army Reserve forces of Puerto Rico (Pace-Fallon, July 1999).

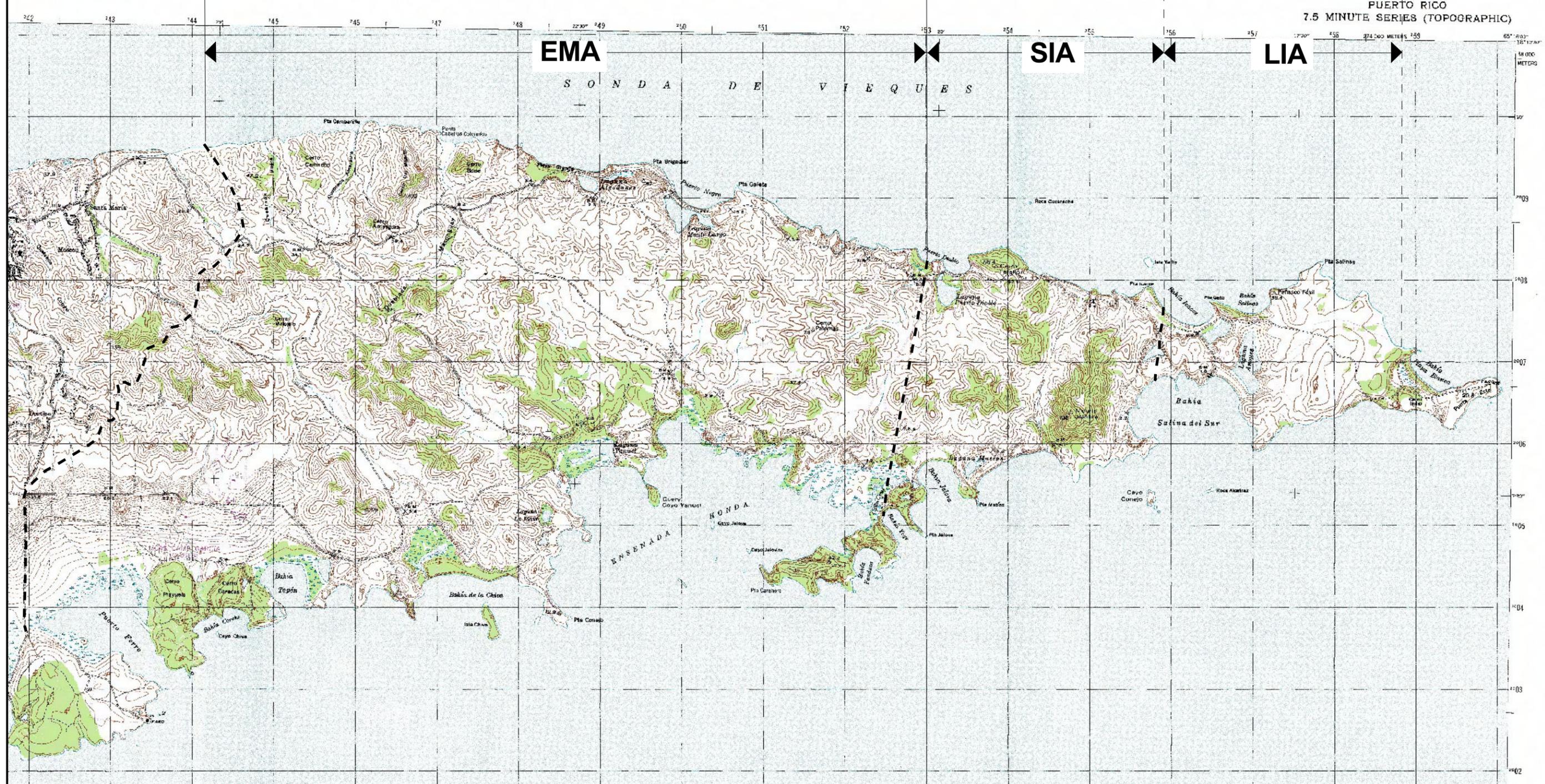
Use of the Vieques Range has also been provided to Marine forces from Brazil, Great Britain, the Netherlands, and Venezuela. Information regarding the types and quantities of ordnance utilized for training purposes by foreign nations were not identified during the records search component of the PRA. A significant effort was made by the records search teams to recover foreign military ordnance type and usage data with no success based on available data at the time of these searches.

## 2.3 Physical Setting

The topography of Vieques is characterized by gentle to steep rolling hills and valleys throughout the island, with the eastern side of the island exhibiting a more rugged terrain. Figure 2-6 illustrates the topography of the VNTR. The LIA is relatively flat with elevations ranging from 0 to approximately 50 feet above sea level. Cerro Matias, located within the EMA as OP-1 (Figure 2-2) is the highest point on VNTR, at approximately 420 ft above MSL. The average elevation across Vieques is approximately 246 ft MSL. The coastal area is relatively narrow, however, the southern coast exhibits wider expanses of beach.

COMMONWEALTH OF PUERTO RICO  
DEPARTMENT OF TRANSPORTATION AND PUBLIC WORKS

ISLA DE VIEQUES QUADRANGLE  
PUERTO RICO  
7.5 MINUTE SERIES (TOPOGRAPHIC)



EMA - Eastern Maneuver Area  
LIA - Live Impact Area  
SIA - Surface Impact Area

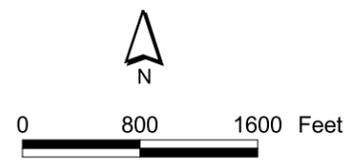


Figure 2-6  
Topographic Map  
Preliminary Range Assessment  
Vieques Naval Training Range  
Vieques, Puerto Rico

### 2.3.1 Climate and Weather

The climate of Vieques is tropical-marine. Temperatures are nearly constant, with an annual average of approximately 79 degrees Fahrenheit (°F). August is the warmest month (82°F) and February is the coolest (76°F). Vieques lies directly in the path of the prevailing easterly trade winds that regulate the climate of Puerto Rico. The trade winds result in a rainfall pattern characterized by a dry season from December through July and a rainy season from August to November. Heavy precipitation may be induced by tropical storms from June to November. The western part of the island averages approximately 50 inches of rainfall per year, 50 percent of which occurs during the rainy season (United States Geological Survey [USGS], 1989). The eastern half of the island is typically drier than the western half. Annual rainfall in the eastern half of the island averages 25 inches per year.

### 2.3.2 Vegetation

Vegetative cover on the eastern third of Vieques consists of thick vegetation dominating most of available land space. The canopy consists primarily of deciduous trees, with the non-native mesquite dominating the species distribution. A number of tree species are thorny, and low-lying brush is present throughout. Tall grasses also populate the landscape in areas where the thorny tree and brush species have not populated. The majority of the island's vegetation (except in populated areas in the center of the island) tends to form a complete ground cover. Leaves are mostly small and sclerophyllous (hard and dry).

Vegetation on the eastern side of the island is slightly less dense than on the western side, with a larger percentage of thorny species, especially young to mid-age mesquite trees. This non-native species was spread by the herds of cows and horses in the EMA, which eat the seed pods off the trees year round, and help distribute them throughout the area. Lower precipitation levels on the eastern end of the island also contributes to the more thorny, rugged terrain observed there. The hillsides are densely vegetated, similar to the western side of the island.

The coastal areas in the eastern side of the island contain level terrain made up primarily of lagoons and mangrove swamps. Coastal dunes and associated vegetation including sea oats are present throughout open beach areas on both the northern and southern sides of the EMA and SIA.

### 2.3.3 Geology

The geology of Vieques is characterized by volcanic rocks generally overlain by alluvial deposits and patches of limestone. The upland areas contain three rock types consisting of sedimentary rocks composed of limestone and volcanic rocks composed of granodiorite and diorite.

The Upper Cretaceous volcanic rocks in the upland areas appear to be the oldest exposed rocks on Vieques, and are believed to have been in a marine environment, as were rocks of the same age on the island of Puerto Rico. Limestone of Upper Tertiary age is found on peninsulas extending into the sea from the southern and eastern coasts. Limestone of the Tertiary-Miocene age is also found along these coasts, and is referred to as the "Puerto Ferro" limestone. Quaternary age deposits are found in the valleys and coastal areas and

include beach, swamp and alluvial deposits. Deposits of sand, swamp, and salt mud occur in the coastal areas and floodplains.

Limestone occurs in sectors of the northern, southern, and eastern parts of the island. The most extensive areas of limestone are found on the south coast peninsulas. The limestone is generally soft, yellowish, and well-indurated where exposed to the atmosphere. The sedimentary deposits consist of a mixture of sand, silt, and clay.

Alluvial deposits are found in the valleys and coastal areas and include beach, swamp and alluvial deposits. Deposits of sand, swamp, and salt mud occur in the coastal areas and floodplains. A recent investigation of the eastern end of Vieques indicated that the alluvial deposits on the eastern end of Vieques range from 5 to 50 feet in thickness (Baker, 1999).

Soils on Vieques Island are primarily residual, due to both climatic and subsurface rock conditions. They typically are classified into five groups and range from rock land soils where bedrock is exposed to deep, well drained soils within the alluvial deposits to shallow soils (Soil Conservation Service and University of Puerto Rico, 1977).

### 2.3.4 Hydrology

The streambeds found on Vieques flow either north or south until they reach the sea. Vieques does not have any perennial surface drainage, and receives an average of 36 inches of rainfall per year. Of the average 36 inches of annual rainfall, approximately 90 percent is lost to evaporation, based on statistics from the U.S. Virgin Islands. Of the remaining 10 percent, approximately 5 percent infiltrates into the groundwater system, and 5 percent becomes surface runoff.

#### 2.3.4.1 Surface Water

Surface water deposits in the VNTR occur primarily in coastal lagoons and intermittent streams, known locally as arroyos and quebradas that channel water downward from hills during rain events. Some of these arroyos and quebradas have standing water year-round, especially in areas abutting the coastline where terrain has leveled sufficiently to allow for standing water. Several mid-sized to large sized lagoons are present near the Purple Beach area just east of Puerto Negro and to the south within the Ensonada Honda area, the Bahía de la Chiva area, and the South Coast Bays area.

Surface water features are less prominent on the eastern side of the island than they are on the western side, and exist primarily very close to the coast as lagoons. Some rainwater does pool for some time in low-lying areas following storm events, but these features dissipate within a few days.

#### 2.3.4.2 Groundwater

The groundwater on Vieques is derived from rainfall on the island. The water flows downhill as intermittent stream runoff or seeps into the soil and underlying deposits. Water in pore space, cracks, and fractures in bedrock eventually flows into alluvial deposits or to the ocean. Yearly variations in island wide rainfall influence groundwater levels locally. Ground levels also exhibit fluctuations near the coastline because of tidal influences.

Two types of aquifers are present in eastern Vieques. The first type of aquifer is found in the upper portion of the bedrock and sedimentary rocks in the EMA. At the east end of Vieques, a groundwater divide occurs near the center of the island. From this location, the groundwater flow is toward the northeast and the southwest (Baker, 1999). The second type of aquifer is within the alluvial deposits found below the hills in the low flat valleys along the coast. Groundwater flow in these aquifers is also downhill and generally towards the sea. The more productive aquifer within is an alluvial aquifer within Esperanza Valley, the largest alluvial valley in Vieques. The groundwater within the Valle de Esperanza aquifer is located beneath the southern portion of the island near Camp Garcia. As discussed above, approximately 5 percent of the annual precipitation infiltrates through the ground and supplies the aquifers. A more detailed discussion of the groundwater conditions within VNTR is provided in the Environmental Baseline Survey (U.S. navy, 2003) and the U.S. Geological Survey of the area (Vargas, 1995).

## 2.4 Natural Resources

The eastern end of Vieques houses a variety of natural resources in the form of wide-ranging plant and wildlife species. A number of conservation zones have been established in the VNTR to help protect these valuable resources. These Conservation Zones are illustrated in Figure 2-7 and include:

- The Punta Este Conservation zone, which is located on the southeastern end of the LIA and consists primarily of drought-resistant scrub that no longer can be found elsewhere in Puerto Rico except on Navy property in Vieques.
- The Cayo Conejo Conservation Zone, a small island located southwest of the LIA in the Bahia Salina del Sur area. This area is an important nesting habitat for the endangered brown pelican and one of the last nesting area for this species in Puerto Rico.
- The Ensonada Honda Conservation Zone, which lies between Blue and Yellow Beaches on the southern coast of Vieques. This area has the best example of lowland forest growth on Vieques and is also home to a variety of extensive mangrove populations that appear to be healthy and expanding.
- The South Coast Bays Conservation Zone, located on the southern coastline of Vieques directly south of the Camp Garcia area and western portions of the EMA. Two bays at this location, Bahia Tapon and Puerto Mosquito, have bioluminescent properties and are a valuable tourism resource for the island.

The Navy integrated these zones into its Land Use Management Plans (LUMP) for Vieques, most recently updated in 1996. The intent of the conservation zones is the preservation of these unique areas as important components of the overall environmental health of Vieques.

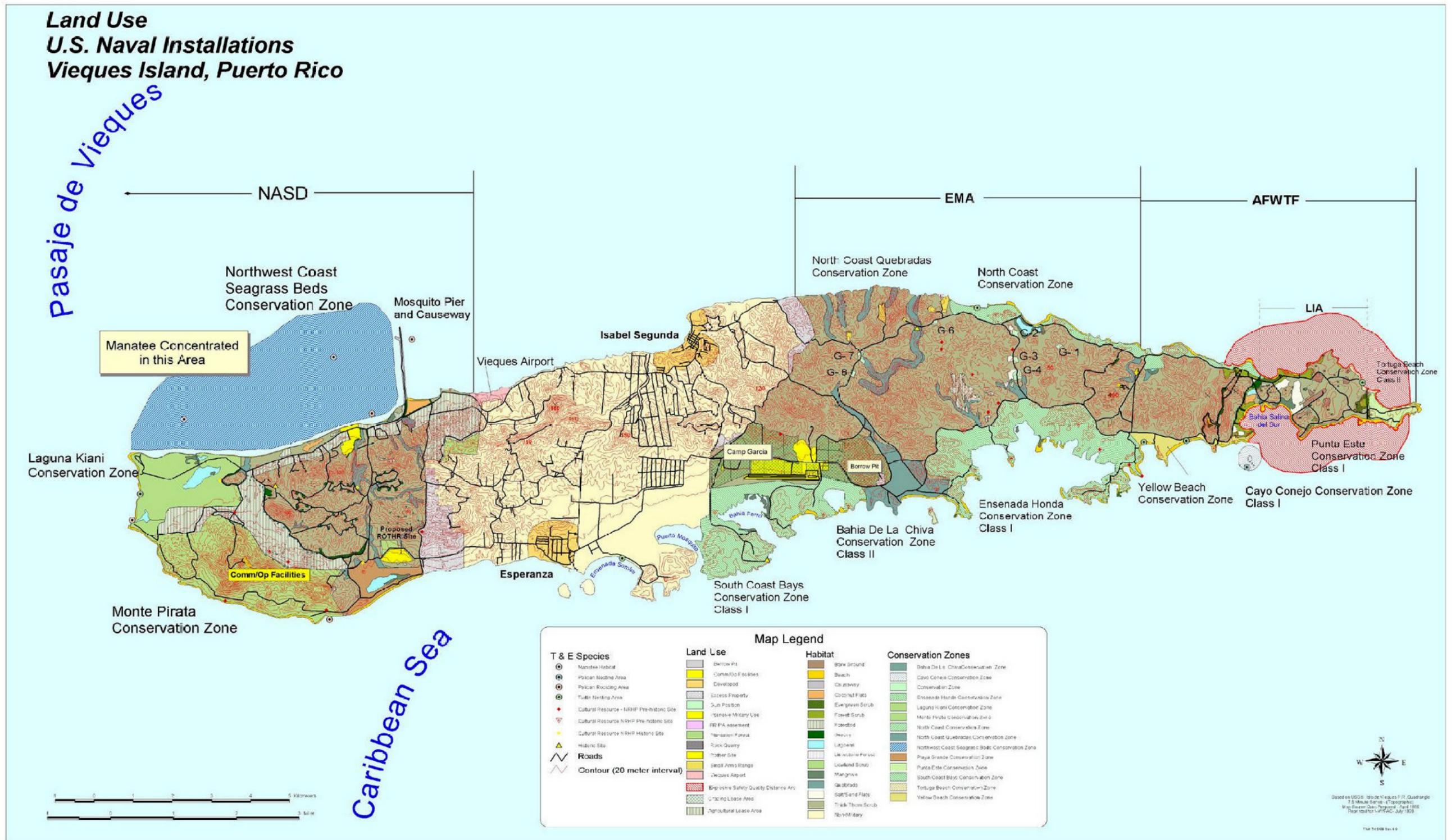


Figure 2-7  
Conservation Zones of Vieques  
Vieques Naval Training Range  
Vieques, Puerto Rico

## 2.5 Cultural Resources

A number of resources exist in the VNTR that are of interest from a cultural perspective including a number of conservation zones, cultural resource and pre-historic (Indian and Spanish historical sites). Navy surveys have located more than 100 sites with the potential to contain significant cultural resources on Vieques. Eleven of the sites are listed in the National Registry of Historic Places (NRHP). One such area is the Puerto Ferro Lighthouse in the EMA, which has been determined to be eligible for the NHRP (TEC, 2002).

### 2.5.1 Archaeological Resources

A total of 17 archaeological sites and districts currently are listed on the NRHP system for Vieques with approximately a half dozen on the eastern end of the island as shown on the land use map of U.S. naval facilities on Vieques (Geo-Marine, Inc., June 1996). This information has been confirmed by the review of other cultural resource maps for Vieques recovered during the record search and NRHP web based searches.

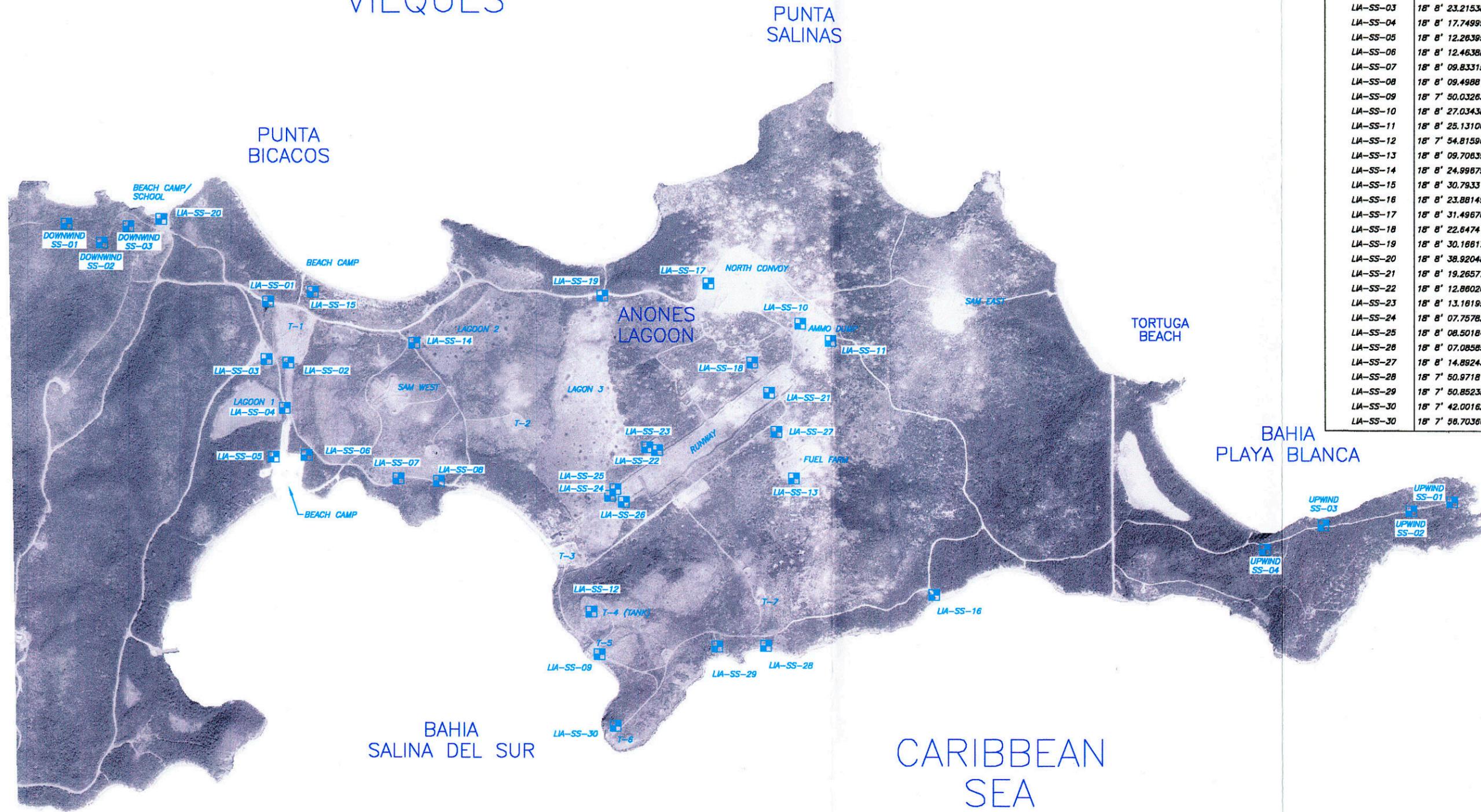
## 2.6 Summary of Previous Investigations

A number of environmental, ecological, public health, and cultural investigations have been conducted at the VNTR. Numerous studies also have been conducted by the Navy, ranging from economic impacts of military training in Vieques to the ecological impacts of military training on the health of the ecosystem in the waters just off shore from the range. The list of references at the end of this report provide the MEC related studies and selected environmental studies that have been conducted at Vieques. A more comprehensive listing of the environmental studies conducted in Vieques are provided in the Environmental Baseline Survey (U.S. Navy, 2003).

Most of the investigations completed at the VNTR were associated with the storage and handling of petroleum and hazardous substances. However, the report titled *Live Impact Area Soil Sampling Report, U.S. Naval Facility Vieques Island, Puerto Rico* (CH2M HILL, 2000) presented the analytical results of 37 soil samples collected throughout the LIA that were used to assess risk within the LIA. Figure 2-8 shows these soil sampling locations.

The analytical results of this sampling showed that explosives were detected in only five of the 37 sampled. A review of the metals data by ATSDR concluded “the levels of the metals and other chemicals detected in the soils would not result in harm to the health of either adults or children who might swallow or touch the soil while living in Vieques.” In addition, ATSDR concluded that the maximum levels of some of the metals detected was moderately elevated in comparison to soils elsewhere, but the levels are not consistent with what one would expect from soils also underlain by igneous or volcanic rocks” (ATSDR, 2001).

# SONDA DE VIEQUES



STATION	LATITUDE	LONGITUDE
UPWIND SS-01	18° 8' 06.871298" N	65° 16' 06.756690" W
UPWIND SS-02	18° 8' 5.874789" N	65° 16' 11.547477" W
UPWIND SS-03	18° 8' 04.315938" N	65° 16' 21.887633" W
UPWIND SS-04	18° 8' 01.579221" N	65° 16' 28.838138" W
DOWNWIND SS-01	18° 8' 38.461792" N	65° 16' 49.546102" W
DOWNWIND SS-02	18° 8' 38.313856" N	65° 16' 45.373228" W
DOWNWIND SS-03	18° 8' 38.141333" N	65° 16' 42.288297" W
LIA-SS-01	18° 8' 29.698560" N	65° 16' 25.935388" W
LIA-SS-02	18° 8' 22.828222" N	65° 16' 23.590350" W
LIA-SS-03	18° 8' 23.215382" N	65° 16' 26.161354" W
LIA-SS-04	18° 8' 17.749996" N	65° 16' 24.024484" W
LIA-SS-05	18° 8' 12.263951" N	65° 16' 25.338714" W
LIA-SS-06	18° 8' 12.463880" N	65° 16' 21.482404" W
LIA-SS-07	18° 8' 09.833158" N	65° 16' 10.766270" W
LIA-SS-08	18° 8' 09.498812" N	65° 16' 08.059872" W
LIA-SS-09	18° 7' 50.032634" N	65° 17' 47.264884" W
LIA-SS-10	18° 8' 27.034388" N	65° 17' 23.398177" W
LIA-SS-11	18° 8' 25.131000" N	65° 17' 19.804051" W
LIA-SS-12	18° 7' 54.815964" N	65° 17' 48.162572" W
LIA-SS-13	18° 8' 09.708393" N	65° 17' 24.278525" W
LIA-SS-14	18° 8' 24.998794" N	65° 16' 08.853806" W
LIA-SS-15	18° 8' 30.793317" N	65° 16' 20.665300" W
LIA-SS-16	18° 8' 23.881495" N	65° 16' 09.916331" W
LIA-SS-17	18° 8' 31.496789" N	65° 17' 34.258476" W
LIA-SS-18	18° 8' 22.647411" N	65° 17' 29.121910" W
LIA-SS-19	18° 8' 30.188172" N	65° 17' 46.708450" W
LIA-SS-20	18° 8' 38.920481" N	65° 16' 38.401139" W
LIA-SS-21	18° 8' 19.265777" N	65° 17' 27.145397" W
LIA-SS-22	18° 8' 12.860268" N	65° 17' 40.378391" W
LIA-SS-23	18° 8' 13.181953" N	65° 17' 41.534415" W
LIA-SS-24	18° 8' 07.757835" N	65° 17' 45.954842" W
LIA-SS-25	18° 8' 08.501849" N	65° 17' 45.323852" W
LIA-SS-26	18° 8' 07.085850" N	65° 17' 44.330580" W
LIA-SS-27	18° 8' 14.892437" N	65° 17' 26.308503" W
LIA-SS-28	18° 7' 50.971816" N	65° 17' 27.668832" W
LIA-SS-29	18° 7' 50.852355" N	65° 17' 33.458931" W
LIA-SS-30	18° 7' 42.001624" N	65° 17' 45.396380" W
LIA-SS-30	18° 7' 58.703667" N	65° 17' 07.691201" W

Figure 2-8  
Soil Sampling Location Map

Live Impact Area and Camp Garcia  
Vieques, Puerto Rico

A report entitled *Results of The Hydrogeologic Investigation Vieques Island, Puerto Rico* (Baker, November 1999) summarized the findings of a soil and groundwater investigation of the EMA to assess whether the potential existed for explosive compounds to migrate off the VNTR. The report concluded that no unacceptable risk to human health existed at the EMA because no explosive-related compounds were detected in the surface soil or groundwater samples.

## 2.7 Regulatory Status

An Interim Status RCRA Subpart X permit for the OB/OD area located within the LIA was issued by the USEPA on November 7, 1980. The OB/OD area is located within the LIA approximately 1,500 feet west of Laguna Anones and just east of the SAM west area (Figure 2-2). This area is utilized by the EOD Mobile Teams for the thermal treatment of expired and unexploded ordnance during range clearance and refurbishment efforts, which historically have been conducted on a semi-annual basis. Each unit (OB and OD) is approximately 100 ft by 100 ft in size with a circular earthen pit approximately 50 ft in radius and six to eight feet deep in the OD unit (ENSAFE Inc, 2002). Records indicate that the OB unit has never been used and only the OD unit is operated during range clearance and refurbishment efforts.

The PREQB had USEPA-delegated authority to inspect the Interim Status permitted unit on a yearly basis. No deficiencies with the Interim Status RCRA permit have been documented from yearly reviews through 1999 (Department of the Navy, 1999). The open detonation was limited to 10,000 lbs. NEW per year, or 3,000 lbs. NEW per event (Tippets, et al., 1979). In September 2000, the Navy withdrew its permit application following agreement to utilize only non-explosive ordnance and limit training to 90 days per year. The Navy then requested a delay of closure due to the dangers of OB/OD closure activities within an active range still containing MEC.

On January 20, 2000, the USEPA and the Navy entered into a 300b(h) Administrative Order of Consent (USEPA, 2000) to perform a RCRA Facility Investigation (RFI) at the VNTR. The purpose of the RFI is to determine the nature and extent of potential releases of hazardous wastes, solid wastes, and/or hazardous constituents at or from historical facility operations. Work plans for the RFI were submitted for public review and comment during November 2002. The comments are currently under review by EPA.

The sites to be investigated under the RFI include: nine Solid Waste Management Units (SWMUs), three Areas of Concern (AOCs), 12 Potential Areas of Concern (PAOCs) and 23 Photo-Identified (PI) areas that will be investigated as part of the Phase I RFI and the EBS. Three sites: the OB/OD site (SWMU 3), the LIA (SWMU 9) and the Non-Explosive Ordnance Firing Range (SWMU 11) were excluded from the Consent Order since they were active ranges at the time. A description of the sites are summarized in Table 2-9 and the locations of these sites are shown on Figures 2-2 and 2-5.

**TABLE 2-9**  
**Description of RCRA Sites at VNTR**

Area Name	Description of Area
SWMU-1 Camp Garcia Landfill	55-acre landfill used from 1954-1978 for construction debris, scrap metal and food packaging
SWMU-2 Fuels Off-Loading Site	Former location of four 20,000-30,000 ASTs and pipelines used to store diesel fuel and gasoline
SWMU-4 Waste Area of Building 303	Waste areas include a spent battery accumulation area, hydraulic oil catch basin, degreasing basin and waste rag storage
SWMU-5 Spent Battery Accumulation Area	An outside waste battery storage area
SWMU-6 Waste Oil and Paint Accumulation Area	A storage area for 55-gallon drums of waste oil and paint
SWMU 07 Waste Oil Accumulation Area at Camp Garcia	Vehicle maintenance area used for the storage of 55-gallon drums of waste oil
SWMU 08 Waste Oil Accumulation Area	Waste accumulation area outside generator building used for the storage of waste oil and lubricants
SWMU 10 Sewage Treatment Lagoon	Four former unlined lagoons used for the equalization and treatment of domestic wastewater
SWMU 12 Solid Waste Collection Unit	A solid waste transfer area used to store domestic trash
AOC A Fuel Fill Pipe Area	An area of petroleum stained soil in the vicinity of a diesel fuel UST
AOC F Rock Quarry	A rock quarry where used tires and waste paper were identified
AOC G Pump Station and Chlorination Building	Pump station and chlorination equipment stored in building next to lagoons
Photo-Identified Areas	23 additional potential sites where aerial photos identified ground scarring and disturbed vegetation

**The Consent Order was issued based on information gathered during a RCRA Facility Assessment (RFA) completed by A.T. Kearney, Inc., on October 13, 1988 (A.T. Kearney, 1988), and an updated RFA completed by the Puerto Rico Environmental Quality Board (PREQB) on September 27, 1995 (PREQB, 1995).**

**As discussed in Section 1, the Navy will transfer the VNTR property to DOI on May 1, 2003. Following the transfer, the Navy will retain access to the RCRA RFI sites for continued investigations and associated remedial actions where warranted.**

## SECTION 3

# Summary Of Field Investigation

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This section presents findings of the PRA field investigation completed by CH2M HILL in November 2002 at the VNTR. Specifically, Section 3 discusses the PRA investigation approach, identification of study areas, and findings from reconnaissance efforts, as well as data management and quality control methods used for this assignment.

## 3.1 PRA Investigation Approach

Field investigations associated with the PRA followed approved methods for the assessment of ranges, and were designed to capture as much visual information as possible in this mostly non-equipment evaluation of the areas under study. Information collected in the ARS conducted in conjunction with the PRA provides the link to conditions encountered during ground truthing efforts. The ARS Report is included in Appendix A.

The ARS effort and initial interviews completed via teleconference with AFWTF personnel were used to help design and execute an effective field reconnaissance program and to facilitate the understanding of historical operations at each location of interest.

In general, the field investigation included the following sequence of tasks completed to gather as much related information as possible on the field reconnaissance:

- Development of Project Instructions describing the methods and procedures to be used during the ARS and the field investigation component of the PRA.
- ARS that included visits to information repositories at various locations throughout the United States and Puerto Rico, personnel interviews at NSRR and Vieques, telephone interviews, web-based searches, and miscellaneous information collection areas. The draft report in Appendix A provides more detail on the breadth of the ARS.
- Evaluation of historical aerial photographs during development of the Project Instructions and project planning to select areas of interest for the field investigation component of program.
- Initial perimeter walk of accessible study area for the purpose of:
  - Collecting GPS points along the boundary of these areas with MEC avoidance support for subsequent mapping purposes.
  - Performing a preliminary evaluation of surface ordnance, scrap metal, or MEC density in areas of study with MEC avoidance support.
  - Preparing initial description of individual areas based on results of perimeter walk, including topography, vegetative cover, structures, evidence of human activity, evidence of military operations, and MEC findings if any.
  - Developing photo-documentation of area features.
- Secondary visit to perform ground truthing activities that include the following tasks:

- Performance of a minimum of 10 to 15 percent walk with MEC avoidance support to investigate surface and subsurface anomaly density using a Schonstedt® metal detector.
- Completion of a Level I Reconnaissance Form at each area that provides a wide range of -specific data. Level I Reconnaissance Forms are provided in Appendix B.
- Further development of individual area descriptions in the specific logbook.
- Development of additional photo-documentation of pertinent area features and vantage points.
- Conducting follow-up face-to-face meetings and teleconferences with past and current Navy, Marine, and AFWTF-specific personnel including employees at OP-1.

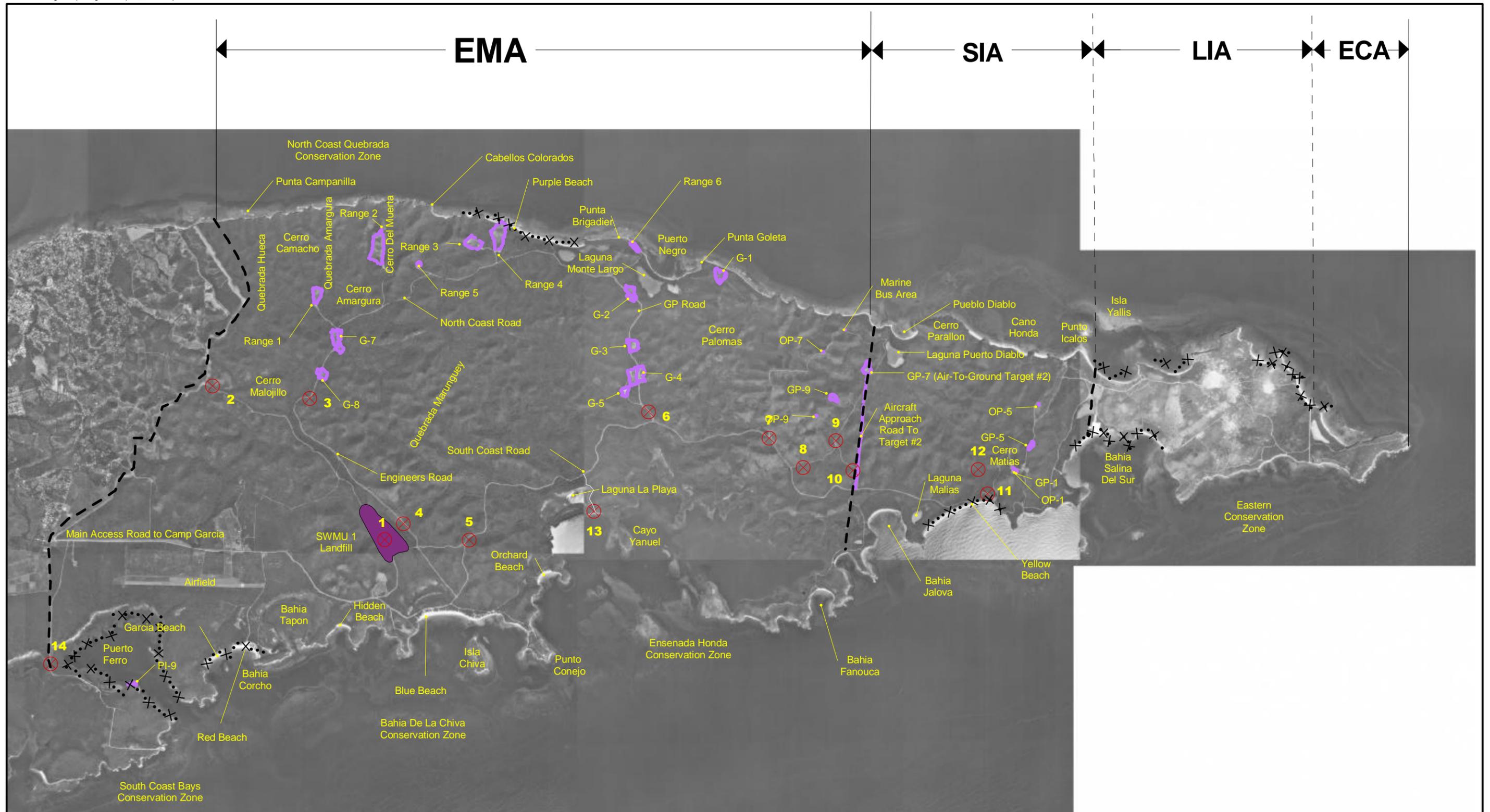
Indicators of the presence or absence of MEC within study areas were noted on the Level I Reconnaissance Forms. Such evidence included any scarring of lands; any surface MEC or scrap metal present; any land features that would indicate MEC-related use such as earthen berms, craters, or pit vegetation that may indicate MEC use; and historical records of MEC use.

## 3.2 Identification of Study Areas

Prior to mobilization for the field reconnaissance, available information was evaluated to design a field program consistent with the scope of this PRA. Information used to design the field program included information from the ARS; aerial photograph review; discussions with various Marine and Navy personnel from NSRR; and discussions with the inner range manager at OP-1, Mr. Nelson Hines.

Results of that effort using the most recent aerial photograph from 1994, indicated 19 areas that appeared accessible for field reconnaissance teams; a number of other suspect locations were also identified for evaluation during mobilization for the PRA. Figure 3-1 shows the locations of these 19 locations and other areas of interest. As previously indicated in Section 2.2 of this report, several additional MEC areas were identified from the analysis of historical aerial photos. However, many of these areas were not accessible for the field reconnaissance.

Table 3-1 summarizes the firing ranges, gun positions, and target areas evaluated during the PRA. The Level I Reconnaissance Forms that summarize area conditions are provided as Appendix B. Digital photographs were taken at all areas to document conditions at the time of the reconnaissance. Appendix C contains the project photographic log.



- X...X... Proposed Sign Posting Areas
- ⊗ Proposed Gate Barrier Locations
- EMA - Eastern Maneuver Area
- LIA - Live Impact Area
- SIA - Surface Impact Area

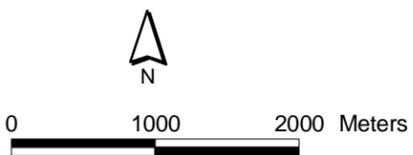


Figure 3-1  
Locations Map of MEC Areas  
Vieques Naval Training Range,  
Vieques, Puerto Rico

**TABLE 3-1**  
 Identification, Use, and Approved Ordnance Type (with Associated NEW) for PRA Areas at the AFWTF and EMA  
 VNTR, Vieques, Puerto Rico  
 November 2002

<b>Area ID</b>	<b>Area Use with Ordnance Area Approval and Associated NEW</b>
G-1	Gun Emplacement/Position – 300 rounds of 155mm per gun position per day
G-2	Gun Emplacement/Position – 300 rounds of 155mm per gun position per day
G-3	Gun Emplacement/Position – 300 rounds of 155mm per gun position per day
G-4	Gun Emplacement/Position – 300 rounds of 155mm per gun position per day
G-5	Gun Emplacement/Position – 300 rounds of 155mm per gun position per day
G-7	Gun Emplacement/Position – 300 rounds of 155mm per gun position per day
G-8	Gun Emplacement/Position – 300 rounds of 155mm per gun position per day
GP-1	Gun Emplacement/Position – 300 rounds of 155mm per gun position per day
GP-5	Gun Emplacement/Position – 300 rounds of 155mm per gun position per day
GP-7	ATG Target # 2 - MK-76 practice bombs with spotting charge; 20mm (amounts unknown)
GP-9	Gun Emplacement/Position – 300 rounds of 155mm per gun position per day
OP-5	Observation Post and former Gun Emplacement/Position - 300 rounds of 155mm per gun position per day
PI-9	Munitions loading/offloading and storage – No ordnance approval or NEW for this
Range 1	Small Arms Range [Battle Zero (BZO) Range] - 30,000 rounds 9mm or smaller per day or the NEW equivalent (30,000 lbs 1.3 or 1.4 hazard class)
Range 2	Small Arms Range (Squad Fire and Maneuver Range) - 30,000 rounds 9mm or smaller per day or the NEW equivalent (30,000 lbs 1.3 or 1.4 hazard class)
Range 3	Rifle Grenade Range (40mm) - 30,000 rounds 9mm or smaller; 500 40mm grenades per day or the NEW equivalent (30,000 lbs 1.3 or 1.4 hazard class)
Range 4	Anti-Fire/Antipersonnel Live Fire Tracking and Rocket Range - 30,000 rounds 9mm or smaller per day or the NEW equivalent; 500 40mm grenades; 100 LAWS per day
Range 5	Hand Grenade Range - 500 hand grenades per day of any type
Range 6	Open Detonation Training Range and Small Arms Range - 1,000 lbs C4 per day or the NEW equivalent

A number of other areas inspected during field efforts are summarized in the end of this section. These include lay down areas, the aircraft approach road to target #2 in the SIA, and a bombed out military bus encountered on the north side of the road along the North Coast Road near target # 2.

Discussions in individual sub-sections on results of MEC findings at specific locations is limited to observations made in the relatively small area evaluated under standard PRA procedures. On most occasions, these procedures included a 15 percent visual evaluation and a Schonstedt® metal detector sweep, coupled with a perimeter walk with Global Positioning System (GPS) coordinates to map boundaries of each. The Schonstedt instrument is a ferrous metal detector that is used to detect ordnance items as small as 40mm within a one foot depth from the surface. Larger ordnance items can be detected at a greater depth but the depth of detection is generally limited to four feet.

Reconnaissance efforts were completed during the weeks of November 4 and 11, 2002, by a three-person field crew that was supported by Explosive Ordnance Disposal (EOD) personnel from the EOD Mobile Team at NSRR.

### 3.2.1 Gun Emplacement/Position (G-1)

#### 3.2.1.1 Physical Characteristics

Position G-1 is located east of Puerto Negro, Laguna Monte Largo, and Purple Beach along the Atlantic coast in the EMA. Position G-1 encompasses an area approximately 450 ft long and 375 ft wide in a north-south orientation that slopes uphill toward the east and slightly to the north. Position G-1 is bisected by the North Coast Road in an east-west direction with approximately the same area on each side of the road. The northern tract of land appears to be a lay-down area for troops with some evidence of human activity including small campfire areas.

Knee-high grass and other vegetation covers the southern tract while ankle-high grass and vegetation was dominant on the northern tract. A 6 to 8 ft-high earthen berm surrounds the southern tract of this position on the east, west, and south sides. The boundaries of the area and centerline of the road were mapped using GPS.

#### 3.2.1.2 Manmade Features

No manmade features currently exist at this position based on results of the two visits. Some evidence of human activity as described previously was noted in the area, but no structures were noted during reconnaissance efforts. Results of the aerial photograph analysis completed by ERI indicated that this field artillery could house up to five revetted gun positions under differing orientations to conduct training operations. This is consistent with information received during interviews with Marine personnel including Captain Torres.

#### 3.2.1.3 Survey/Investigation Parameters and Results

Investigation parameters were described in detail in Section 3.1.

Results of the perimeter walk and interviews with Captain Torres of the Marine Corps unit, who is the Marine liaison with AFWTF, indicated that this location was used historically as a gun position firing 105mm to 155mm artillery rounds toward the SIA and LIA.

### 3.2.1.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 10 to 15 percent of the area. Few subsurface anomalies were noted. Only one 7.62mm expended cartridge was observed over the full length of the perimeter walk. No MEC items or evidence of burial pits or burning grounds were noted during reconnaissance efforts at this location.

Future characterization efforts of the area may encounter more evidence of historical operations such as former burial pits or burning ground which have known to be associated with large artillery firing positions such as those being evaluated as part of this PRA.

## 3.2.2 Gun Emplacement/Position (G-2)

### 3.2.2.1 Physical Characteristics

Position G-2 is located south of Range 6 and just west of Laguna Monte Largo along GP Road, which connects the North and South Coast Roads in the EMA. The gun position area is approximately 450 ft long by 500 ft wide. A large lay down area exists on the southeast portion of this area and is contiguous with the gun position area. Position G-2 is bisected by the access road (GP Road) with the gun position area having a positive relief of approximately 50 ft in the northern direction. The southern lay down tract is essentially flat with little relief. The gun position area has a 4 to 6 ft earthen berm surrounding it on three sides.

### 3.2.2.2 Manmade Features

No manmade features or structures were noted during the two visits to the area, which included an approximate 15 percent walkover.

### 3.2.2.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the perimeter walk indicate that this area is the location of a field artillery with the potential to house up to four revetted gun positions. Very few subsurface anomalies were detected. Two water-filled depressions were noted in the southwest corner of the area. The boundaries of the area and centerline of the road were mapped using GPS.

### 3.2.2.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 10 to 15 percent of the area. A few pieces of small arms ammunition items were encountered during the perimeter walk. No MEC items or evidence of burial pit or burning grounds were noted during the reconnaissance at this location.

## 3.2.3 Gun Emplacement/Position (G-3)

### 3.2.3.1 Physical Characteristics

Position G-3 is located approximately 0.7 miles south of Range 6 along GP Road, which connects the North and South Coast Roads. The gun position area is approximately 500 ft long x 350 ft wide, with a smaller 100 ft x 100 ft lay down area near the northwest corner of

the primary gun position area. Relief rises approximately 15 to 20 ft from the southwest corner to the northern boundary. An 8-ft berm surrounds the area on three sides with elevations ranging from 70 to 85 ft MSL. Open areas are characterized by knee-high grass and other mixed vegetation, predominantly young mesquite.

#### 3.2.3.2 Manmade Features

No manmade features or structures were noted during the two visits to the area, which included an approximate 15 percent walkover. This area has very similar characteristics to other gun position locations evaluated during the PRA.

#### 3.2.3.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the perimeter walk and follow-up ground truthing efforts indicated that this area was the location of a former gun position that fired artillery toward the SIA to the east. Results of the ERI historical aerial photograph analysis indicated this field artillery could house up to six revetted gun positions. Interviews with NSRR Marine Corps personnel confirmed this location as a historical large artillery gun position where 105mm to 155mm projectiles were fired toward the SIA.

The boundaries of the area and centerline of the road were mapped using GPS. Digital photographs of the area were collected during the perimeter walk.

#### 3.2.3.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 10 to 15 percent of the area. Very few subsurface anomalies were noted. A number of small arms ammunition and casings were encountered during the perimeter walk. No MEC items or evidence of burial pits or burning grounds were noted during reconnaissance efforts at this location.

### 3.2.4 Gun Emplacement/Position (G-4)

#### 3.2.4.1 Physical Characteristics

Position G-4 is located south of G-3 along GP Road and is approximately 550 ft wide and 400 ft long, in a north-south orientation. This is a relatively flat area with little relief, except for a very slight uphill slope towards the northeast. This appears to have been maintained recently, as characterized by the ankle-high vegetation in the open areas.

GPS coordinates of the area boundaries and centerline of the access road were collected during the initial perimeter walk.

#### 3.2.4.2 Manmade Features

No manmade features or structures were noted during the two visits to the area, which included an approximate 10 percent walkover.

#### 3.2.4.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the area perimeter walk indicated that this was the location of a former field artillery position. Information from the ERI draft report indicated that this location had the ability to house up to four revetted gun positions in a number of fixed orientations.

#### 3.2.4.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 10 percent of the area. Very few contacts were noted within this limited percentage of the area.

Only three pieces of small arms ammunition items were encountered during the perimeter walk. No MEC items or evidence of burial pits or burning grounds were noted during reconnaissance efforts at this location.

### 3.2.5 Gun Emplacement/Position (G-5)

#### 3.2.5.1 Physical Characteristics

Position G-5 is located south-southeast of G-4 along a branch dirt road that originates from GP Road. G-5 is approximately 375 ft wide and 150 ft long, in a north-south orientation. The area is relatively flat with little relief across it, and is bisected by this secondary access road. This area is characterized by knee-high vegetation in the open areas with sporadic vegetation of various types.

A water-filled depression was detected in the southeast corner of the area. GPS coordinates of the boundaries and centerline of the access road were collected during the initial perimeter walk.

#### 3.2.5.2 Manmade Features

No manmade features or structures were noted during the two visits to the area, which included an approximate 15 percent walkover.

#### 3.2.5.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the perimeter walk indicated that this was the location of a former field artillery position. Information from the ERI draft report indicates that this location had the ability to house up to three revetted gun positions in a number of fixed orientations.

#### 3.2.5.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 15 percent of the area. Very few contacts were noted within this limited percentage of the area. The Level I Reconnaissance Form in Appendix B provides additional details from the area walks.

Only two 5.56mm expended rifle cartridges were encountered during the perimeter walk. No MEC items or evidence of burial pits or burning grounds were noted during the reconnaissance at this location.

## 3.2.6 Gun Emplacement/Position (G-7)

### 3.2.6.1 Physical Characteristics

Position G-7 is approximately 1.7 miles north-northeast of Camp Garcia along Engineers Road. G-7 is approximately 600 ft wide and 450 ft long, and is bisected by Engineers Road. A large lay down area exists southeast of the firing positions.

Elevation at this location ranges from 195 ft to 250 ft above MSL with an elevation of 210 ft above MSL along Engineers Road. Knee-high grass and young mesquite trees dominate G-7. The area is bermed on all four sides and is oriented so that artillery would have been pointed east toward the SIA.

GPS coordinates of the boundaries and centerline of Engineers Road were collected during the initial perimeter walk.

### 3.2.6.2 Manmade Features

No manmade features or structures were noted during the two visits to the area, which included an approximate 15 percent walkover.

### 3.2.6.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the perimeter walk indicated that this was the location of a former field artillery/mortar with the ability to house up to six revetted weapons under different positions. Little evidence of past operations exists based on perimeter walk and ground truthing efforts. The units that utilized this area followed good housekeeping practices, probably because it was policed after each exercise in preparation for future operations.

Discussions with NSRR personnel indicated that this gun position was used for artillery training utilizing howitzers that fired 105mm to 155mm projectiles toward the SIA.

### 3.2.6.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 10 to 15 percent of the area with very few low signature subsurface anomalies were noted.

No MEC items or evidence of burial pits or burning grounds were noted during reconnaissance efforts at this location.

## 3.2.7 Gun Emplacement/Position (G-8)

### 3.2.7.1 Physical Characteristics

Position G-8 is located in the northwest portion of the facility along Engineers Road. G-8 is approximately 400 ft wide and 300 ft long, with a smaller 200 ft by 100 ft lay down area on the northwest side of Engineers Road. The open areas are characterized by waist-high grass and assorted vegetation. The area is surrounded by an 8 to 10 ft high earthen berm on its northern, southern, and eastern sides.

G-8 sits at an elevation of approximately 150 to 210 ft above MSL with a center point elevation of approximately 160-ft above MSL. GPS coordinates of the area boundaries and centerline of Engineers Road were collected during the initial perimeter walk.

#### 3.2.7.2 Manmade Features

No manmade features or structures were noted during the two visits to the area which included an approximate 15 percent walkover.

#### 3.2.7.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the perimeter walk indicated that this was the location of a former field artillery with the ability to house up to four revetted weapons under different positions. Discussions with NSRR Marine Corps personnel indicated that this gun position was used for artillery training utilizing howitzers that fired 105mm to 155mm projectiles toward the SIA.

#### 3.2.7.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 10 to 15 percent of the area. Very few low signature subsurface anomalies were noted. Five pieces of expended small arms ammunition and two expended CS tear gas canisters were the only surface items encountered during reconnaissance efforts.

No MEC items or evidence of burial pits or burning grounds were noted during the reconnaissance at this location. As with all areas in this investigation, findings for the perimeter walk and subsequent 10 to 15 percentage evaluation did not eliminate the possibility of MEC contamination both on the surface and subsurface in areas not investigated.

### 3.2.8 Gun Emplacement/Position (GP-1)

#### 3.2.8.1 Physical Characteristics

Position GP-1 is located at OP-1 and is the former location of a field artillery/mortar position that fired down to the LIA from this vantage point. Remnants of the concrete structure that probably held the guns are evident in this approximately 85 ft by 75 ft area. A small access road that leads to the former gun position could have been used to bring in larger guns to fire from this position.

This position sits approximately 420 ft above MSL and clearly provides the best possible view of the LIA. The boundaries of GP-1 were collected with GPS data points during reconnaissance efforts.

#### 3.2.8.2 Manmade Features

A number of structures exist at OP-1 to support Naval and Marine Training operations in the VNTR. A large operations building with an observation tower on the fourth floor is the principal and largest building at OP-1 with a base of approximately 4,000 square feet. One dozen individual living spaces are located on the second floor of this building for staff that man this observation post including the inner range manager. A smaller building that houses

four generators, a single story supply building, a hurricane locker, and a helicopter landing pad were also noted at OP-1. Two potable water tanks and a 15,000-gallon fuel underground storage tank (UST) are also present at OP-1 as is a paved parking lot and gravel roads that provide access to the compound from the north and east.

### 3.2.8.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the walkover indicated that the concrete apron in front of the small guard observation shack on the easternmost point of OP-1 was the likely former position of the revetted gun positions that would have fired down onto the LIA and SIA. Discussions with NSRR Marine Corps personnel during the November 12, 2002 field tour confirmed this, indicating that mortar rounds were historically fired from this position toward the LIA and SIA.

### 3.2.8.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 50 percent of the former gun position (not the entire OP-1). Excessive interference from concrete rebar precluded the evaluation of anomaly density around the former gun position locations.

Surface MEC items were not encountered during the walk as expected, since the functions of this facility would have required a sweep for any remaining munitions after firing operations ceased.

## 3.2.9 Gun Emplacement/Position (GP-5)

### 3.2.9.1 Physical Characteristics

Position GP-5 is located north of GP-1 along the main access road that leads down to the western edge of the LIA. The area is approximately 200 ft long and 100 ft wide, and sits at an approximate elevation of 290 ft above MSL. GP-5 is currently used as the location for two fenced EOD ready service magazines.

The area has been re-worked extensively to accommodate the ready service magazines and has little relief across its boundaries. The boundaries of the area were mapped using GPS.

### 3.2.9.2 Manmade Features

Two 10 ft by 20 ft fenced areas exist at GP-5. These house the two EOD ready service magazines. Four telephone poles are the only other manmade structures noted by the reconnaissance team within the boundaries.

### 3.2.9.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the perimeter walk identified a few ammunition cans along the toe of the slope on the southern side of the area. Little other evidence of past firing or training operations was noted during the two visits.

### 3.2.9.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 25 percent of the area. Very few low signature subsurface anomalies were noted.

No small arms ammunition items, cartridges, or MEC items were noted during reconnaissance efforts at this location.

## 3.2.10 Air to Ground Target (GP-7)

### 3.2.10.1 Physical Characteristics

GP-7 is located southwest of the Puerto Diablo area just west-southwest of Laguna Diablo at the north end of the aircraft strafing road. GP-7 encompasses an area approximately 2 to 3 acres in size and is relatively flat with little relief because of extensive re-work to accommodate its function as an ATG target zone. The area sits at an elevation of approximately 105 ft above MSL and is accessed from an earthen ramp leading up from the termination point of the aircraft strafing road.

A 6-ft berm surrounds the area on all sides, except for a small access road opening on the southern end of the area. The boundaries of the area and the aircraft approach lane were mapped using GPS. Digital photographs of the area were also collected during ground truthing efforts.

### 3.2.10.2 Manmade Features

Three rings of painted tires approximately 100 ft, 200 ft, and 300 ft in diameter were noted during visits.

### 3.2.10.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

During the perimeter walk, MK-76 and MK-106 practice bombs and painted tire targets were observed in the open areas and along the berms. These observations suggested that this location was an airdrop for training with inert bombs only. A large piece of a fire bomb or aircraft fuel tank, possibly used as a target, was noted in the center of the open area. During reconnaissance efforts, significant quantities of ordnance-related scrap (ORS), primarily fin assemblies, and were noted in the south to north strafing road lane leading to this range.

### 3.2.10.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 15 percent of the area. Heavy subsurface anomaly densities were noted throughout the approximate 15 percent investigation area, and surface contamination was similar in density.

The earthen berms that surround the area are moderately contaminated with MK-76 practice bombs and fin assemblies both on the berm surface and partially buried within it. A number of items were also noted along the toe of the boundaries of the area some 50-ft or greater down from the berms. Significant MEC was also noted in the earthen ramp leading up to the

entrance from the strafing lane, including MK-76 inert bombs and 20mm UXO distributed throughout the ramp and onto the strafing lane.

### 3.2.11 Gun Position (GP-9)

#### 3.2.11.1 Physical Characteristics

Position GP-9 is located to the south-southwest of GP-7 at the summit of one of the many hills in the general vicinity of the strafing lane leading to GP-7 (Target # 2). GP-9 is approximately 275 ft long and 200 ft wide, and sits at an approximate elevation of 200 ft above MSL. Elevation relief moves downward slightly across the area from north to south. The area is dominated by grass and thorny brush.

GPS coordinates of the boundaries were collected during the initial perimeter walk.

#### 3.2.11.2 Manmade Features

An 8 ft by 20 ft conex box with a large cross-painted on it was noted near the center of GP-9, indicating that this location is used as an orientation point for aircraft as they navigated toward the drop zone at GP-7. No other structures or manmade features were observed during the perimeter walk.

#### 3.2.11.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

This location appears to have functioned as an orientation point for aircraft training runs, although its location and orientation relative to the LIA area could have made this an optimal location for field artillery positions. No evidence that this location served in that role has been discovered either by ARSs, interviews, or ground truthing efforts.

#### 3.2.11.4 MEC-Related Findings

A Schonstedt metal detector was used to evaluate subsurface anomaly density on approximately 10 percent of the area. Very few low signature subsurface anomalies were noted within that 10 percent area.

No surface MEC was encountered during the perimeter and walk although a piece of a bomb ejection rack from an aircraft wing was noted in the access road leading to the area. A bomb brace was also noted along the same access road, which had to be ascended on foot because of the condition of the road and extreme slope of terrain.

### 3.2.12 Former Gun Position (OP-5)

#### 3.2.12.1 Physical Characteristics

The observation post at OP-5 is located at the top of a hill on the eastern end of the SIA, north of gun positions GP-1 and GP-5 at an approximate elevation of 300 ft above MSL. OP-5 is roughly 1.5 to 2 acres in size with little change in relief across the because of extensive grading activities completed as part of development. The OP-5 area is covered by vegetation consisting of grass and thorny brush.

GPS data points of OP-5 boundaries were collected during the initial perimeter walk.

### 3.2.12.2 Manmade Features

One 12 ft by 15 ft concrete observation building at OP-5 is equipped with video cameras that document aircraft training operations. Remnants of a concrete bunker were also observed at this area. No additional structures or manmade features were noted during reconnaissance efforts.

### 3.2.12.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the perimeter and secondary ground truthing efforts indicated that this area had been used as a gun position for mortars and small artillery guns in addition to its current use as an OP.

### 3.2.12.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 15 to 20 percent of the area. Anomaly densities ranged from moderate to heavy throughout the investigation area. Significant quantities of scrap metal, projectile fragments, bomb fragments, and small arms ammunition were observed on the surface at OP-5.

## 3.2.13 Ordnance Transport/Offloading Location (PI-9 East)

### 3.2.13.1 Physical Characteristics

Photo-Identified 9 east (PI-9 East) is located near the southwest corner of the EMA, approximately 1,000 meters south of the Camp Garcia airfield runway on a point along Puerto Ferro Bay. The analysis of historical aerial photos identified this location as an area used for open storage of munitions in 1959 and 1962. The elevation is essentially at MSL, and tidal effects are evident along the shoreline to the north and east.

The area is bisected by a gravel pack access road that leads to the bay opening. A 35- to 40-ft tall escarpment bounds the area to the south with water surrounding the area on the north and east sides. The northern edge of the area between the access road and the waterline is populated by black and red mangroves, with a variety of other coastal marsh species.

The boundaries and approximate limits of debris piles were mapped using GPS.

### 3.2.13.2 Manmade Features

The remnants of a concrete pier structure are evident along the waterline on the eastern edge of the. This pier likely functioned as the loading and offloading platform for munitions transport. Large debris piles cover the northern and southern edges of the access road leading back some distance into the canopy.

### 3.2.13.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the reconnaissance identified significant debris piles that included mostly steel artillery cartridge cases and other ORS. The debris piles extend approximately 150 ft west of

the waterline on both sides of the access road, which leads to the water. Significant numbers of steel artillery casings were also noted in the water.

#### 3.2.13.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 40 percent of the area. Moderate to heavy anomaly densities were reported.

Although no MEC was encountered on the surface during this visual observation, the items observed in the water could not be positively identified because of the murkiness of the water and the density of these items as noted in the water. In addition, the contents of the debris pile, although laden with metallic anomalies, are unknown at this time and could potentially contain MEC.

### 3.2.14 Small Arms Range SAR-1 (Range 1)

#### 3.2.14.1 Physical Characteristics

Range 1 was a squad fire and maneuver range located northwest of G-7 at the end of an access road that splits off from Engineers Road. Range 1 is approximately 500 ft wide and 1,100 ft long. It is approximately 200 ft above MSL. The north-south orientation consists of gently rolling terrain with a deep, dry gully that bisects the area in an east-west direction. The gully sits at the center of the area and topography rises approximately 35 to 40 ft to the north and 40 to 45 ft south toward the observation tower. A 7- to 8-ft earthen berm surrounds the area on the north, east, and west.

The open areas are characterized by waist-high grass with sporadic miscellaneous vegetation. The perimeter of the area was mapped with GPS data points during the initial perimeter walk.

#### 3.2.14.2 Manmade Features

One control tower and one survey marker were noted. Earthen berms surround the area on three sides.

#### 3.2.14.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Records recovered during archive searches indicated that M-16 service rifles, pistols, M-249 SAW, M-60 and M-240G submachine guns, practice grenades, and pyrotechnics were authorized for use at this range. Approved munitions included 9mm, 5.56mm and 7.62mm small arms ammunition, practice hand grenade (types G811 and G878), and pyrotechnics (types not confirmed). Direction of fire was to the north with a firing fan between 345 and 035 degrees magnetic.

#### 3.2.14.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 15 percent of the area. Results of that effort only identified a few targets, although the northern berm area did exhibit significant amounts of small arms ammunition fragments. This helped confirm that this was a small arms range.

Approximately 12 small arms ammunition items, expended small arm cartridges, and one grenade clip were noted during the limited visual reconnaissance effort. The Range 1 area appears to have been well policed following operations, indicating good range management practices.

### 3.2.15 Small Arms Range SAR-2 (Range 2)

#### 3.2.15.1 Physical Characteristics

Range 2 is located approximately 1,000 meters to the east-northeast of Range 1, bound to the south by Cerro Amargura and to the north by Cerro Del Muerta. Range 2 is accessed from a gravel packed road that emanates south off Engineers Road. The range is roughly 1,000 ft wide and 2,300 ft long in a north-south orientation, at an approximate elevation of 175 ft above MSL. A steep drop in elevation relief (approximately 125 ft) occurs northward from the control tower to the target areas.

Open areas of the range are characterized by knee-high grass, young to mature mesquite trees, and other assorted vegetation types. The boundaries of this range were mapped by collecting GPS data points during the initial perimeter walk for subsequent use in development of report figures.

#### 3.2.15.2 Manmade Features

One range control tower and some random targets were noted. No other structures or manmade features were noted during perimeter walk.

#### 3.2.15.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

All investigation parameters indicated that this was a small arms range. Allowable weapons were recorded as M-16 service rifles, pistols, M-249 SAW, M-60 and M-240G submachine guns, practice grenades, and pyrotechnics. Approved munitions included 9mm, 5.56mm and 7.62mm small arms ammunition, practice hand grenades and pyrotechnics (types not confirmed).

Direction of fire was to the north with a firing fan between 345 and 025 degrees magnetic. Very little evidence remains of past operations, indicating that regiments policed themselves well following training activities and/or that the range was well-maintained during range refurbishment efforts.

#### 3.2.15.4 MEC-Related Findings

A Schonstedt metal detector was used to evaluate subsurface anomaly density on approximately 10 percent of the area. Results of this effort indicated low anomaly densities in areas investigated (transect lines over 10 percent of range). A number of small arms ammunition items including one “fully up” rifle round were encountered on the surface during field reconnaissance activities.

### 3.2.16 Rifle Grenade Range, 40mm (Range 3)

#### 3.2.16.1 Physical Characteristics

Range 3 is located approximately 0.3 miles south of Punta Cabellos Colorados on the southern flank of Cerro Bone. The range is roughly 800 ft wide and 650 ft long, at an approximate elevation of 75 ft above MSL. It is oriented in a northeast-southwest direction. Elevation relief trends upward 40 to 45 ft in the northern direction toward the firing berm and Cerro Bone.

Shin-high grass and sporadic growth of young mesquite and other thorny species dominate open areas of the Range. The boundaries of the range were mapped using GPS data points during the initial perimeter walk conducted on November 6, 2002.

#### 3.2.16.2 Manmade Features

One control tower, three wooden barricades, and seven telephone pole stumps were observed at this range. The is bounded on all four sides by a 6 to 8-ft high earthen berm. Evidence of target tires was noted on northern berm. 40mm cartridge cases were driven into the two of the telephone pole stumps were noted during the walkovers.

#### 3.2.16.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Records reviewed as part of the ARS indicate that this was a “BZO” range that allowed light machine guns, rifles, pistols, and shotguns. Direction of firing was to the north-northwest with a firing fan between 290° and 305° magnetic. Random targets were set up on the sloping hill to the north.

Results of the perimeter walk and ground truthing efforts, along with notes made at the range control tower indicate that this location was more recently used as a 40mm rifle grenade rang. This use was confirmed during interviews with installation personnel.

#### 3.2.16.4 MEC Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 10 to 15 percent of the area. Minimal subsurface anomalies were noted at this range.

Significant numbers of 40mm projectiles were observed in an area along the northern berm during the perimeter walk (MEC avoidance provided during walks). A number of small arms ammunition items were also encountered during the perimeter walk. Subsequent ground truthing confirmed that this had been used as a conventional small arms range in addition to the more recent use as a 40mm rifle grenade range.

### 3.2.17 Rocket Range (Range 4)

#### 3.2.17.1 Physical Characteristics

Range 4 is located just to the east-northeast of Range 3 at the end of an access road that branches off from where Engineers Road becomes the North Coast Road. The range is

approximately 1,000 ft wide and 2,600 ft long in a north-south orientation that ultimately meets the northern coastline between Cabellos Colorados and Playa Grande.

The area is relatively flat in relation to other locations, with much less relief than other ranges. Elevations across this range from 15 ft above MSL at the gully that bisects the area in an east-west direction, to 50 ft above MSL at the northern berm, and up to 79 ft above MSL at the range control tower at the southern end of the range.

The open areas are characterized by waist-high grass and other mixed vegetation types, predominantly young mesquite. GPS coordinates of the boundaries were collected during the initial walk.

#### 3.2.17.2 Manmade Features

One range control tower, pieces of aircraft and one 75mm gun were set up as targets at distances ranging from 300 to 350 meters from firing points. Earthen berms were present exist on three sides of the range.

#### 3.2.17.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Initial observations from the tower indicated that this location was used as a rocket range. This was supported by results of the perimeter walk and subsequent ground truthing efforts. This area was likely utilized as a rocket and rifle grenade range, shooting down to the targets from an area just in front of the range control tower.

Record identified during the archives record search confirmed that this location was an Anti-armor/Antipersonnel Live Fire Tracking Range that accommodated the M-79 and M-203 grenade launcher; M-72, M-73, AT-4 and Dragon light anti-tank weapons; 3.5-inch rockets; M-249 SAW and MK-153 SMAW; and M-60 and M-16 rifles. Field of fire is from the berm at firing line where the hill makes 15-meter drop, followed by a gradual rise to the coastline where a 10-meter-high cliff forms the center of the target area. The firing fan was from 010 to 045° magnetic.

#### 3.2.17.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 10 to 15 percent of the area. The subsurface anomaly density was moderate to high in the northern portion of the area, and low on the southern portion near the observation tower.

Numerous expended rocket motors and rocket motor parts, along with other ORS, were identified throughout the range during the perimeter walk, especially in the area of the targets that abutted the northern perimeter of the area.

A brief walk along the waterline just north of the Range 4 target area identified several rocket motor parts, other ORS, and scrap metal.

### 3.2.18 Grenade Range SAR-5 (Range 5)

#### 3.2.18.1 Physical Characteristics

Range 5 is located approximately 0.6 miles south of Punta Carbellos Colorados on the northern coast of Vieques just east of Cerro Del Muerta. Range 5 is located between Small Arm Range 2- and 40mm Rifle Grenade Range 3. This covers approximately 1.5 acres oriented in an east-west direction, with an approximate elevation ranging from 95 ft above MSL in the west to 118 ft above MSL in the east. The area has significant changes in relief, trending approximately 25 ft downward from the four -bay concrete hand grenade-throwing bunker toward the east.

The area has approximately 95 percent vegetation coverage, dominated by knee-high grass, thorny brush, and young mesquite trees. GPS coordinates of the boundaries were collected during the initial perimeter walk.

#### 3.2.18.2 Manmade Features

A concrete barricade with four separate and protected positions for throwing grenades overlooks the range impact area, as depicted in Appendix C. Included within each throwing position is a safety sump at the forward wall that provides protection for personnel when grenades are accidentally dropped prior to being thrown down range. Evidence of the former control tower was noted behind the grenade-throwing bunker in the firing line toward the field of fire. No targets were noted during reconnaissance efforts.

#### 3.2.18.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the perimeter walk and ground truthing identified a number of grenade clips that further confirmed the use of this location as a hand throwing grenade-training area. No small arms ammunition was noted during the perimeter walk or ground truthing efforts. Approximately 25 percent of the area was investigated visually with a number of transects, using a metal detector for MEC avoidance during ground truthing efforts.

#### 3.2.18.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 20 to 25 percent of the area. Subsurface anomaly density was low. No scrap metal or MEC was noted on the surface during visits.

### 3.2.19 OB/OD Training Range with Small Arms Range (Range 6)

#### 3.2.19.1 Physical Characteristics

Range 6 is located east of Range 4 along the Atlantic coast between Playa Grande and Punta Brigadier. The area is reached from an access road that branches off from the North Coast Road. Range 6 encompasses an area of approximately 2 acres, with elevations at the area ranging from 5 ft to 12 ft above MSL. Relief across the area is gradual, and the area could be characterized as mostly scrubby open beach area.

The little vegetation that exists at the area is mostly coastal grasses and brush, with an occasional sea oat or red mangrove strand near the coast. The boundaries were mapped using GPS. Digital photographs of the area were collected during ground truthing efforts.

#### 3.2.19.2 Manmade Features

Remnants of a concrete bunker were observed near entrance to. Four pits were also noted during the two visits to the area, which included an approximate 15 percent walkover.

#### 3.2.19.3 Survey/Investigation Parameters and Results

See Section 3.1 for investigation parameters.

Results of the reconnaissance identified four distinct pits that exhibited evidence of being training areas for open detonation. Discussions with NSRR personnel confirmed that this area was a historical open detonation training area. In addition, an area was identified where bunkers associated with open detonation training would have stood (lay down area). Evidence of small arms ammunition and a small berm were found at the area, indicating that this was also used as a small arms range for rifle training.

#### 3.2.19.4 MEC-Related Findings

A Schonstedt® metal detector was used to evaluate subsurface anomaly density on approximately 15 percent of the area. Results of that effort indicated a moderate subsurface anomaly density in investigated areas. The anomaly density is likely to be the result of ORS fragmented across the area from open detonation training.

An M-60 fuze lighter and a number of expended 5.56mm and 7.62mm cartridge cases were noted on the surface at Range 6 during the two ground truthing visits.

### 3.2.20 Other Areas of Interest

A number of other areas of interest in the EMA and SIA were investigated by the CH2M HILL field reconnaissance team based on evaluation of the 1994 aerial photograph. Brief descriptions of these areas are provided in the following subsections.

#### 3.2.20.1 Approach Road to Target # 2

The approach road that leads aircraft to the target # 2 area was traversed on November 8, 2002, with GPS data points collected along the centerline of the road moving north from target # 2 south toward the South Coast Road. A number of practice bomb fragments and 20mm projectile fragments were noted along the road beginning approximately 0.25 miles south of target # 2. A limited metal detector sweep along the centerline of the road indicated moderate anomaly densities.

#### 3.2.20.2 Former Marine Corps Artillery Target Area

The former Marine Corps Artillery Target Area was located in an area just south of the North Coast Road between Cerro Farallon and Punta Icacos in a generally flat area located between two hills approximately 240 ft high. Most information gathered about this location, including discussions with the Inner Range Manager Mr. Nelson Hines indicated that this location was a “former target area” not recently utilized for training purposes.

Preliminary reconnaissance efforts along North Coast Road near this area did not identify any relic roads or other access points into the very thick thorny brush and canopy. The 1994 aerial photograph showed no evidence of this area, indicating that the jungle has taken this area and access roads over. This prevents preliminary evaluations of this area.

#### 3.2.20.3 Lay Down Areas near OP-7

Two open areas on the access road off the North Coast Road that leads up to OP-7 were visited on November 11, 2002 during reconnaissance efforts. These two locations appear to be areas where troops can set up lay down facilities for their training stays in the area. Area walks did not identify evidence of any past firing or other munitions activity at this location.

#### 3.2.20.4 Open Area West of G-4 and G-5

This area exists approximately 1,000 ft west of positions G-4 and G-5 off GP Road. The area was identified on the 1994 aerial photograph as being a partially open area that appeared to have been free of vegetation just prior to that date. The remnants of a road accessing this area were evident on the 1994 aerial photograph and efforts were made by the field team on November 6, 2002, to reach this location.

Although the relic road does exist, it was found to be heavily overgrown with thorny mesquite, making access quite difficult. Through the use of machetes, appropriate personal protective equipment (PPE), and field team perseverance, the suspect area was reached. The area was largely overgrown with mesquite and other invasive tree species of heights up to 6 ft. No evidence (earthen berms or other manmade structures) was encountered in the area or the access road leading to it.

#### 3.2.20.5 Marine Corps Bus off North Coast Road

A shot-up bus was noted on the northern bank of North Coast Road just west of Cerro Farallan near Laguna Monte Largo. Marine Corps markings were noted on the bus, which appeared to have been dumped here. A water tank (also shot up) was also noted in the area adjacent to the bus. Observations indicated no evidence of MEC. These observations were limited by the terrain, vegetative cover, and the unstable position in which the bus rested.

#### 3.2.20.6 Small Open Area Fork in Road at North Coast and GP Roads

This area was noted on the 1994 aerial photograph and was visited on November 7, 2002, by the CH2M HILL field team. This area turned out to be a large exposed bedrock area (approximately 60 square ft) where no vegetation can grow. This showed up prominently on the aerial photograph.

### 3.3 Data Management

Data management associated with the PRA consists of the custody of data and information collected and categorized during the archives record search process, the Level I Screening Forms that document the ground truthing efforts, and information gathered during personnel interviews, all to be used in preparation of this report. Because this PRA is preliminary in nature, no geophysical data collection component was included in this phase of work.

The Final PRA report and all source information used in the development of the report will be placed electronically into the existing project management web for Vieques. The electronic document submissions will consist primarily of a .PDF deliverable of the report that is linked to the source information. The mapping data collected during field efforts will be input into the existing ArcView Geographic Information System (GIS) for Vieques. This data includes ArcView project and shape files that delineate the area based on the PRA information gathered, range types, conditions, past and present uses, historical photographs, and other information gathered during the study.

### 3.4 Quality Control

No geophysical data collection efforts or intrusive operations were conducted under this preliminary assessment. Therefore, no defined quality control (QC) programs were used.

## SECTION 4

# Conceptual Site Model (CSM) and Preliminary MEC Hazard Assessment

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This section summarizes the preliminary MEC conceptual site model (CSM) and hazard analysis completed as part of the PRA. Each area evaluated under this assignment is presented in individual subsections that provide the information necessary to summarize individual MEC risks. The initial CSM for the EMA and SIA is introduced in Section 4.1 in a narrative, pictorial, and graphic format that describes in a preliminary fashion the sources, pathways, and receptors of potential MEC hazards within the areas of study.

Preliminary hazard analysis and risk discussions on firing points, target areas, and range fans are limited by factors discussed in Section 3.2.20. These factors include range dimension changes, some uncertainty regarding all weaponry and munitions allowed on a range because of incomplete records, and dense vegetation coupled with the steep terrain.

In addition to results of the ARS and field truthing efforts, interviews with current and past NSSR and AFWTF personnel provided much of the institutional knowledge gained under this assignment. This information was factored into hazard and risk analysis evaluations.

## 4.1 VNTR Conceptual Site Model

### 4.1.1 Primary Sources

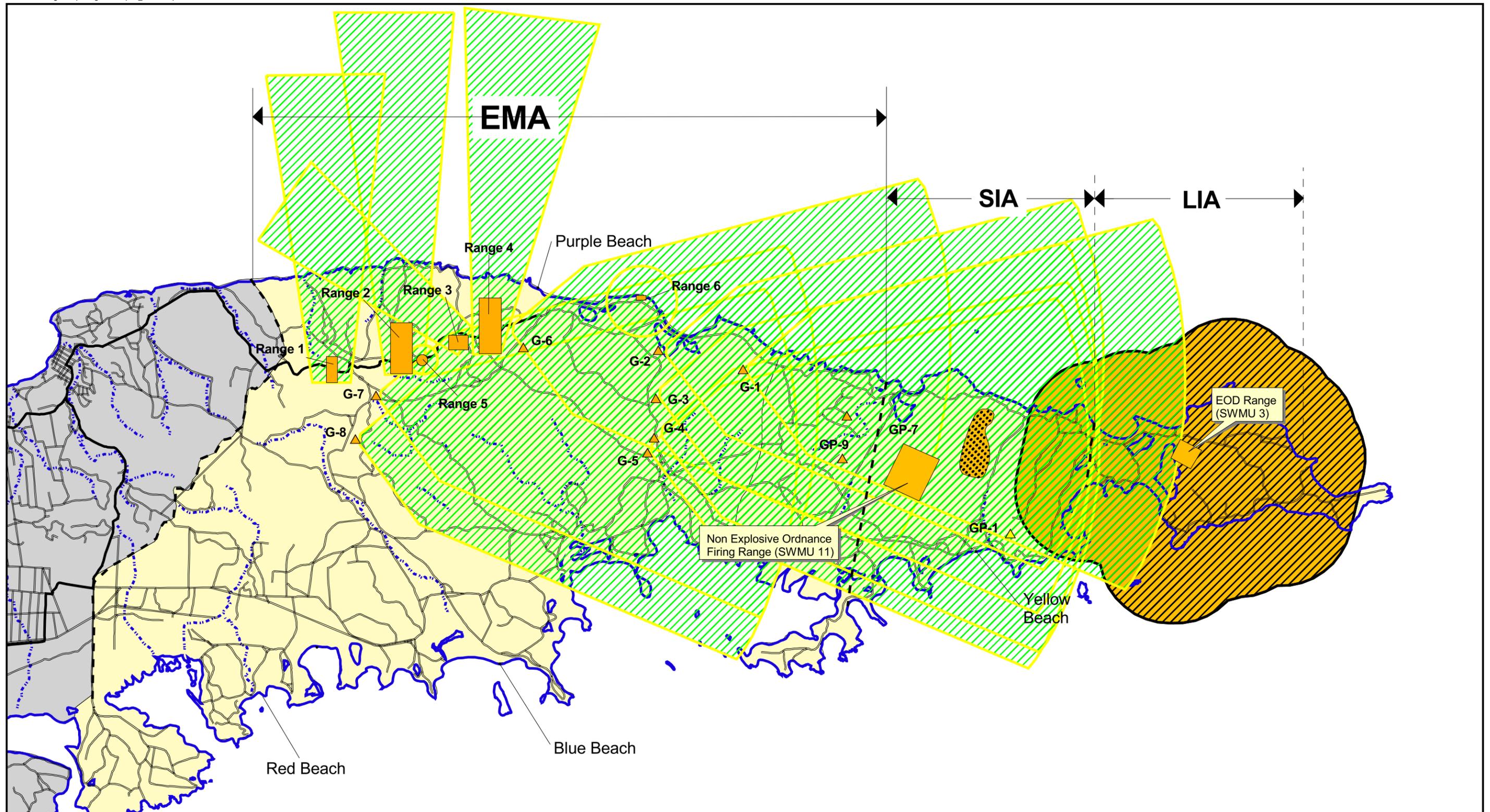
The primary sources of MEC are based on past ordnance-related activities identified from the ARS, results of the field reconnaissance and personnel interviews. Table 4-1 identifies the primary MEC sources for the VNTR. The locations of these sources were illustrated in Figure 3-1, presented previously.

A series of preliminary range safety fans associated with historical ranges and gun emplacements have been developed for the VNTR. The safety fans provide an estimate of the lateral extent of the potential MEC impact area extending from the ranges and marine artillery gun positions. The highest density of MEC impact occurs within the one-third of the fan located furthest from the firing point. To better understand the safety fans, the orientation and dimensions of the MEC area need to first be determined so that the location of the source area and preliminary estimated distributions of projected MEC can be evaluated.

The safety fans associated with the field artillery emplacements/positions extend eastward from their firing position toward the target areas in the SIA. Figure 4-1 shows the range fans associated with the gun emplacements/positions and ranges in the 16 field-verified MEC areas included under this PRA. Range fans typically will evolve over time as firing points and target areas are altered to accommodate various training activities. Range dimensions and projected range fans emanating from the MEC areas would be modified when firing points and target areas were altered.

TABLE 4-1  
 Primary MEC Sources  
 VNTR, Vieques, Puerto Rico

ID	MEC Area Type	MEC Activity
<b>Live Impact Area</b>		
LIA Bombing Range	Bombing Range	ATG bombing, naval gunfire, OB/OD
LIA OB/OD	OB/OD	Open burn open detonation, possible burial
<b>Surface Impact Area</b>		
Surface Impact Area	Artillery/Bombing Targets	Artillery gunfire, strafing of, ATG bombing of inert bombs
GP-1	Gun Emplacement/Position	Artillery Gunfire towards SIA and LIA
GP-5	Gun Emplacement/Position	Artillery Gunfire towards SIA and LIA
GP-7	Target	Bombing target
GP-9	Gun Emplacement/Position	Artillery Gunfire towards SIA and LIA
OP-5	Observation Post/Gun Position	Artillery Gunfire towards SIA and LIA
OP-10, OP-11, Op-12, OP-13	Photo-Identified Observation Posts	Potentially used for artillery fire
G-20, G-21, G-22, G-25, G-34, G-35	Photo-identified Gun positions	Potentially used for mortar or artillery fire
<b>Eastern Maneuver Area</b>		
G-1	Gun Emplacement/Position	Artillery Gunfire towards SIA and LIA
G-2	Gun Emplacement/Position	Artillery Gunfire towards SIA and LIA
G-3	Gun Emplacement/Position	Artillery Gunfire towards SIA and LIA
G-4	Gun Emplacement/Position	Artillery Gunfire towards SIA and LIA
G-5	Gun Emplacement/Position	Artillery Gunfire towards SIA and LIA
G-7	Gun Emplacement/Position	Artillery Gunfire towards SIA and LIA
G-8	Gun Emplacement/Position	Artillery Gunfire towards SIA and LIA
G-9 through G-19, G-23, G-24, G-26 through G-33	Photo-identified artillery Gun Positions or mortar	Artillery Gunfire towards SIA and LIA
Range 1	Small Arms Range	Service rifle, M-16s, submachine guns, pistols
Range 2	Small Arms Range	M-60 machine guns, service rifle, M-16s, submachine guns, pistols
Range 3	Grenade Range	Rifle grenade fire
Range 4	Rocket Range	M-60, M-16 rifles, rocket fire, antitank weapons
Range 5	Hand grenade Range	Hand grenades
Range 6	Open Detonation range	OB/OD, small arms fire
Photo-identified Ranges 7, 8, 9	Small Arms Range	M-60 machine guns, service rifle, M-16s, submachine guns, pistols
PI-9	Photo-Identified Munitions Storage	Munitions storage, loading/unloading, potential OB/OD



**LEGEND**

- Roads
- Hydrography
- Streams
- Property Line
- Non-Navy Property

- Ordnance / Explosives Sites**
- Gun Position
  - Explosive Safety Quantity Distance Arc
  - General Location of Marine Artillery Targets
  - Small Arms/Artillery Ranges
  - Artillery Safetyfan

AFWTF - Atlantic Fleet Weapons Training Facility  
 EMA - Eastern Maneuver Area  
 LIA - Live Impact Area  
 SIA - Surface Impact Area

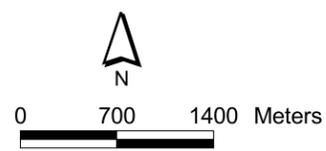


Figure 4-1  
 Potential MEC Impacted Areas  
 Vieques Naval Training Range  
 Vieques, Puerto Rico

Because most of the locations exhibited little evidence of past use (firing positions, target areas), only the dimensions visually observed were documented. Range fans can be better evaluated for the presence and density of MEC contamination through the more comprehensive Investigation (SI) phase of the investigation/remediation process.

#### 4.1.2 Primary Release Mechanisms

The primary release mechanisms are actions taken by individuals at the MEC areas that may have resulted in the release of ordnance-related contamination. The lateral and vertical extent of contamination is dependent upon both the primary source and the type of release mechanism. The primary release mechanisms for the VNTR include:

- Firing
- Kickouts/Incomplete Destruction
- Burial
- Mishandling, Loss, or Abandonment

##### 4.1.2.1 Firing

The sources of firing of munitions at Vieques include ATG delivery of munitions in the LIA and SIA; direct and indirect firing of naval gunfire ordnance from ships located offshore to the south of Vieques; direct and indirect firing of Marine Corps artillery toward the SIA and LIA from the gun positions in the EMA and SIA; training on six infantry training ranges to the north end of the EMA, which included small arms ammunition in Ranges 1, 2, 3, and 4, and delivery of dud-producing munitions in Ranges 3, 4, 5, and 6. The firing may result in either incomplete detonation of the munitions from duds or completed detonation of the munitions. The depth of impact for the various types of MEC fired through ATG delivery in the LIA and SIA is illustrated in Figure 4-3.

Safety fans have been developed to estimate the potential maximum extent of the munitions fired from the infantry training ranges and the 10 known artillery gun positions within the VNTR. An illustration of the safety fans is shown on Figure 4-1. The fans were based on the munitions that would have the longest projectile distance. For the artillery fans, the munitions used was the 175mm. For the ranges, the fans were based on the following munitions:

- Range 1: submachine guns
- Range 2: M-60 machine guns
- Range 3: rifle grenade fire (40mm)
- Range 4: 3.5 inch rockets

Based on the extent of the range fans within the EMA, it is estimated that 5,200 of the 11,070 acres of the EMA may contain munitions.

##### 4.1.2.2 Kick-outs/Incomplete Destruction

Kick-outs are associated with the destruction of munitions at OB/ODs. Two of these areas are located within the LIA and EMA (Range 6). The types of munitions destroyed at these two areas include the full range of munitions utilized and stored for training operations. To estimate the extent of the MEC-impacted areas associated with these two areas, the safety arc

has been developed and is presented in Figure 4-1. As indicated by the safety arc for the LIA OB/OD, the extent of the MEC from this extends outside the LIA into the Eastern Conservation Area (ECA) and the SIA.

#### 4.1.2.3 Burial

The burial of munitions was not a general practice for the disposition of old, unused munitions. These munitions were typically demolished at the OB/OD in the LIA or EMA. In addition, no burial sites are readily identified from the field reconnaissance. As a result, no known burial sites have been identified on the maps. Potential burial locations, however, may include burial of munitions that did not burn or detonate at the OB/ODs; burial pits associated with the artillery gun positions, and burial of ORS from range maintenance operations.

#### 4.1.3 Secondary Sources

Secondary sources for MEC areas generally will either be the ground surface or the soil below the ground surface. Since there are no perennial streams at the VNTR stream sediments are not a significant secondary source. Areas do exist inland, however, that have high erosion rates and dry streambeds where ordnance may be found that has washed down from higher elevations from major storm events.

#### 4.1.4 Transport Of MEC Constituents

Transport of MEC constituents (including migration and transport processes, exposure media, and exposure routes) is addressed during the environmental investigations of the MECs, and therefore are not described in detail as part of this CSM. The various components of transport, however, are depicted graphically in Figure 4-2. Figure 4-3 illustrates the CSM for the VNTR.

#### 4.1.5 Potential Receptors

As indicated in Section 1, the property currently owned by the Navy will be transferred to the DOI. By statute, the LIA will be developed into a wilderness area with no public access, the remaining property will be developed into a national wildlife refuge. Following the transfer of the property the Navy will continue to investigate and remediate the MEC areas where appropriate. Based on this information, the following potential receptors, who may be exposed to MEC constituents, include wildlife managers, recreational users, aquatic wildlife, terrestrial wildlife, trespassers, construction workers, and MEC investigation/cleanup personnel.

## 4.2 Preliminary Explosive Hazard Evaluation

The Risk Assessment Code is an approach used by DoD as a tool for conducting preliminary evaluations of explosive hazards at MEC areas. The procedure provides a uniform procedure for assessing explosives safety risk at MEC areas. The evaluation is completed using the best information available concerning potential hazards related to military munitions at the VNTR. Following the evaluation, each area is assigned a RAC score that is used to evaluate

**Primary Sources**  
Why OE/UXO was originally present

- Live Impact Area Air-Ground Targets
- Live Impact Area Naval Gunfire Targets
- Surface Impact Area Non-Explosive Range
- Surface Impact Area Marine Artillery Targets
- Surface Impact Area Gun Positions
- Eastern Maneuver Area Gun Positions
- Eastern Maneuver Area Firing Ranges
- Eastern Maneuver Area Hand Grenade Ranges
- Open Burn/Open Detonation at LIA and EMA

**Primary Release (Delivery) Mechanisms**  
How OE/UXO got into the environment

- Mishandling Loss or Abandonment
- Firing-Incomplete Detonation/Duds
- Firing-Complete Detonation
- Burial
- Kickouts/Incomplete Destruction

**Secondary Sources**  
Initial media impacted by OE/UXO

- Ground Surface
- Subsurface Soil
- Surface Water
- Sediment

**Migration and Transport Processes**  
How the OE/UXO could have subsequently moved or been moved

- Atmospheric Dispersion
- Human Activity/Redistribution
- Precipitation Run-off
- Leaching
- Erosion
- Coastal Erosion
- Flooding
- Tidal/Wave Action
- Dredging

**Exposure Media**  
Where the OE/UXO may be now

- Ambient Air
- Ground Surface
- Groundwater
- Subsurface Soil
- Surface Water
- Sediment

**Exposure Routes**  
How people and other receptors may be exposed

- Inhalation
- Direct Contact
- Inhalation
- Ingestion
- Direct Contact
- Inhalation
- Groundwater Ingestion
- Direct Contact
- Ingestion
- Direct Contact
- Ingestion
- Direct Contact
- Ingestion

**Potential Receptors**  
(Who May Be Exposed)

Construction Worker	Wildlife Mgt. Worker	Recreational User	Research Scientist	Trespassers	Terrestrial Wildlife	Aquatic Wildlife	Park Ranger	UXO Invest/Cleanup Worker
L	L	L	L	L	L	L	L	L
M	M	M	M	M	M	M	M	M
L	L	L	L	L	L	L	L	L
M	M	M	M	M	M	L	M	M
L	L	L	L	L	L	L	L	L
L	L	L	L	L	L	L	L	L
L	L	L	L	L	L	L	L	L
M	L	L	L	L	L	L	L	L
M	L	L	L	L	L	L	L	L
L	L	L	L	L	L	M	L	L
L	L	L	L	L	L	M	L	L
L	L	L	L	L	L	L	L	L
L	L	L	L	L	L	L	L	L

Figure 4-2  
Graphical Depiction of MEC Conceptual Site Model For Eastern Vieques Naval Training Range Vieques, Puerto Rico

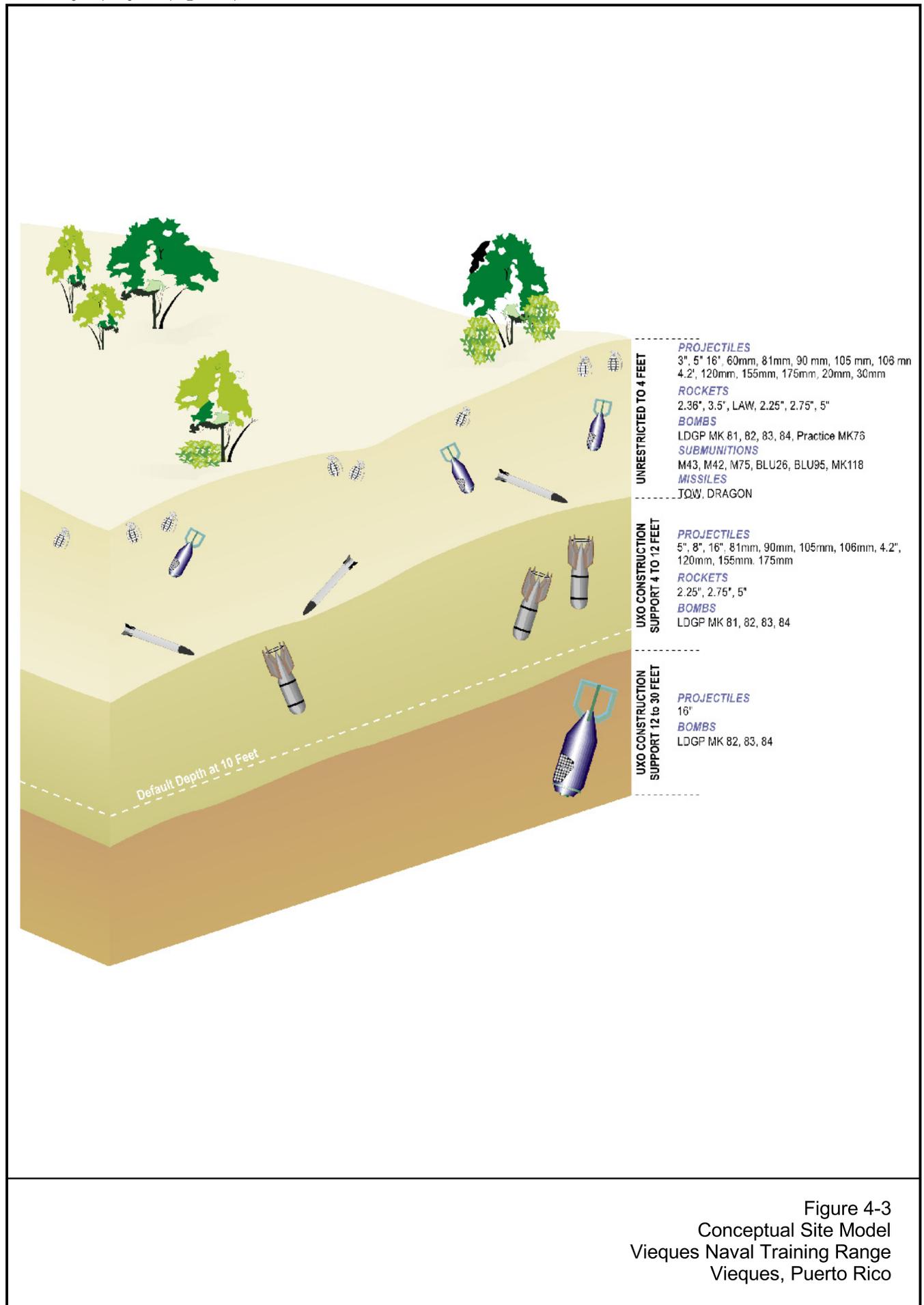


Figure 4-3  
Conceptual Site Model  
Vieques Naval Training Range  
Vieques, Puerto Rico

the explosive safety risk and determining whether a response action would be required to address the MEC. The RAC approach takes into account two factors: hazard severity and hazard probability.

An initial RAC assessment was completed for several MEC areas in VNTR based on the best available information that was obtained from record searches, field observations, and interviews with Navy personnel. Of the 62 MEC areas identified in this PRA, 23 MEC areas were assessed using the initial RAC evaluation. The remaining areas where sufficient data was not available to complete the evaluation were classified as “incomplete.” This initial RAC evaluation can also be updated as necessary to reflect new information that becomes available for each MEC. Table 4-2 summarizes the RAC evaluation.

#### 4.2.1 Hazard Severity

The hazard severity component of the RAC procedure takes into account five factors (catastrophic, critical, marginal, negligible, and none) that provide a qualitative measure of the worst credible event resulting from personnel exposure to various types and quantities of unexploded ordnance. The types of ordnance considered include: 1) conventional ordnance ranging from small arms to explosive bombs and rockets; 2) pyrotechnics including flares, napalm, and munitions containing white phosphorus; 3) bulk high explosives including TNT, demolition charges, and primary explosives; 4) un-containerized bulk propellants that are not an integral part of conventional munitions; and 5) toxic chemical warfare material and radiological weapons.

The total hazard severity value for each MEC in the VNTR was calculated to determine the Hazard Severity Category. The scoring for each sub-category ranges from 1-10, with 10 having the highest hazard severity. As shown on Table 4-2A, the MEC areas in the VNTR with the highest hazard severity include the LIA bombing range and the SIA target area, both of which show a Catastrophic Hazard Severity Category. The known Marine Corps artillery positions as well as Range 3, Range 4, Range 5, and Range 6 show a Critical Hazard Severity Category. Although the field reconnaissance showed that the open area of the gun position was clear of explosive ordnance, the forward area of the gun position safety fan may contain artillery ordnance, which is why an ordnance score of 10 was assigned. Range 1 and Range 2 have been categorized as having a marginal severity. The 39 photo-identified ranges and gun positions have been categorized as incomplete until more field data is collected for these sites.

#### 4.2.2 Hazard Probability

The hazard probability provides a qualitative measure of personnel exposure to MEC that takes into consideration the probability that a hazard has been, or will be, created due to the presence and other related factors (frequent, probable, occasional, remote, improbable) of UXO on a MEC. The following five factors are related to the probability of exposure: 1) location of MEC and MEC hazard such as on the surface, within a building or within the subsurface; 2) the distance, ranging from less than 1,250 feet to more than 2 miles, to the nearest inhabited location likely to be at risk from a MEC hazard; 3) number of buildings, ranging from 0 to more than 26, within a 2-mile radius measured from the MEC hazard area; 4) types of buildings (residential, commercial, industrial, agricultural) within a two mile radius from the MEC ; and 5) accessibility by humans to MEC based on isolation, security guard presence, fencing or other types of barriers.

The total hazard probability value for each MEC at the VNTR was calculated to determine the Hazard Severity Category. The scoring for each sub-category ranges from 1-10, with 10 having the highest hazard probability. Four categories have been established by the RAC procedure which include Improbable, Remote, Occasional, Probable, and Frequent. The RAC data included in Table 4-2B show that all of the MEC areas containing explosives at East Vieques have been calculated to have a hazard probability level of Occasional. The hazard probability level is primarily attributed to the following conditions: 1) the long separation distance (from 1,250 feet to more than 2 miles) between the MEC hazards and nearest inhabited location, 2) the moderate restricted access in which fencing denies access to VNTR; and 3) the dynamics where the conditions are subject to change to increased accessibility to the MEC areas. Should the security be breached at the facility, which has occurred on several occasions in the past, the hazard probability level could significantly increase.

### 4.2.3 MEC Safety Risk Assessment

The RAC procedure determines an MEC safety risk assessment category for each MEC based on the results of the Hazard Severity score and the Hazard Probability score. Five categories have been identified: RAC 1) High Risk-highest priority for further action; RAC 2) Serious Risk-priority for further action; RAC 3) Moderate Risk-Recommended further action; RAC 4) Low Risk-recommended further action; RAC 5) Negligible Risk-indicates that No DoD action is necessary. As summarized in Table 4-2 (A and B), all the MEC areas in the VNTR are recommended for further action. Based on the information obtained from the PRA, an initial explosives safety risk assessment was conducted for the MEC areas in the VNTR. The risk assessment procedure used (RAC) is an interim internal DoD wide approach for providing a single consistent preliminary evaluation of explosives hazards posed by MECs. The risk assessment is based on two factors, hazard severity and hazard probability. Based on the results of an explosives safety risk assessment, the MEC areas have been categorized as follows:

- Serious Risk - Priority for Further Action; the entire LIA including the Bombing Range and the OB/OD area
- Moderate Risk - Recommended Further Action; the SIA target areas, 15 gun positions in the SIA and EMA, 3 ranges within the EMA (Range 3, Range 4, Range 5)
- Low Risk - Recommended Further Action; 3 ranges within the EMA (Range 1, Range 2, Range 6)

The low to moderate risk categorizations are primarily attributed to the restricted access and the long distance to the nearest inhabited location. Should the security be breached at VNTR by trespassers, similar to what has occurred on several occasions during the last few years, the explosive safety risk will increase to a High-Risk category for these MEC areas.

TABLE 4-2A  
 Risk Assessment Code Summary  
 VNTR, Vieques, Puerto Rico

Location	Conventional MEC	Pyrotechnics	Bulk High Explosives	Bulk Propellants	Chemical Radiologic Warfare	Hazard Severity Value	Hazard Classification
<b>LIA</b>							
LIA Bombing Range	10	10	3	0	15	38	I
LIA OB/OD	10	10	10	0	0	30	I
<b>SIA</b>							
SIA Target Areas	10	10	0	0	0	20	II
GP-1	10	0	0	0	0	10	II
GP-5	10	0	0	0	0	10	II
GP-7	10	0	0	0	0	0	II
GP-9	10	0	0	0	0	0	II
OP-5	10	0	0	0	0	10	II
OP-10	IC	IC	IC	IC	IC	IC	IC
OP-11	IC	IC	IC	IC	IC	IC	IC
OP-12	10	0	0	0	0	0	II
OP-13	10	0	0	0	0	0	II
G-20							
G-21							
G-22							
G-25	IC	IC	IC	IC	IC	IC	IC
G-34							
G-35							
<b>EMA</b>							
G-1	10	0	0	0	0	10	II
G-2	10	0	0	0	0	10	II
G-3	10	0	0	0	0	10	II
G-4	10	0	0	0	0	10	II
G-5	10	0	0	0	0	10	II
G-7	10	0	0	0	0	10	II
G-8	10	0	0	0	0	10	II
G-9 through G-19, G-23, G-24, G-26 through G-33	IC	IC	IC	IC	IC	IC	IC
Range 1	4	4	0	0	0	8	III
Range 2	4	4	0	0	0	8	III
Range 3	10	0	0	0	0	10	II
Range 4	10	0	0	0	0	10	II
Range 5	10	0	0	0	0	10	II
Range 6	10	0	0	0	0	10	II
Photo-identified Ranges 7, 8, 9	IC	IC	IC	IC	IC	IC	IC
PI-9	IC	IC	IC	IC	IC	IC	IC

Hazard Categories: I- Catastrophic; II- Critical; III- Marginal; IV- Negligible; V- None  
 IC- Incomplete

Table 4-2B  
 Risk Assessment Code Summary  
 VNTR, Vieques, Puerto Rico

	Location of MEC Hazard	Distance to Nearest Inhabited location	# of Buildings within 2 miles	Types of Buildings within 2 miles	Access To Site	Dynamics	Hazard Probability Score	Hazard Probability Level	Risk Assessment Code
<b>LIA</b>									
LIA									
Bombing Range	5	3	0	0	3	5	16	C	RAC 2
LIA OB/OD	5	2	0	0	3	5	15	C	RAC 2
<b>SIA</b>									
SIA Targets	5	5	0	0	3	5	18	C	RAC 3
GP-1	5	5	0	0	3	5	18	C	RAC 3
GP-5	5	3	0	0	3	5	16	C	RAC 3
GP-7	5	2	0	0	3	5	15	C	RAC 3
GP-9	5	2	0	0	3	5	15	C	RAC 3
OP-5	5	3	0	0	3	5	16	C	RAC 3
OP-10	IC	IC	IC	IC	IC	IC	IC	IC	IC
OP-11	IC	IC	IC	IC	IC	IC	IC	IC	IC
OP-12	5	3	0	0	3	5	16	C	RAC 3
OP-13	5	3	0	0	3	5	16	C	RAC 3
G-20									
G-21									
G-22									
G-25	IC	IC	IC	IC	IC	IC	IC	IC	IC
G-34									
G-35									
<b>EMA</b>									
G-1	5	2	0	0	3	5	15	C	RAC 3
G-2	5	2	0	0	3	5	15	C	RAC 3
G-3	5	2	0	0	3	5	15	C	RAC 3
G-4	5	3	0	0	3	5	16	C	RAC 3
G-5	5	3	0	0	3	5	16	C	RAC 3
G-7	5	2	0	0	3	5	15	C	RAC 3
G-8	5	2	0	0	3	5	15	C	RAC 3
G-9 through G-19, G-23, G-24, G-26 through G-33	IC	IC	IC	IC	IC	IC	IC	IC	IC
Range 1	5	4	0	0	3	5	17	C	RAC 4
Range 2	5	2	0	0	3	5	15	C	RAC 4
Range 3	5	2	0	0	3	5	15	C	RAC 3
Range 4	5	2	0	0	3	5	15	C	RAC 3
Range 5	5	2	0	0	3	5	15	C	RAC 3
Range 6	5	1	0	0	3	5	14	D	RAC 4
Photo- identified Ranges 7, 8, 9	IC	IC	IC	IC	IC	IC	IC	IC	IC
PI-9	IC	IC	IC	IC	IC	IC	IC	IC	IC

Hazard Probability Code: A- Frequent; B- Probable; C- Occasional; D- Remote; E- Improbable

Risk Assessment Code 1- High Risk, High Priority for Further Action; 2- Serious Risk, Priority For Further Action; 3- Moderate Risk- Recommended Further Action; 4- Low Risk – Recommended Further Action; 5- Negligible Risk- Indicates No Further DoD Action Is Necessary.

IC- Incomplete Data

# Conclusions and Recommendations

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## 5.1 Conclusions

Table 5-1 (at the end of this section) summarizes the MEC information for the MEC areas at the VNTR. The information includes the MEC locations shown on Figure 2-5, the types of MEC activities at each area, the types of MEC associated with each area, the potential extent of the MEC impacted area, the RAC risk assessment classification, and any additional comments that address potential hazards at each MEC.

Based on the information obtained from the PRA, an initial explosives safety risk assessment was conducted for the MEC areas in the VNTR. The risk assessment procedure used, the RAC is an interim internal DoD wide approach for providing a single consistent preliminary evaluation of explosives hazards posed by MEC sites. The risk assessment is based on two factors, hazard severity and hazard probability. Based on the results of an explosives safety risk assessment, the MEC areas have been categorized as follows:

1. Serious Risk - Priority for Further Action; the entire LIA including the Bombing Range and the OB/OD area
2. Moderate Risk - Recommended Further Action; the SIA target areas, 15 gun positions in the SIA and EMA, 3 ranges within the EMA (Range 3, Range 4, Range 5)
3. Low Risk - Recommended Further Action; 3 ranges within the EMA (Range 1, Range 2, Range 6)

The areas with low to moderate risk categorizations are primarily attributed to the restricted access and the long distance to the nearest inhabited location. Should the security be breached at VNTR by trespassers, similar to what has occurred on several occasions during the last few years, the explosive safety risk will increase to a High-Risk category for these MEC areas. The MEC areas in the VNTR with the highest hazard severity include the LIA bombing range, the SIA target area, 15 marine artillery positions, Range 3, Range 4, Range 5, and Range 6. A brief summary of the hazards associated with these areas follows.

**The Live Impact Area:** The LIA consisted of point and area targets for ships to practice NGFS. In addition, the LIA includes an air impact area where numerous mock-ups such as old tanks and vehicles were used as targets for air delivered munitions with live and inert ordnance. From 1974 to 1998, more than 7,600 rounds per year of Naval gunfire were directed at the LIA. The Naval gunfire MEC typically ranged from 3-inch/50 to 5-inch/54 type rounds. For the same period of time, the ATG MEC expended averaged more than 3,000 rounds per year. The ATG MEC typically included all general-purpose bombs, rockets, and submunitions. The total weight of the ATG and NGF munitions fired at the LIA from 1974-1998 exceeded 14,700 tons.

**The Surface Impact Area:** The SIA was established during the 1950s when several Marine Corps artillery targets were constructed. Marine Corps artillery, ranging from 76mm rounds to 203mm projectiles, was directed toward these targets from artillery gun positions within the

SIA and EMA. During the mid-1970s, bulls-eye targets were established in the SIA for ATG bombing with MK-76 and MK-106 practice bombs and inert rockets. An aerial photographic analysis of this area identified that the eastern two-thirds of the SIA was covered by numerous craters caused by bombing and artillery fire. The craters were most visible on the 1962 photography. The aerial photograph analysis also identified 18 potential artillery positions or observation posts within the SIA.

**Artillery Positions:** Ten artillery firing positions have been field-verified and an additional 29 potential gun positions were identified to be located within the EMA and SIA based on an aerial photographic analysis. Large scale artillery (105mm, 175mm, 8-inch, tank [90mm]) were fired from these positions toward the SIA and LIA. From 1974 to 1998, 4,459 rounds per year of ordnance was fired. The total weight for these rounds over the years was more than 2,100 tons.

**Range 3:** This range is approximately 800 ft wide and 650 ft long and served as a 40mm rifle grenade range with small arms ammunition also allowed. Field reconnaissance detected small arms and 40mm grenades MEC. The range was also used as a small arms range and was approved for firing of up to 30,000 rounds of 9mm per day.

**Range 4:** This range is approximately 2,600 feet long and 1,000 feet wide. Weapons utilized on this range included M-79 and M-203 grenade launchers, light anti-tank weapons, M-60 and M-16 rifles. Maneuvering was not allowed on this range. Field reconnaissance detected expended rocket motors MEC and ORS. The range was also approved for firing of up to 30,000 rounds of 9mm per day, 500 40mm grenades per day and 100 LAWS per day.

**Range 5:** This range is bowl-shaped with a diameter of approximately 250 ft. It was used as a hand grenade range. Field reconnaissance did not detect MEC. However, the range was approved for firing of up to 500 hand grenades per day.

**Range 6:** This range consisted of a section of the beach over an area approximately 400 ft long and 130 ft wide. This range was a cleared demo-blasting area with an overhead bunker. Field reconnaissance detected small arms MEC and the range was approved for use of up to 1,000 lbs. of C4 per day.

## 5.2 Recommendations

Based on the conclusions derived from the PRA, the following recommendations are presented for consideration.

It is recommended that the explosives safety risk assessment be re-evaluated following the development of engineering controls (EC) by the Navy and DOI. These security measures will be outlined in the proposed Memorandum of Agreement (MOA) between both parties associated with the transfer of the property from the Navy to DOI. As an interim safety precaution, it is recommended that the access to the following locations be further restricted: the LIA, SIA, the Marine Corps artillery firing positions, and EMA Ranges 3, 4 and 5. Access restrictions could include the installation of road barriers or gates across the access roads to these areas, the installation of fencing to restrict walking access, and the installation of signage to provide a warning of the hazards associated with MEC.

A more extensive relative risk ranking of the MEC areas is recommended to eliminate from further consideration those MEC areas that pose no threat to public health or the environment;

to identify MEC areas requiring further investigation prior to arriving at decisions on the need (or lack of need) for remedial actions; to identify the need for an accelerated remedial action or removal action because of an imminent threat to human health or the environment; and to prioritize or sequence areas for further action.

Following the completion of the relative risk ranking, additional investigations are recommended to further characterize the nature and extent of MEC at each area. These investigations may include a geophysical instrument aided surface survey for surface clearance of MEC; digital geophysical surveys to delineate the extent of subsurface MEC; and environmental investigations, including soil and groundwater sampling, to assess environmental impacts.

TABLE 5-1  
 Summary Of MECs  
 VNTR, Vieques, Puerto Rico

ID On Figure 2-5	MEC Area Type	MEC Activities	Potential MEC	Potential Area Of Impact	RAC Code	Comments
<b>Live Impact Area</b>						
LIA Bombing Range	Bombing Range	ATG bombing, naval gunfire, OB/OD	5"/54, 5"/38, 4.5"/38, 3"/50, MK16-MK-84 bombs, submunitions	900 acres	RAC 2	Established in 1964, since 1974 over 150,000 rounds and 4,700 tons of Naval gunfire; over 40,000 rounds (10,000 tons) of ATG bombing.
LIA OB/OD	OB/OD	OB/OD, possible burial	MK-16-MK-84 bombs, 3"-5" NGF, submunitions	1,800 acres	RAC 2	Area is located within LIA, explosive safety quantity distance arc shows MEC impacts may cover an 1,800-acre area.
<b>Surface Impact Area</b>						
Surface Impact Target Area Includes PI-16, PI-17	Artillery/Bombing Targets	Artillery gunfire, strafing of ATG bombing of inert bombs	60mm, 81mm, 90mm, 105mm, 120mm, 155mm, 175mm, submunitions	2,500 acres	RAC 3	Established in the 1950s for marine exercises, aerial photos indicate munitions craters covered over 1,800 acres; since 1974 over 100,000 rounds (over 2100 tons) of marine artillery fired at SIA.
GP-1	Gun Emplacement/ Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm, submunitions	5,500 acres	RAC 3	Field reconnaissance did not detect MEC within the open area of the gun position, was approved for firing of up to 300 rounds of 155mm per day.
GP-5	Gun Emplacement/ Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm, submunitions	5,500 acres	RAC 3	Field reconnaissance did not detect MEC within the open area of the gun position, was approved for firing of up to 300 rounds of 155mm per day.
OP-5	Observation Post/Gun Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm, submunitions	5,500 acres	RAC 3	Field reconnaissance detected bomb fragments, projectile fragments, small arms; was approved for firing of up to 300 rounds of 155mm per day.
OP-11, OP-12, OP-13, PI-15	Photo-Identified Observation Posts	Potentially used for artillery fire	60mm, 81mm, 105mm, 120mm, 155mm, 175mm, submunitions	Unknown	IC	OP-12 was present prior to 1967; OP-13 was deteriorated in 1967, P-15 was identified in the EBS as a potential OP.
G-21	Photo-identified Gun positions	Potentially used for mortar or artillery fire	60mm, 81mm, 105mm, 120mm, 155mm, 175mm, submunitions	Unknown	IC	Aerial photos identified mortar at G-21.
<b>Eastern Maneuver Area</b>						
G-1	Gun Emplacement/ Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm	5,500 acres	RAC 3	Field reconnaissance did not detect MEC within the open area of the gun position; was approved for firing of up to 300 rounds of 155mm per day.
G-2	Gun Emplacement/ Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm	5,500 acres	RAC 3	Field reconnaissance detect small arms MEC, was approved for firing of up to 300 rounds of 155mm per day.

TABLE 5-1  
 Summary Of MECs  
 VNTR, Vieques, Puerto Rico

ID On Figure 2-5	MEC Area Type	MEC Activities	Potential MEC	Potential Area Of Impact	RAC Code	Comments
G-3	Gun Emplacement/ Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm	5,500 acres	RAC 3	Field reconnaissance detected small arms MEC, was approved for firing of up to 300 rounds of 155mm per day.
G-4	Gun Emplacement/ Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm	5,500 acres	RAC 3	Field reconnaissance detected small arms MEC, was approved for firing of up to 300 rounds of 155mm per day.
G-5	Gun Emplacement/ Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm	5,500 acres	RAC 3	Field reconnaissance did not detect MEC within the open area of the gun position; was approved for firing of up to 300 rounds of 155mm per day.
G-7	Gun Emplacement/ Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm	5,500 acres	RAC 3	Field reconnaissance did not detect MEC within the open area of the gun position; was approved for firing of up to 300 rounds of 155mm per day.
G-8	Gun Emplacement/ Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm	5,500 acres	RAC 3	Field reconnaissance did not detect MEC within the open area of the gun position; was approved for firing of up to 300 rounds of 155mm per day.
GP-7	Target	Bombing target	MK-76, 20mm, submunitions	5,500 acres	RAC 3	Field reconnaissance detected MEC items including MK-76 inert bombs and 20mm, was approved for firing of up to 300 rounds of 155mm per day.
GP-9	Gun Emplacement/ Position	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm, submunitions	5,500 acres	RAC 3	Field reconnaissance detected bomb rack and bomb brace, was approved for firing of up to 300 rounds of 155mm per day.
OP-10	Photo-Identified Observation Posts	Potentially used for artillery fire	60mm, 81mm, 105mm, 120mm, 155mm, 175mm, submunitions	Unknown	IC	Aerial photos identified OP-10 was a cleared area in 1962 but re-vegetated in 1967.
G-9 through G-19 G-22 through G-35, PI-13, PI-18, PAOC-FF	Photo-identified artillery Gun Positions or mortar	Artillery Gunfire towards SIA and LIA	60mm, 81mm, 105mm, 120mm, 155mm, 175mm	Unknown	IC	Aerial photo analysis identified the following number of revetted gun positions: 3 at G-9; 6 at G-10; 9 at G-12; 6 at G-13; 3 at G-14; 6 at G-15; 10 at G-16; 6 at G-17; 3 at G-18; 4 at G-19; 6 at G-20; mortar at G-22; 3 at G-24; 6 at G-25; 6 at G-26; 4 at G-27; 6 at G-28; 4 at G-29; 6 at G-30; 6 at G-31; 6 at G-32; 6 at G-33; 8 at G-34; 8 at G-35; PI-13, PI-18, PAOC-FF identified from interviews for EBS.
Range 1	Small Arms Range	Service rifle, M-16s, M-249 SAW, submachine guns, pistols, pyrotechnics	M-16, M-249 SAW, M-60, M240 G, practice hand grenades	1,330 acres	RAC 4	Field reconnaissance detected small arms MEC; was approved for firing of up to 30,000 rounds of 9mm per day.
Range 2	Small Arms Range	M-60 machine guns, service rifle, M-16s, submachine guns, pistols	9mm, M-60, M-16s	1,550 acres	RAC 4	Field reconnaissance detected small arms MEC; was approved for firing of up to 30,000 rounds of 9mm per day.

TABLE 5-1  
 Summary Of MECs  
 VNTR, Vieques, Puerto Rico

ID On Figure 2-5	MEC Area Type	MEC Activities	Potential MEC	Potential Area Of Impact	RAC Code	Comments
Range 3	Rifle Grenade Range	Rifle grenade fire	40mm Grenades	730 acres	RAC 3	Field reconnaissance detected small arms and 40mm MEC; was approved for firing of up to 30,000 rounds of 9mm per day.
Range 4	Rocket Range	M-60 M-16 rifles, rocket fire, anti-tank weapons, anti-armor/ antipersonnel live fire tracking range, M-203 and M-79 grenade launchers	M-60s, M-16s, M-72, M-73 LAW, 40mm Grenades, 2.36" and 3.5" rockets, Dragon Missile	1,650 acres	RAC 3	Field reconnaissance detected expended rocket motors MEC and ORS; was approved for firing of up to 30,000 rounds of 9mm per day, 500 40mm grenades per day, 100 LAWS per day.
Range 5	Hand grenade Range	Hand grenade training area	Hand grenades	1.2 acres	RAC 3	Field reconnaissance did not detect MEC; was approved for firing of up to 500 hand grenades per day.
Range 6	Open Detonation range	OB/OD, small arms fire	9mm, M-60, M-16s, all surface infantry munitions and munitions formerly stored at NASD	1-2 acres	RAC 4	Field reconnaissance detected small arms MEC; was approved for use of up to 1,000 lbs. of C4 per day.
Photo-identified Ranges 7, 8, 9, PI-2, PI-3,	Small Arms Range	M-60 machine guns, service rifle, M-16s, submachine guns, pistols	9mm, M-60 M-16s	Unknown	IC	Aerial photo analysis identified Range 7 may have been used for longer-range weapons and had numerous targets/impact areas; Range 8 and Range 9 were visible in 1994.
PAOC- EE	Photo-identified munitions storage	Munitions Storage within earthen berms	Unknown	Unknown	IC	Identified from interviews for EBS.
PI-9	Photo-Identified Munitions Storage	Munitions storage, loading/unloading, potential OB/OD	Unknown	Unknown	IC	Field reconnaissance identified 106mm artillery casings; Aerial photos identified Open storage of probable munitions in 1959 and 1962. Containers within bermed areas, disposal of white material in large trench at north end of EBS identified as a potential OB/OD.

Risk Assessment Code:

- 1 High Risk – High Priority for Further Action
- 2 Serious Risk – Priority For further Action
- 3 Moderate Risk - Recommended further Action
- 4 Low Risk – Recommended Further Action
- 5 Negligible Risk - Indicates No further DoD Action Is Necessary

## SECTION 6

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# Glossary of Terms

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This glossary of terms is provided as a tool for better understanding the terminology used in the delivery of Ordnance Explosives (OE) type projects including preliminary assessments such as this Preliminary Range Assessment. As such, not all terms provided here may be utilized in the contents of this report.

**Abandoned Ordnance and Explosives**—Ordnance and explosives (OE), which were disposed by abandonment, to include land or water dumping/burial. The OE may or may not have been fuzed, could be armed or unarmed, but were not employed as designed.

**Active Range**—An operational military range that is currently in service and is being regularly used for training, demonstrations, research, development, testing or evaluation.

**Ammunition and Explosives**—Includes (but is not necessarily limited to) all items of U.S.-titled (owned by the U.S. Government through Department of Defense [DoD] Components) ammunition; propellants, liquid and solid; pyrotechnics; high explosives; guided missiles; warheads; devices; and chemical agent substances and components presenting real or potential hazards to life, property and the environment. Excluded are wholly inert items and nuclear warheads and devices, except for considerations of storage and stowage compatibility, blast, fire, and non-nuclear fragment hazards associated with the explosives.

**Ammunition, Explosives, and Dangerous Articles (AEDA)**—As defined in DoD 4160.21-M, this is any substance that by its composition and chemical characteristics, alone or when combined with another substance, is or becomes an explosive or propellant or is hazardous or dangerous to personnel, animal or plant life, structures, equipment or the environment as a result of blast, fire, fragment, radiological or toxic effects. It includes, but is not limited to, ammunition and explosives as defined in DoD 5154.4S, DoD Ammunition and Explosive Safety Standards. AEDA is not a criterion for-demilitarization. Only items of AEDA which are included on the Munitions List have been assigned a demilitarization code other than “A.”

**Blank Ammunition**—Ammunition that consists of a cartridge case with primer and powder charge but which does not contain a projectile. Blank ammunition is used for simulated fire, for signaling, and for training exercises.

**Bomb**—An explosive or other lethal agent, together with its container or holder, which is planted or thrown by hand, dropped from an aircraft, or projected by some other slow-speed device and used to destroy, damage, injure, or kill.

**Caliber (Cal)**—The diameter of a projectile or the bore of a gun or launching tube. In rifled arms, the caliber is measured from the surface of one land to the surface of the land directly opposite. The bore diameter (caliber) of a gun used as a unit for indicating the length of its bore, measured from the breech face of the tube to the muzzle. (i.e., .50 cal, 3-inch, 90mm).

**Cartridge**—A complete round of ammunition in which the primer, propelling charge and projectile or bullet are completely assembled to the cartridge case as fixed ammunition; or the primer and the propelling charge are assembled in the cartridge case and closed by a friable plug.

**Debris**—Any solid particle thrown by an explosion or other strong energetic reaction. For aboveground detonations, debris usually refers to secondary fragments. For underground storage facilities, debris refers to both primary and secondary fragments, which are transported by a strong flow of detonation gases.

**Dud**—Explosive munition, which is not armed as intended or which has failed to function after being armed.

**Electromagnetic Induction**—Transfer of electrical power from one circuit to another by varying the magnetic linkage.

**Empty Ammunition**—An ammunition item or component that does not contain explosive material or inert material. Empty ammunition items and components include:

- a) Ammunition items or components that were manufactured empty or without the components that contain the explosive material.
- b) Ammunition items or components that have had their explosive material completely removed by disassembly, firing, thermal treatment or other means.

**Engineering Controls**- Any type of physical mechanism that restricts the use of, or limits access to, real property to prevent or reduce risk to human health or the environment.

**Expended Ordnance**—Ordnance that has functioned as designed, leaving a shell or container behind. This shell or container may or may not contain explosive/pyrotechnic/toxic residue. This material would not be considered inert, and could not be salvaged as scrap without appropriate visual inspection, sampling, and/or treatment.

**Explosive Material**—Any chemical material with hazard-producing characteristics, loaded into ammunition and/or ammunition components. This includes explosives, propellants, white phosphorous, incendiary mixtures, pyrotechnic mixtures, tracer mix, toxic materials, riot control agents.

**Explosive Ordnance**—All munitions containing explosives. This includes bombs and warheads, guided and ballistic missiles, artillery, mortar, rocket and small arms ammunition; all mines, torpedoes and depth charges; demolition charges; pyrotechnics; clusters and dispensers; cartridges and propellant-actuated devices; clandestine and improvised explosive devices; and similar or related items or components explosive in nature.

**Explosive Ordnance Disposal (EOD)**—The detection, identification, on- evaluation, rendering safe, recovery, and final disposal of explosive ordnance which has been fired, dropped, launched, projected, or placed, in such a manner as to constitute a hazard to operations, installations, personnel, or material. It may also includes the rendering safe or disposal of ordnance which has become hazardous or unserviceable by damage or

deterioration when disposal of such ordnance is beyond the capabilities of personnel normally assigned the responsibility for routine disposition.

**Explosive Ordnance Disposal (EOD) Personnel**—Active duty military personnel who have completed the training course at the U.S. Naval School, Explosive Ordnance Disposal, and are currently assigned to a military EOD unit.

**Explosives**—The term “explosive” or “explosives” includes any chemical compound or mechanical mixture which, when subjected to heat, impact, friction, detonation or other suitable initiation, undergoes a very rapid chemical change with the evolution of large volumes of highly heated gases which exert pressures in the surrounding medium. The term applies to high explosives, propellants and pyrotechnics that either detonate, deflagrate, burn vigorously, and generate heat, noise, smoke, or sound. Also see High Explosives.

**Flare**—A pyrotechnic designed to produce a single source of intense light for illumination or a pyrotechnic device designed to produce infrared radiation of greater intensity than that produced by jet engine exhaust for a sufficient time to decoy and divert enemy heat-seeking missiles from launching aircraft.

**Fragment or Fragmentation (Frag)**—The breaking up of the confining material of a chemical compound or mechanical mixture when an explosion takes place. Fragments may be complete items, subassemblies, and pieces thereof, or pieces of equipment or buildings containing the items.

**Grenade**—Munitions used offensively or defensively to incapacitate or kill. Grenades are capable of being thrown by hand, projected with a rifle, or placed as a booby trap device.

**High Explosive (HE)**—A substance which, in its application as a primary explosive, booster or main charge, in warheads and other applications, is generally required to detonate. This material may also be used as an energetic ingredient in propellants, pyrotechnics or other applications. RDX, HMX and TNT are examples of high explosives.

**Howitzer**—A weapon with a medium length barrel with a bore diameter over 30mm and a high muzzle velocity.

**Impact Area**—The primary danger area for indirect fire weapons that is established for the impact of all rounds. When applied to direct fire weapons, it is the area located between established range limits. The impact area is within the approved surface danger zone.

**Inactive Range**—An operational range that is not currently being used, but that is still under military control and which the military considers to be a potential range area, and that has not been put to a new use that is incompatible with range activities.

**Inert Ammunition**—Ammunition and components that contain no explosive material. Inert ammunition and components include:

- a) Ammunition and components with all explosive material removed and replaced with inert material.
- b) Empty ammunition or components.

- c) **Ammunition or components that were manufactured with inert material in place of all explosive material.**

**Land use controls-** Any type of physical, legal, or administrative mechanisms that restricts the use of real property.

**Low Explosive-** An explosive that burns rather than detonates.

**Magnetometer-** An instrument for measuring the intensity and direction of magnetic fields

**Military Munitions**—All ammunition products and components produced or used by or for the DoD or the U.S. Armed Forces for national defense and security, including military munitions under the control of the DoD, U.S. Coast Guard, U.S. Department of Energy (DOE), and National Guard personnel. The term military munitions includes: confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DoD components including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. Military munitions do not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices and nuclear components thereof. However, the term does include non-nuclear components of nuclear devices, managed under DOE's nuclear weapons program after all required sanitization operations under the Atomic Energy Act of 1954, as amended, have been completed.

**Military Range**—Designated land and water areas set aside, managed, and used to conduct research on, develop, test, and evaluate military munitions and explosives, other ordnance, or weapons systems, or to train military personnel in their use and handling. Ranges include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas and buffer zones with restricted access and exclusionary areas.

**Mortar**—A weapon with a short barrel and a low muzzle velocity.

**Munitions and Explosives of Concern**---Military munitions that are UXO or have been abandoned, as defined in the EPA Munitions Rule. Also includes soil, facilities, equipment, or other materials contaminated with a high concentration of explosives that it presents an explosive hazard.

**Munitions Constituents**---Any materials originating from military munitions, including explosive and or non explosive materials, and emission, degradation, or breakdown products. Munitions constituents are the substances or chemical residues that result from the proper functioning or use of munitions (e.g., residual created and remaining in soil, water, or air from the burning or explosion of energetic material) or that are present in UXO. Such constituents may or may not present an immediate risk of acute physical injury from fire or explosion resulting from accidental or unintentional detonation or ignition of UXO or energetic materials. Similarly, such constituents may or may not result in environmental contamination requiring a response (i.e., response action).

**Non-Intrusive Investigation**—Locating/investigating ordnance on the surface of the ground where excavation is not required.

**Open Burning**- The combustion of any material without control of combustion air to maintain adequate temperature for efficient combustion.

**Open Detonation (OD)**—A process used for the treatment of unserviceable, obsolete, and or waste munitions whereby an explosive donor charge initiates the munitions to be detonated.

**Ordnance and Explosives (OE)** consists of:

1. Ammunition, ammunition components, chemical or biological warfare materials that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried or fired. Such ammunition, ammunition components, and explosives are no longer under accountable record control of any DoD organization or activity.
2. Explosive Soil. See definition under “explosive soils.”
3. OE market includes: Unexploded Ordnance (UXO), Chemical Weapons Materials (CWM), OE Contaminated Soils and Groundwater, Range Maintenance, Ordnance Demilitarization (Demil), and Demining (DM).

**Ordnance Related Scrap (ORS)**—Material including, but not limited to, practice bombs, expended artillery, small arms and mortar projectiles, aircraft bombs and missiles, rockets and rocket motors, hard targets, grenades, incendiary devices, experimental devices, and other material fired on, or upon a military range.

**Practice Ammunition**—Ammunition specifically designed or modified for use in exercises, practice or operational training. Practice ammunition may be either expendable or recoverable. Practice ammunition is not inert and may contain all the explosive material normally contained in service ammunition. Practice ammunition may contain additional explosive material such as pyrotechnics, spotting charges or flotation devices to assure destruction, location or recovery.

**Projectile**— An object projected by an applied exterior force and continuing in motion by virtue of its own inertia, as a bullet, bomb, shell, or grenade. Also applied to rockets and to guided missiles.

**Pyrotechnic**— Substances or mixtures of substances which, when ignited, undergo an energetic chemical reaction at a controlled rate intended to produce, on demand and in various combinations, specific time delays or quantities of heat, noise, smoke, light or IR radiation. Pyrotechnics must be capable of functioning in their application without undergoing a deflagration-to-detonation transition (DDT).

**Range (Active)**—Designated air, land, and water areas set aside, managed, and used to research, develop, test, and evaluate military munitions, other ordnance, or weapons systems or to train personnel in their use and handling. Ranges include firing areas, and buffer zones with restricted access and exclusionary areas. This includes the airspace above the range.

**Range (Inactive)**—An area that at one time had been active and is necessary or required for training, testing, and mobilization requirements but is currently not being used.

**Range Residue**—Material including, but not limited to, practice bombs, expended artillery, small arms and mortar projectiles, aircraft bombs and missiles, rockets and rocket motors, hard targets, grenades, incendiary devices, experimental devices, and other material fired on, or upon a military range.

**Service Ammunition**—Ammunition intended for combat rather than for training is classified as service ammunition. This ammunition has been approved for service use and contains explosives, pyrotechnics, or chemical agent filler and the propellant, if required, is of service or reduced charge weight.

**Service Explosives**—High, initiating, or low explosives that are used principally and primarily in the loading, preparation, and assembly of ammunition of all types for the U.S. Armed Forces as contracted by explosives for commercial use such as dynamite, blasting gelatin, black powders, or permissible explosives which are granulated or prepared for blasting, mining, and construction purposes.

**Shape Charge**—A cylindrical (conical) or linear (rectangular) explosive charge that focuses energy of a detonation, enabling penetration of very thick and hard targets such as armor plate.

**Small Arms Ammunition**—Ammunition for small arms (i.e., all ammunition up to and including .60 caliber and all gauges of shotgun cartridges). Also includes 14.5mm and 20mm ammunition which does not have high explosive or incendiary loaded projectiles.

**Tracer**—A burning pyrotechnic element which produces bright light and/or smoke to aid in visual tracking of the munition in flight. A device that fits into or is attached to ordnance. It normally contains a starting mixture and illuminant, and leaves a trail of flame or smoke to show the trajectory of the ordnance.

**Unexploded Ordnance (UXO)**—Military Munitions that have been primed, fuzed, armed, or otherwise prepared for action, and have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material, and remain unexploded either by malfunction, design, or any other cause. For the purpose of this project, the definition of UXO is limited to items larger than 50-caliber.

**Unexploded Ordnance (UXO) Personnel**—Any individual who has graduated from a DoD-approved UXO specialist course. Examples are the U.S. Naval School, Explosive Ordnance Disposal or International UXO Training Program, Texas A&M.

**White Phosphorus (WP)**—A screening smoke, WP burns on contact with air and can be used as an incendiary.

**APPENDIX A**

# **Draft Archives Record Search Report**

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# Archives Records Search Report Associated with the Preliminary Range Assessment (PRA) for the Vieques Naval Training Range, Vieques, Puerto Rico

PREPARED FOR: Department of the Navy, Atlantic Division  
 Naval Facilities Engineering Command  
 Norfolk, Virginia

PREPARED BY: CH2M HILL

DATE: March 28, 2003

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## 1. Introduction and Archives Record Search Objective

This technical memorandum (TM) presents findings of the archives record search (ARS) component of the preliminary range assessment (PRA) for the Vieques Naval Training Range (VNTR) which includes the Eastern Maneuver Area (EMA), the Live Impact Area (LIA), and the Surface Impact Area (SIA). Information collected during the records search and presented here, along with results from interviews conducted with personnel from the Atlantic Fleet Weapons Training Facility (AFWTF) Command at Naval Station Roosevelt Roads (NSRR) and the field investigation portion of the PRA provide the requisite historical ordnance type and usage information necessary to form preliminary conclusions as to the munitions and explosives of concern (MEC) safety hazards that exist for the VNTR.

The objective of the Eastern Vieques records search was to collect all available information related to MEC areas and MEC areas within the VNTR lands and to compile that information into this ARS TM which is an appendix to the PRA Report. The information in this ARS TM helps drive the preliminary Risk Assessment Code (RAC) scoring as assigned in Section 4.2 of the Draft PRA. A wide breadth of data and information is available on the lands of the VNTR including a variety of health, ecological, and cultural and historical studies. For the objective of this record search, emphasis was placed on collecting only that information that was useful in describing and summarizing historical MEC types, uses, quantities, densities and associated hazard risks for these areas which included the following types of information.

- Maps and Aerial Photographs

- Descriptions of environmental, cultural, and historical conditions
- Records from the Public Works Office, Command Histories
- Ordnance inventory records
- Range utilization records
- Range refurbishment records
- Results from previous surface clearances/maintenance
- Explosives Ordnance Disposal (EOD) records
- Range Control Records (dud books, historical EOD responses, and location of targets and firing points)
- Reports of accidental encounters with UXO or munitions
- Interviews with active and retired DoD, civilian, and government personnel including the range manager and weapons officers from NSRR
- Federal Archives and Navy Libraries
- Historical records/internet search
- Any on-range physical investigations, and identification of potential pathways and receptors
- Real estate records
- Property Land use master plans
- Photo documentation

This TM contains five sections, the remainder of which are organized as follows:

**Section 2, History of Vieques Naval Training Range**– Presents a detailed summary on the history of the VNTR and is a supplement to Section 2 of the PRA Report which provides a detailed history of Eastern Vieques and military operations on the Naval Facility lands.

**Section 3, Records Search Methods and Sources Used** – Describes the approach and methods employed to complete the records search and also provides a comprehensive listing of the sources used to compile this TM.

**Section 4, Summary of Records Search Results** - Summarizes search results by location visited and information reviewed. This section is supported by a series of tables that present historical range usage, MEC type, quantities, and usages for select periods. Typical range clearance and refurbishment operations for select periods are also presented in this section.

**Section 5, Record Search Conclusions** - This section builds on the first four sections of this TM and summarizes the overall results of the records search effort.

## 2. History of Vieques Naval Training Range

Vieques is located in the Caribbean Sea approximately seven miles southeast of the eastern tip of the main island of Puerto Rico and 20 miles southwest of St. Thomas, U.S. Virgin

Islands. Vieques is the largest offshore island that is part of the Commonwealth of Puerto Rico at 20 miles long, 4.5 miles wide, and about 33,088 acres (51 square miles) in area. Vieques lies between 18°10'N and 18°05'N latitude and between 65°35'W and 65°16'W longitude. The location map of Vieques and the supporting base at NSRR is presented as Figure 2-1 the PRA Report.

The average elevation of Vieques is approximately 246 feet (ft) above mean sea level (MSL) with Mount Pirata the highest point on the western end of Vieques at approximately 984 ft above MSL and Cerro Matias being the highest point on the eastern end of the Island at 420 ft above MSL. A topography map of the VNTR lands is presented as Figure 2-6 in the PRA Report.

The VNTR is situated on the eastern third of the Vieques, starting at the property fence line that traverses the island north to south from Punta Campanilla to Puerto Ferro. The entire VNTR consist of approximately 14,313 acres including the approximate 240-acre Camp Garcia area, the 2,500-acre SIA land, the 900-acre LIA, and the EMA which comprises an area approximately 10,673 acres in size. The 200-acre Eastern Conservation Area (ECA) is situated east of the western LIA boundaries at the easternmost tip of Vieques.

#### Land Use History of the Vieques Naval Training Range

The Navy has occupied portions of Vieques since land was purchased for \$1.5 million between 1941 and 1950 for use as a live ordnance range in support of World War II training requirements (Pace-Fallon Report, 1999).

Before the Navy intervention, the property was vacant and used for mostly sugar cane production or cattle grazing. In 1960, the Navy established naval gunfire support (NSFS) and air-to-ground (ATG) targets on Vieques and subsequently began holding training exercises there. Starting with the Navy's withdrawal from nearby Culebra Island as a training facility in 1975, there was a significant increase of conjunct armed forces training activities performed within the Inner Range.

Training operations on Vieques were significantly reduced in the 1980s following the 1983 signing of a Memorandum of Understanding (MOU) between the Government of Puerto Rico and the U.S. Navy. Up until April 1999, the VNTR was utilized approximately 180 days per year, a number that had stayed fairly constant since the 1983 MOU signing. Since 1999 military usage of the VNTR has again been reduced. The U.S. Navy currently plans to cease military training operations on the VNTR by May 2003.

#### AWFTF Command History

The AFWTF is the Atlantic Fleet Command responsible for the VNTR since its opening in 1963 and is expected to continue as such until the VNTR planned closure by May 2003. The AFWTF Command mission was 1) to operate, maintain, and develop weapons range facilities and services in direct support of the training of Atlantic Fleet and allied forces and 2) to test and evaluate weapons systems to enhance fleet readiness. The ATWTF Command utilized approximately 3,500 acres of the eastern end of Vieques Island as an impact area for fleet training in NGFS, ATG ordnance delivery, air-to-surface mine delivery, and ground forces artillery/tank firing. The VNTR was largely undeveloped except for areas cleared of vegetation for training activities (7.4 acres). In 1964, the Navy established a gunnery range

on the eastern end of Vieques, which consisted of point and area targets for ships to practice NGFS. The purpose of NGFS is to destroy enemy targets, to saturate enemy areas and troop concentrations with gunfire, and to eliminate enemy counter-battery fire (Appendix A, Draft EIS, 1979).

In 1965, a live ordnance impact area and observation post were established within the VNTR lands. The air impact area used old tanks and vehicles as targets for aerial bombing with live and inert ordnance. In the mid-1970s, the Navy began installing more sophisticated equipment to create realistic training exercises. In 1975, the Navy changed the name of the former Atlantic Fleet Weapons Range (ATWR) to the AFWTF Command to more accurately reflect the actual range activities (Appendix A, Draft EIS, 1979). Training fleets at the VNTR frequently used high explosive, high capacity, and illumination projectiles and less frequently used armor-piercing and white phosphorous projectiles. High-explosive rounds with mechanical fuses were used because of their reliability and flexibility. Inner range operations were controlled by a Range Control Officer (RCO) located at Observation Post #1 (OP-1) located on Cerro Matias, the highest hill on the eastern end of Vieques.

### EMA History

The EMA is an approximate 10,673-acre area that provides maneuvering space and ranges for the training of marine amphibious units and battalion landing teams in exercise of amphibious landings, small arms fire, artillery and tank fire, shore fire control, and combat engineering tasks. Over 95 percent of the EMA is undeveloped and covered with dense thorn scrub and lowland/upland forest vegetation.

In 1947, the Navy purchased land on the eastern end of the island to hold its annual amphibious maneuvers. The 240-acre Camp Garcia area was established as a tent camp between 1954 and 1955 to support deployment of a Marine regiment. Tents were replaced by metal buildings between 1960 and 1965. Camp Garcia was decommissioned in 1978 but was used after that for occasional support during military training exercises and the Seabee Battalion that has routinely been stationed at the facility (Pace-Fallon Report, 1999).

In 1966, a series of small arms ranges were established along the northern coast of the EMA. Firing positions were also established along the boundary of the surface impact area and in the western end of the EMA along Engineers Road. Artillery fire was directed into the SIA and LIA at fixed targets consisting of old vehicles and large material suitable for targets. Observation posts were constructed to provide tactical training for observers (Appendix A, Draft EIS, 1979).

### Present Use

A land use management plan (LUMP) was established for the VNTR and includes the continued use of Navy lands by the civilian population of Vieques for activities that are compatible with military use and that benefit the local population by providing added employment and income. The LUMP has most recently been revised in 1996. There are several conservation zones that are meant to protect and ensure the continued existence of species that are protected by Commonwealth and Federal agencies. These Class I Conservation Zones are located in the following areas: Monte Pirata, Laguna Kiani, Playa Grande, South Coast Bays, Ensenada Honda, Cayo Conejo, and Punta Este. These

boundaries were developed with consultation with the US Fish and Wildlife Service and the Commonwealth Department of Natural Resources. Each one of these areas has certain restrictions that are enforced by the Navy as part of its land stewardship program.

Additional guidance for land use activities can be found in the AFWTF Command range manual, which includes the 1996 LUMP. Other activities that are permitted within the EMA are cattle grazing and hay production by a local cooperative.

Table 1 describes the type of training conducted at ranges and positions included in the PRA field investigation. This table also provides a summary of site ordnance approval requests and associated net explosive weight (NEW) equivalents. Additional historical gun emplacements and ranges have been identified through a historical aerial photograph analysis completed in December 2002 that were not accessible during field truthing efforts completed in November 2002. These areas are not summarized in Table 1 but are summarized in the PRA report.

TABLE 1  
Identification, Use, and Approved Ordnance Type for PRA Areas at the AFWTF and EMA, November 2002  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Site ID	Site Use with Ordnance Site Approval and Associated NEW
G-1	Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
G-2	Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
G-3	Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
G-4	Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
G-5	Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
G-7	Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
G-8	Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
GP-1	Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
GP-5	Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
GP-7	ATG Target # 2 - MK-76 practice bombs with spotting charge; 20mm (amounts unknown)
GP-9	Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
OP-5	Observation Post and former Gun Emplacement/Position - Up to 300 rounds of 155mm per gun position per day
PI-9	Munitions loading/offloading and storage - No ordnance site approval or NEW for this site
Range 1	Small Arms Range - Up to 30,000 rounds 9mm or smaller per day or the NEW equivalent (30,000 lbs. 1.3 or 1.4 hazard class)
Range 2	Small Arms Range (Squad Fire and Maneuver Range) - Up to 30,000 rounds 9mm or smaller per day or the NEW equivalent (30,000 lbs. 1.3 or 1.4 hazard class)
Range 3	Rifle Grenade Range (40mm) - Up to 30,000 rounds 9mm or smaller; 500 40mm grenades per day or the NEW equivalent (30,000 lbs. 1.3 or 1.4 hazard class)
Range 4	Anti-Fire/Antipersonnel Live Fire Tracking and Rocket Range - Up to 30,000 rounds 9mm or smaller per day or the NEW equivalent; 500 40mm grenades; 100 LAAWS per day
Range 5	Hand Grenade Range - Up to 500 hand grenades per day of any type
Range 6	Open Detonation Training Range and Small Arms Range - Up to 1,000 lbs. C4 per day or the NEW equivalent

Source: U.S. Navy memorandum, *Request for Ordnance Site Approval for Vieques, January 1998*

### 3. Record Search Methods and Sources Used

The ARS Report contains information obtained through historical reviews at various archives and records holding facilities including Navy and Marine record repositories along the East Coast and at the AFWTF Command at NSRR and from interviews with personnel associated with other U.S. Navy Installations or their operations and inspection of the areas. Web-based searches were also conducted and that information was collated along with other information and data.

Six CH2M HILL employees were directly involved in data collection efforts for this ARS TM including personnel from the Tampa, Virginia Beach, and Washington D. C. offices. Typically, one team member would coordinate a visit with personnel from the location of interest then proceed to that location to review and copy as necessary information available there. Mr. Gary Webb, CH2M HILL's MEC Safety Officer, conducted a number of the site visits in an effort to utilize as many MEC knowledgeable personnel as possible during these efforts to help assure that information stored in repositories is evaluated by a trained eye that could recognize important range related information.

An interview sheet with a series of questions related to historical MEC and MEC area usage was developed for personnel interviews conducted with former and active AFWTF personnel, particularly personnel from the NSRR Mobile EOD Team. The interview sheets are presented as Appendix D to the PRA Report.

Several teleconferences were also held during the record search with active or former personnel that have/did serve under the AFWTF Command in Eastern Vieques. These teleconferences provided some useful information primarily in the areas of range refurbishment efforts and range usage.

In April 2001, an ARS was conducted for Western Vieques to support the Green Beach Preliminary OE Site Assessment and the property transfer of the Former Naval Ammunition Support Detachment (NASD). Results of the Western Vieques ARS were reviewed during this ARS for documents applicable to the VNTR. That effort did provide some level of information that was useful in the preparation of this document.

#### Information Repositories Visited and Records Reviewed

A summary of the record search information sources, locations and records reviewed is presented in Table 2. Web-based searches are listed in Table 2 although a series of Vieques related stories beyond those listed were reviewed on the web during this search that provided little additional information on historical MEC usage and are not summarized here. The law offices of Christopher Goodwin and the offices of Environmental Resources Inc, (ERM) were visited for a records search prior to the Green Beach effort completed in 2001. Records retrieved from that effort were reviewed by the ARS team during the visit to the CH2M HILL Washington D.C. office in January 2003. The EOD Command at Little Creek and the National Ordnance Center were not physically visited during the ARS efforts. Calls placed to those locations prior to any planned trip indicated that information related to ordnance or range utilization data for the VNTR was not available at those locations and that a more likely location for this type information could be found at the AFWTF Command at NSRR or at the LANTDIV archive data repository in Norfolk, Virginia.

**TABLE 2**  
 Archive Records Search Locations  
*Vieques Naval Training Range, Vieques, Puerto Rico*

<b>Source</b>	<b>Location</b>	<b>Records Reviewed</b>
National Archives and Records Administration (NARA)	Washington, D.C.	Federal archives and Navy libraries
NARA	College Park, MD	Federal archives and Navy libraries
Commander Navy Region Southeast	Jacksonville, FL	National Marine Fisheries Service (NMFS) after action reports, ecological studies, cultural studies, range refurbishment data, some range dimension and usage information
Naval Station Roosevelt Roads (NSRR)	Ceiba, PR	Personnel interviews; records from the Public Works Office, Command histories; explosives ordnance disposal (EOD) records; range refurbishment records; Range Control Records (dud books, historical EOD responses, and location of targets and firing points); range utilization data; gun position usage information
Marine Corps Base	Camp LeJeune, NC	Marine command histories
LANTDIV	Norfolk, VA	Reports of accidental encounters with UXO or munitions; real estate records; photo documentation; any on-range physical investigations, and identification of potential pathways and receptors; ordnance inventory records; property land use master plans; results from previous surface clearances/maintenance; descriptions of environmental, cultural, and historical conditions
National Historical Center (NHC)	Washington Navy Yard Washington, D.C.	Federal archives and Navy libraries
Marine Corps Historical Center (MCHC)	Washington Navy Yard Washington, D.C.	U.S. Marine command histories
National Archives website (NAIS)	(Website)	Historical records; internet search
NARA Cartographic Research Center	College Park, MD	Maps and aerial photographs
CINCLANTFLT	Norfolk, VA	EOD command histories
AFWTF	Vieques, PR	Personnel interviews with active and retired DoD, civilian, and government personnel including the range manager, weapons officer, and the EOD Mobile teams.

**Table 3 presents a comprehensive listing of documents reviewed and copied during the ARS efforts for the VNTR. Table 4 provides a list of documents reviewed that were associated**

with the Western Vieques ARS for the Green Beach work. These two tables also serve as a reference to the sources and information used in preparing this TM and the PRA Report.

**TABLE 3**  
References for the Archive Records Search for the Naval Facilities of Eastern Vieques  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Date	Description
2002	U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). Letter to Deputy for Environment, Commander, Navy Region Southeast regarding increase in the number of rounds to be used during training exercises. August 9, 2002.
2002	U.S. Department of Commerce, NOAA. <i>Ser N46E/1047: Section 7 Consultation on U.S. Navy Training Exercises at the Atlantic Fleet Weapons Training Facility (AFWTF), Inner Range, Vieques, Puerto Rico: Combined Joint Task Force Exercise (JTFEX)/Multiple Unit Level Training Exercise (Multi-ULT), January-February 2002.</i> Letter to Acting Commander, Navy Region Southeast. January 2, 2002.
2001	U.S. Navy. <i>Ser N46E/1047: Section 7 Consultation on U.S. Navy Training Exercises at the Atlantic Fleet Weapons Training Facility (AFWTF), Inner Range, Vieques, Puerto Rico: Combined Joint Task Force Exercise (JTFEX)/Multiple Unit Level Training Exercise (Multi-ULT), January-February 2002.</i> Letter to Regional Administrator, U.S. Department of Commerce, NOAA, National Marine Fisheries Service. December 21, 2001.
2001	U.S. Navy. <i>Ser N46E/1046: Section 7 Consultation on U.S. Navy Training Exercises at the Atlantic Fleet Weapons Training Facility (AFWTF), Inner Range, Vieques, Puerto Rico: Combined Joint Task Force Exercise (JTFEX)/Multiple Unit Level Training Exercise (Multi-ULT), January-February 2002.</i> Letter to Field Supervisor, U.S. Fish and Wildlife Service, Caribbean Office. December 21, 2001.
2001	Library of Congress. <i>Vieques, Puerto Rico Naval Training Range: Background and Issues for Congress.</i> December 17, 2001.
Undated (circa 2001)	U.S. Navy. <i>Environmental Restrictions for Combined Joint Task Force Exercise 02-1 (JTEX) and Multiple Unit Level Training (ULT) Including Combat Search and Rescue, Special Operations and Naval Coastal Warfare Training, Vieques Inner Range, Puerto Rico.</i> Undated (circa December 2001).
2001	U.S. Department of Commerce, NOAA. <i>Ser N46E/0585: Section 7 Consultation on U.S. Navy Training Exercises at the Atlantic Fleet Weapons Training Facility (AFWTF), Inner Range, Vieques, Puerto Rico: Combined Composite Unit Training (COMPTUEX) – Multiple Unit Level Training (Multi-ULT), September-October 2001.</i> Approval letter to Acting Commander, Navy Region Southeast. September 14, 2001.
2001	U.S. Navy. <i>Formal Consultations with National Marine Fisheries Service Pursuant to Endangered Species Act Section 7 for Naval Training Operations at the Vieques Inner Range.</i> March 8, 2002.
2001	U.S. Department of Commerce, NOAA. <i>Ser N46EL/0292: June 2001 Combined Composite Unit Training (COMPTUEX) – Multiple Unit Level Training (Multi-ULT) Exercise: Endangered Species Act (ESA) Section 7 Consultation on Proposed U.S. Navy Inert-Fire Training Activity at the Atlantic Fleet Weapons Training Facility (AFWTF), Inner Range, Vieques, Puerto Rico.</i> Approval letter to Commander, Navy Region Southeast. May 22, 2001.
Undated (circa 2001)	U.S. Navy. <i>Environmental Restrictions for Combined Composite Training Unit Exercises (COMPTUEX) and Multiple Unit Level Training (ULT), Including Combat Search and Rescue, Special Operations and Naval Coastal Warfare Training, Vieques, Puerto Rico.</i> Undated (circa May 2001).

**TABLE 3**  
References for the Archive Records Search for the Naval Facilities of Eastern Vieques  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Date	Description
2001	U.S. Navy. <i>Consultation for a Proposed Naval Surface Fire Support and Limited Air-to-Ground Exercise at the Vieques Inner Range</i> . Letter to U.S. Department of Commerce, NOAA. April 19, 2001.
2001	U.S. Department of Health and Human Services. <i>Petitioned Public Health Assessment for Isla de Vieques Bombing Range, Vieques, Puerto Rico</i> . February 20, 2001.
2000	U.S. Navy. <i>Environmental Restrictions for Naval Surface Fire Support for Multiple Unit Level Training, Vieques Puerto Rico</i> . Letter to U.S. Department of Commerce, NOAA. November 22, 2000.
2000	U.S. Navy. Letter to Kathy C. Callahan, Director, Division of Environmental Planning and Protection, U.S. EPA Region 2, that provides details of the Navy's non-explosive ordnance usage for renewal of NPDES permit #PRG 990001. July 12, 2000.
2000	U.S. Navy. <i>Consultation Package for National Marine Fisheries Service, Endangered Species Act, Section 7 Compliance for Inert Naval Exercises and Training in the Vieques Inner Range, Puerto Rico</i> . July 2000.
2000	U.S. Navy. <i>Environmental Assessment: Naval Surface Fire Support and Air-to-Ground Bombing (Inert Only), to Include June 2000 Training Activity, on Vieques Island, Puerto Rico</i> . June 20, 2000.
2000	Covington & Burling. <i>Navy Weapons Training at the Island of Vieques, Puerto Rico</i> . Letter to U.S. Department of Commerce National Oceanic and Atmospheric Administration (NOAA). May 16, 2000.
Undated (circa 2000)	U.S. Navy. <i>Statement by the Honorable Richard Danzig, Secretary of the Navy, Concerning the Report of the Special Panel for Military Operations in Vieques</i> . (Circa 1999-2000).
1999	U.S. Navy. <i>Consultation Package for Endangered Species Act, Section 7 Compliance for JTFEX 00-1 (December 2-15)</i> . November 10, 1999.
1999	U.S. Navy. <i>Small Arms Ranges at Vieques</i> . Memorandum from Commanding Officer, Atlantic Fleet Weapons Training Facility, to Commanding Officer, Naval Station Roosevelt Roads. September 15, 1999.
1999	U.S. Marine Corps. <i>The National Security Need for Vieques: A Study Prepared for the Secretary of the Navy (Pace-Fallon Report)</i> . July 15, 1999.
1999	U.S. Navy. <i>Standard Operating Procedures (SOP) for Clearance and Retrograde Ordnance Disposal Review</i> . May 7, 1999.
1999	U.S. Navy. <i>A Summary of the Department of the Navy's Environmental Stewardship and Economic Development Efforts on the Island of Vieques, Puerto Rico</i> . 1999.
1998	U.S. Navy. <i>Request Ordnance Site Approval for Vieques</i> . Memorandum from Inner Range Officer to Manuel Torres. January 27, 1998.
Undated (circa 1998)	U.S. Navy. <i>Section 4: Inner Range Test Resources Scenario</i> . (Circa 1998).
1997	National Imagery and Mapping Agency. <i>Gun Emplacement Geodetic Control, Vieques Island, Puerto Rico</i> . Memo to the U.S. Navy Atlantic Fleet Weapons Training Facility. December 9, 1997.

**TABLE 3**  
References for the Archive Records Search for the Naval Facilities of Eastern Vieques  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Date	Description
1997	National Imagery and Mapping Agency. <i>Gun Emplacement Survey, Camp Garcia Range</i> . Memo to the U.S. Navy Range Control Officer, Camp Garcia Range. March 24, 1997.
1994	U.S. Navy. <i>Site Approval Request for Inner Range Training Activities on Vieques Island, U.S. Naval Station, Roosevelt Roads, Puerto Rico</i> . Memorandum from Commander, Atlantic Division, Naval Facilities Engineering Command, to Commanding Officer, Naval Station Roosevelt Roads. March 23, 1994.
1993	U.S. Navy. <i>Bomb Incident of 24 October 93</i> . Memo to the Officer in Charge, Explosive Ordnance Disposal. November 18, 1993.
1993	U.S. Navy. <i>Site Approval Request for Inner Tange Training Activities on Vieques Island, U.S. Naval Station, Roosevelt Roads, Puerto Rico</i> . Memo from Commander, Naval Ordnance Center, to Commander, Atlantic Division, Naval Facilities Engineering Command. November 10, 1993.
1993	U.S. Navy. <i>Memorandum of Understanding Regarding the Island of Vieques</i> . October 11, 1993.
1993	U.S. Navy. <i>Standard Operating Procedures for Unexploded Ordnance (UXO) Clearances and Retrograde Ordnance Disposal</i> . May 7, 1993.
1993	U.S. Navy. <i>Land Use Management Plan</i> . 1993.
1992	U.S. Navy. <i>Laser Safety Evaluation of Vieques Target Complex, U.S. Naval Station Roosevelt Roads, Puerto Rico</i> . April 1992
1988	U.S. Navy. <i>Monthly Report – August 1988</i> . Memorandum from Manager, AFWTF O&M Project, to Manager, Inner Range/AFWTF. August 31, 1988.
1987	U.S. Navy. <i>Trig List, Vieques Island, Puerto Rico, 10<sup>th</sup> Marines Survey</i> . November 1987.
1987	Atlantic Fleet Weapons Training Facility Request for Project Site Approval/Explosive Safety Certification. NAVFAC 11010/31 (Rev. 4-87). Project: Inner Range Training Activities on Vieques Island.
1987	U.S. Navy. <i>Improvements to the Vieques Eastern Maneuver Area</i> . Memorandum from Commanding Officer, Atlantic Fleet Weapons Training Facility, to U.S. Naval Station, Roosevelt Roads, Puerto Rico. May 1, 1987.
Undated (circa 1986)	U.S. Navy. <i>Preliminary Environmental Assessment (PEA), South Mine Field Expansion, Vieques Island</i> . (Circa 1986).
1985	U.S. Navy. <i>Analysis of Naval Operations on Vieques</i> . Memorandum from Commander, Atlantic Division, Naval Facilities Engineering Command, to Commander in Chief, U.S. Atlantic Fleet. April 23, 1985.
1981	U.S. Navy. <i>CNO Coordinated Visits by RCA to the Atlantic Fleet Weapons Training Facility</i> . Memorandum from Commanding Officer, AFWTF, to Chief of Naval Operations. August 13, 1981.
1979	U.S. Navy. <i>Appendix A of DEIS for AFTWF Vieques: Analysis of Naval Operations on Vieques</i> . December 1979.
1979	U.S. Navy. <i>Detonation Site; Vieques Island, Puerto Rico</i> . Memo from Commanding Officer, U.S. Naval Station Roosevelt Roads to Commander, Atlantic Division, Naval Facilities Engineering Command. June 27, 1979.

**TABLE 3**  
References for the Archive Records Search for the Naval Facilities of Eastern Vieques  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Date	Description
1973	<i>Atlantic Fleet Integrated Weapons Training Ranges (Culebra Study)</i> . Draft Environmental Impact Statement, prepared for Commander in Chief, U.S. Atlantic Fleet, by Tippetts-Abbott-McCarthy-Stratton Engineers and Consultants, New York, NY, 30 March 1973. Part 3, Vieques. (Provided as Adobe Acrobat (PDF) files.)

**TABLE 4**  
References for the Archives Record Search for the Naval Air Facilities of Western Vieques  
*Western Vieques, Puerto Rico*

**Naval Historical Center** (Review of trip report only, copying was not permitted at this facility)

1946–1990	Amphibious Forces Command Files.
1968–1999	Department of Navy, Atlantic Fleet Weapons Training Facility, Commanding Officer Logs.

The following documents and maps were copied at the **Marine Corps Historical Center** and reviewed for this effort:

1966	United States Marine Corp, 1st Battalion, 6 <sup>th</sup> Marine, 2 <sup>nd</sup> Marine Division, Fleet Marine Force. <i>Post Deployment Report</i> , CARIB 1-66, 1 July 1966.
1964	<i>El Mundo</i> newspaper: "Of 26,000 Acres the Navy Owns in Vieques, 10,000 Are Not Being Used for Defense. Mayor Sees Condemnation Unnecessary." By A. Quinones Calderon, 27 April 1964.
1965	<i>El Mundo</i> newspaper: "Woolner Corporation Give up Tourism for Vieques." By Walter W. Wurfel, 18 July 1964.

The following maps were copied at the **National Archives at College Park** and reviewed for this effort :

1952	Vieques, Puerto Rico. Proposed permit to R. Ortiz Suarez. PW Drawing No. 2214. District Public Works Office, 10th Naval District, San Juan, Puerto Rico. Signed 6/5/52.
Undated	Maneuver Areas & Corridors Established for LANTFLEX 52. Revised from PW Drawing No. 2085 (circa 1951-1952)

## 4. Summary of Records Search Results

This section builds on information summarized in Tables 2, 3, and 4. A summary of recovered archives information is presented in this section by location visited and is supported by a series of tables that provide a sampling of ordnance type, quantities, and usage's for select periods of time for the VNTR.

### AFWTF Command at NSRR

The AFWTF command at NSRR was visited for a record search and interview session during the week of February 10, 2003. Interviews were conducted with members from the NSRR Mobile EOD command, AFWTF Marine command personnel, and the NSRR Weapons office personnel to obtain information on historical and current command histories, range operations, and ordnance uses. Available records at NSRR included range utilization data, site mapping (including historical maps illustrating the location of the former marine camp), and information on range refurbishment, range usage, and gun position usage.

In addition to significant information gathered related to ordnance types, quantities, uses, and operational summaries at the VNTR, a series of documents relating to range clearance and refurbishment were also located at this location including:

- Standard operating procedures (SOP) for range clearance and refurbishment methods
- Information related to make-up of range clearance teams and typical clearance schedules
- Records of LIA ordnance items recovered and thermally destroyed within the open detonation (OD) pit within the LIA.
- Records of ordnance items recovered in the SIA and the EMA ranges and destroyed thermally in the OD pit at the LIA
- Records of explosives and materials used during thermal operations of expended munitions or MEC

This information on range clearance and refurbishment activities is presented along with ordnance type, quantities, and uses in Section 2 of the PRA Report in both a narrative and tabular format.

### Marine Corps Base Camp LeJeune

A records search visit was made to this location during the week of January 17, 2003. Interviews were conducted with the Base Historian, Ordnance Range Control Lead, and Environmental Office at Camp LeJeune. No specific information on training exercises on Vieques Island was available through personnel interviews or archive searches at Camp LeJeune although some information on Marine Command histories for Vieques was available and copied for this report.

## Commander Navy Region Southeast, Jacksonville, Florida

The records at the environmental offices of the Commander Navy Region Southeast at Naval Air Station (NAS) Jacksonville were visited on January 11, 2003. This location housed a significant amount of information related to Vieques including ecological information, after action reports issued by the Navy to the NMFS, and copies of a variety of historical documents including the 1979 EIS.

One folder marked “Small Arms Ranges” was found that provided some good information related to range dimensions and utilization records including allowable weaponry and a summary of expended munitions at the VNTR small arms ranges for the period 1995 through 1998 as presented in Table 5.

TABLE 5  
Small Arms Ammunition Fired at the EMA Ranges by Type  
*VNTR, Vieques, Puerto Rico*

Year	5.56 mm	7.62 mm	9 mm	.38 CAL	.50 CAL	12 Gage	Grenades	Total
1995	139,964	207,680	17,951	2,450	38,364	174	739	407,322
1996	99,424	147,692	3,480	2,592	50,846	2,000	292	306,326
1997	161,070	491,534	9,205	NA	54,605	200	240	53,048
1998	207,605	147,712	30,390	3,825	80,759	3,427	720	474,438

Source: EPCRA 313 From  
NA: Data not available

Another folder was encountered during our search that provided information on the uses of the gun emplacements and ranges along with discussions on range dimensions, firing points, and lines of fire (that support range safety fans).

A series of maps and figures were also reviewed and copied at this location that added to the knowledge of past and more recent configurations of the VNTR. In particular, one map provided additional information on historical Marine facilities within the VNTR going back several decades including the former Marine Camp and former Marine artillery gun target area in the SIA.

## Naval Facilities Engineering Command, Atlantic Division

The Naval Facilities Engineering Command (NAVFACENGCOM) records at the LANTDIV headquarters in Norfolk, Virginia were reviewed during the weeks of November 18, 2002 and January 17, 2003. Significant data and information related to historical military operations in Vieques was available at this location and collected as necessary. Information at this repository was catalogued and indexed according to data type and a copy of this index was provided to the record search team prior to the visits. The index was instrumental in directing search teams to the information and data of interest.

This records search generated the majority of archives data collected and reviewed for this TM. Information from ordnance type, range utilization data (usage), and range refurbishment to ecological and human health studies was encountered during this search. Historical documents related to the VNTR such as the 1979 Draft Environmental Impact

Statement (EIS), the 1983 Memorandum of Understanding (MOU), and other related documents were also available at this location. Consultation packages prepared for the National Marine Fisheries Service (NMFS) were also reviewed and copied. Considerable amounts of legal documentation (non-classified) were also noted during our searches at this location and portions of that information that was copied for use in this report.

Table 6 presents a listing of ordnance types historically used on the VNTR from the period 1974 through early 2003. A description of a select number of these items is also presented in Table 6. Historical range utilization data for select period at the VNTR is presented in Tables 7 through 9.

TABLE 6  
Listing of Ordnance Types Used on the VNTR, 1974 – 2003  
*VNTR, Vieques, Puerto Rico*

Live	Inert	Small Caliber	Other
3" 50	MK-20I	38 CAL	Mine
4.5"	MK-76I	50 CAL	MK-24 Flare
5" 38	MK-82I	5.56mm	MK-45 Flare
5" 54	MK-83I	7.62mm	
16" 50	MK-84I	9mm	
60mm	MK-106I	20mm	
76mm	LGTRI	25mm	
81mm	BDU33	27mm	
100mm	GBU12	30mm	
105mm	GBU10	40mm	
120mm	GBU16	12 Gage	
155mm	2.75" Rocket	MK-14	
MK-20	Zuni 5"	MK-16	
MK-77	5" 54I		
MK-78	16" 50I		
MK-81	<b>Description of Select Ordnance Terminology</b>		
MK-82	MK-76I - 25 lb. Practice bomb with signal cartridge		
MK-83	MK-82I - 500 lb. Inert practice bomb with signal cartridge		
MK-84	MK-82 - 500 lb. Low drag general purpose (LDGP) bomb with 192 lbs. NEW		
MK-118	MK-83 - 1000 lb. LDGP bomb with 445 lbs. NEW		
2.75" Rkt	MK-84 - 2000 lb. LDGP bomb with 945 lbs. NEW		
Hellfire	5" 54 - 5" 54 caliber projectile		
C4	5" 54I Caliber Projectile – 57 pound inert target projectile, no spotting charge/fuze		
AT4	7.62mm - 7.62mm small arms ammunition with 0.00054 lbs. NEW		
Grenade	20mm - 20mm HE projectile with 0.0243 lbs. NEW		
Tank	40mm - 40mm HE projectile with 0.06875 lbs. NEW		
LAW	81mm - 81mm HE projectile with 4.75 lbs. NEW		
Dragon	105mm - 105mm HE projectile with 15.7 lbs. NEW		
SMALS	155mm - 155mm HE projectile with 14.6 lbs. NEW		

Zuni 5"

Zuni - Zuni rocket with 54.4 lbs. NEW  
 16" 50 - 16" 50 caliber shell with 154 lbs. NEW

**TABLE 7**  
 Number of NGFS Rounds Expended Annually by Type, 1974-1998  
*VNTR, Vieques, Puerto Rico*

Year	16"/50	5"/54	5"/38	4.5"/38	3"/50	Total
1974	NA	3,051	1,362	1,235	1,308	6,956
1975	NA	3,498	3,289	324	691	7,802
1976	NA	5,547	1,414	290	679	7,930
1977	NA	6,591	1,667	530	1,066	9,854
1978	NA	6,116	738	233	179	7,266
1979	NA	5,789	892	91	1,203	7,975
1980	NA	7,499	1,081	267	77	8,924
1981	NA	7,749	439	105	1,094	9,387
1982	NA	5869	721	41	106	6,737
1983	NA	6938	491	0	1044	8,473
1984	0	5940	849	75	274	7,138
1985	0	7136	756	31	331	8,254
1986	19	5931	1209	104	42	7,305
1987	384	11596	2552	1143	563	16,238
1988	0	13012	1013	301	1246	15,572
1989	229	11938	1193	1041	862	15,263
1990	58	11121	920	243	563	12,905
1991	0	3902	0	131	196	4,229
1992	0	3873	0	397	413	4,683
1993	0	523	0	54	0	577
1994	0	774	0	15	0	789
1995	0	519	0	361	0	880
1996	0	3065	36	150	0	3,251
1997	0	4261	0	188	0	4,449
1998	0	7301	0	308	0	7,609
Total Rounds	690	149,539	20,622	7,658	11,937	190,446
Weight of each round (lbs)	2795	63	55	50	50	
Total Wt. (lbs)	1928550	9,420,947	1,134,210	382,900	596,850	13,463,467
Average Rounds per year	28	5,981	825	306	478	7,617
Percent of Total Rounds	0.3	78.5	10.8	4.0	6.3	100

**TABLE 8**  
 Air-to-Ground Ordnance Expended at Live Impact Area Annually by Type, 1974-1998  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Year	MK-81	MK-82	MK-83	MK-84	MK-77	MK-78	MK-16	Total
1974	12	612	0	0	24	8	8	656
1975	134	2,164	34	40	203	0	4	2,579
1976	186	1,281	127	0	0	0	0	1,594
1977	242	4,771	715	144	41	0	0	5,943
1982	0	762	14	0	0	0	0	776
1983	0	2,547	92	64	0	0	0	2,703

TABLE 8

Air-to-Ground Ordnance Expended at Live Impact Area Annually by Type, 1974-1998  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Year	MK-81	MK-82	MK-83	MK-84	MK-77	MK-78	MK-16	Total
1984	0	857	45	10	0	0	0	912
1985	0	575	72	20	0	0	0	667
1986	0	780	289	75	0	0	0	1,144
1987	0	1,108	160	0	0	0	0	1,268
1988	12	1,486	251	20	0	0	0	1,769
1989	27	1,737	805	66	0	0	0	2,635
1990	23	1,884	494	75	0	0	0	2,476
1991	106	2,441	340	37	0	0	0	2,924
1992	8	1,904	213	145	0	0	0	2,270
1993	0	1,687	192	0	0	0	0	1,879
1994	0	1,458	287	19	0	0	0	1,764
1995	0	939	246	14	0	0	0	1,199
1996	0	1,899	393	14	0	0	0	2,306
1997	121	1,865	329	3	0	0	0	2,318
1998	0	857	246	2	0	0	0	1,105
<b>Total</b>	<b>871</b>	<b>33,614</b>	<b>5,344</b>	<b>748</b>	<b>268</b>	<b>8</b>	<b>12</b>	<b>40,865</b>
Weight (lb)	250	500	1,000	2,000	509	650	463	
Total Wt. (lb)	217,750	16,807,000	5,344,000	1,496,000	136,412	5,200	5,556	24,011,918
<b>Average</b>	<b>41</b>	<b>1,601</b>	<b>254</b>	<b>36</b>	<b>13</b>	<b>0.38</b>	<b>0.57</b>	<b>1,947</b>
Percent	2.1	82.2	13.1	1.9	0.66	0.02	0.02	100

TABLE 9

Marine Ordnance Expended Annually by Type, 1974-1998\*  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Year	175 mm	155 mm	106 mm	105 mm	90 mm	81 mm	76 mm	Total
1974	4,933	3,508	2,741	15,100	1,996	5,947	0	34,255
1975	0	2,388	305	8,162	440	1,422	78	12,795
1976	1,066	3,124	0	5,525	0	244	1,957	11,916
1977	0	0	0	212	0	16	3,928	4,156
1982	NA	100	NA	1343	NA	2,599	12	4,054

**TABLE 9**  
 Marine Ordnance Expended Annually by Type, 1974-1998\*  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Year	175 mm	155 mm	106 mm	105 mm	90 mm	81 mm	76 mm	Total
1983	NA	177	NA	NA	NA	1,007	NA	1,184
1984	NA	146	NA	186	NA	1,049	223	1,604
1985	NA	311	NA	253	NA	288	44	896
1986	NA	165	NA	538	NA	855	70	1,628
1987	NA	817	NA	144	NA	869	139	1,969
1988	NA	1,336	NA	698	NA	2,342	891	5,267
1989	NA	667	NA	464	NA	1,333	442	2,906
1990	NA	1,505	NA	1,088	NA	620	306	3,519
1991	NA	515	NA	NA	NA	1,073	155	1,743
1992	NA	NA	NA	49	NA	471	470	990
1993	NA	156	NA	351	NA	1,002	625	2,134
1994	NA	NA	NA	NA	NA	639	355	994
1995	NA	517	NA	NA	NA	273	468	1,258
1996	NA	223	NA	397	NA	1,199	757	2,576
1997	NA	NA	NA	320	NA	625	700	1,645
1998	NA	816	NA	NA	NA	1,364	641	2,821
<b>Total</b>	<b>5,999</b>	<b>16,471</b>	<b>3,046</b>	<b>34,830</b>	<b>2,436</b>	<b>25,237</b>	<b>12261</b>	<b>100,280</b>
Weight (lb)	130	95	41	33	23	10	28	
Total Wt. (lb)	779,870	1,564,745	124,886	1,149,390	56,028	252,370	343,308	4,270,597

Note: Data incomplete for the years 1978, 1979, 1980, and 1981

NA - Data not available

**A series of maps and figures were also reviewed during the record search at this location and are summarized below in Table 10.**

**TABLE 10**  
 Selected Maps and Drawings Reviewed for the Archive Records Search  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Date	Description
1994	U.S. Navy. <i>VF-41 Tactical Reconnaissance: Target Guide, Vieques Target Range.</i> November 14, 1994.
1986	Lump E&E. <i>Figure 1.3-5: Range Facilities, Target Locations and Transportation Routes on the Atlantic Fleet Weapons Training Facility (AFWTF).</i> 1986.

**TABLE 10**  
 Selected Maps and Drawings Reviewed for the Archive Records Search  
*Vieques Naval Training Range, Vieques, Puerto Rico*

<b>Date</b>	<b>Description</b>
1986	Lump E&E. <i>Figure 1-6: Range Facilities, Target Location, Target and Run Lines on the ATWTF.</i> 1986.
1985	U.S. Navy. <i>Figure 2-1: Range Facilities, Target Locations, and Access Roads in the AFWTF.</i> 1985.
Undated	U.S. Navy. <i>Figure 11: Explosives Anchorage, Naval Station Complex, Roosevelt Roads, Puerto Rico.</i> Undated.
Undated	Untitled map of training areas on Vieques Island including the Western Training Area, the Eastern Training Area, and the Live Impact Area.
Undated	U.S. Navy. <i>Map #1: Surface and Air Impact Areas.</i> Undated.
Undated	U.S. Navy. <i>Figure B: Vieques Target Complex.</i> (From Site Approval for Inner Range Training Activities on Vieques).
Undated	U.S. Navy. <i>Figure C: Vieques Close Air Support Range/Live Impact Area</i> (from Site Approval for Inner Range Training Activities on Vieques).
Undated	U.S. Navy. <i>Figure D: Vieques Fisherman Notice Areas.</i> (From Site Approval for Inner Range Training Activities on Vieques).
Undated	U.S. Navy. <i>Land Use, U.S. Naval Installations, Vieques Island, Puerto Rico.</i> Undated.

A table is also provided as an attachment at the end of this document that summarizes range use data from the period 1982 through 1998.

### Naval Historical Center

During the 2001 visits to this location for the Western Vieques ARS, copies of documents were not allowed. Notes taken by CH2M HILL personnel indicate that some records of marine amphibious training within the VNTR did exist. This location was not re-visited as part of this ARS.

### Marine Corps Historical Center

Calls placed to this location indicate that records from the 1960s through 1989 were available at this location as documented on the CH2M HILL trip report dated March 17, 2001. Records of Marine commands and battalion exercises were collected during that effort and was reviewed by CH2M HILL staff while in the Washington D.C. office during the week of January 17, 2003.

### National Archives at College Park, Maryland

A visit was made to this location during the week of January 17, 2003. The only Vieques related information at that location were aerial photograph overlays which already are in our possession as a result of the aerial photography analysis conducted by ERI, Inc., in 2000 and 2002. A visit was also made during this same week to the CH2M HILL Washington D.C. office to discuss results of 2001 ARS with CH2M HILL staff face to face. Results of that

effort provided some additional information useful to the VNTR but nothing related to ordnance usage or command histories.

### National Archives Electronic Search

The NAILS web-site was searched in November and December 2002 looking for information related to Vieques, specifically the VNTR. A search was performed using the following keywords: Vieques Island, U.S. Marine Corps, U.S. Navy, Eastern Vieques Naval Facilities, and a variation of these.

Very little useful information was pulled from this web-site as it relates to ordnance and command histories at the VNTR.

### Library of Congress

In September 2001, the Federal Research Division of the Library of Congress prepared a bibliography of U.S. Navy exercises on Vieques Island, Puerto Rico (Project No. FRD/NTIS-01-2386). The bibliography is summarized in Table 11. The research was conducted to find official U.S. Government data on the types of ordnance used during U.S. Navy exercises since 1950. The Navy concentrated its training activities on Vieques Island after 1975 when exercises were discontinued on the Island of Culebra.

No data were found for the period from 1950 to 1968. Later records included documentation of hearings before the U.S. House Committee on Armed Services regarding training operations on Vieques from 1968 to 1977.

TABLE 11  
Bibliography of Library of Congress Records Search, September 2001  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Date	Description
2001	O'Rourke, Ronald. "Vieques, Puerto Rico Naval Training Range: Background and Issues for Congress." <i>CRS Report for Congress</i> , RS20458, June 15, 2001. Washington: Library of Congress.
2001	Amerault, James F. "Encroachment" <i>Issues Having a Potentially Adverse Impact on Military Readiness</i> . U.S. Navy. Naval Operations, Fleet Readiness and Logistics, March 20, 2001.
1999	U.S. Navy. <i>A Summary of the Department of the Navy's Environmental Stewardship and Economic Development Efforts on the Island of Vieques, Puerto Rico</i> . October 19, 1999.
1999	"The U.S. Navy Responds to the Release of the Special Panel for Military Operations Report on Vieques." <i>News Special, Navy Office of Information</i> . October 18, 1999.
1999	Fallon, William J., and Peter Pace. <i>The National Security Need for Vieques: A Study Prepared for the Secretary of the Navy</i> . July 15, 1999.
1999	United States Department of Defense. <i>Report to the Secretary of Defense of the Special Panel on Military Operations on Vieques</i> . June 9, 1999.
1981	United States Congress. House of Representatives Committee on Armed Services Panel to Review the Status of Navy Training Activities on the Island of Vieques. <i>Naval Training Activities on the Island of Vieques, Puerto Rico</i> . No. 31, February 3, 1981. Washington: GPO, 1981, 17p. [Call number VA68.V7U54]

TABLE 11  
Bibliography of Library of Congress Records Search, September 2001  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Date	Description
1980	United States Congress. House of Representatives Committee on Armed Services Panel to Review the Status of Navy Training Activities on the Island of Vieques. <i>Naval Training Activities on the Island of Vieques, Puerto Rico</i> . H.A.S.C. No. 96-66 Washington: GPO, 1980. 456p. [Call number KF27.A7644 1980]

## 5. Records Search Conclusions

In summary, the information reviewed during this ARS for the VNTR was significant and covered a variety of subjects including data related to the objective of the PRA as presented in Section 1.1 of the PRA Report. Substantial information and data related to historical ordnance uses and operational histories of the AFWTF Command was available at the time of these record searches as summarized in Section 2.2 of the PRA Report and presented throughout Section 4 of this TM.

The information, data, and maps that are presented in this TM, along with results of the personnel interviews and field investigation efforts conducted from November 2002 through February 2003, provide the necessary documentation to complete preliminary range evaluations and to define associated MEC hazard and explosive safety risks at MEC areas within the VNTR.

The information presented in this TM, coupled with the conclusions and recommendations presented in Section 5 of the PRA Report, confirm that MEC safety hazards and explosive safety risks are present in the VNTR lands. This conclusion is based on records of historical military training operations at the VNTR and results of the RAC scoring system utilized to define MEC area rankings in terms of MEC hazards present and explosive safety risks associated with those hazards. A summary of the RAC scoring system for MEC areas within the VNTR is presented in Tables 4-2A and 4-2B of the PRA Report.

A more extensive relative risk ranking of the MEC areas is recommended to eliminate from further consideration those MEC areas that pose no threat to public health or the environment; to identify MEC areas requiring further investigation prior to arriving at decisions on the need (or lack of need) for remedial actions; to identify the need for an accelerated remedial action or removal action because of an imminent threat to human health or the environment; and to prioritize or sequence sites for further action.

Following the completion of the relative risk ranking, additional investigations are recommended to further characterize the nature and extent of MEC within these areas. These investigations may include a geophysical instrument aided surface survey for surface clearance of MEC areas; digital geophysical surveys to delineate the extent of subsurface MEC; and environmental investigations, including soil and groundwater sampling, to assess the environmental impacts to the areas from munitions constituents (MC).

ATTACHMENT TABLE 1  
Range Use Data Summary, 1974 – 1998  
Vieques Naval Training Range, Vieques, Puerto Rico

Type of Ordnance	FY74	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98	TOTALS	
<b>Inert Ordnance</b>																											
2.75"	2,036	3,097	4,975	3,246	1,227	1,555	237	398	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5"	395	710	191	50	1,470	831	141	397	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MK76	1,566	4,965	3,574	12,675	23,438	14,898	15,766	16,547	7,691	14,094	7,422	5,798	3,719	6,318	4,547	6,861	5,985	4,363	5,089	5,781	7,030	4414	8615	5637	4628	107,992	
MK106	NA	NA	NA	NA	NA	NA	NA	NA	522	534	611	684	130	641	516	759	422	633	384	229	300	24	NA	NA	NA	6,389	
MK201	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13	110	185	35	NA	NA	18	NA	NA	NA	364	
MK82	NA	NA	NA	NA	NA	NA	NA	NA	762	2,547	857	575	780	1108	1,486	1,737	1,884	2,441	1,904	1,687	1,458	939	1899	1865	857	24,786	
MK83	NA	NA	NA	NA	NA	NA	NA	NA	14	92	45	72	289	160	251	805	494	340	213	192	287	246	393	329	246	4,468	
MK84	NA	NA	NA	NA	NA	NA	NA	NA	NA	64	10	20	75	NA	20	66	75	37	145	NA	19	14	14	3	2	564	
GBU16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	1	
LGTR	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	52	52	
5"54 PUF	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,525	4,812	3,796	4485	3180	NA	NA	18,798	
16IN	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	93	9	42	NA	NA	67	NA	NA	NA	NA	NA	NA	NA	NA	NA	211	
<b>Live Ordnance</b>																											
3"50	1,308	691	679	1,066	179	1,203	77	1,094	106	1,044	274	331	42	563	1,246	862	563	196	413	NA	NA	NA	NA	NA	NA	5,640	
4.5"^\	NA	NA	NA	NA	NA	NA	NA	NA	41	NA	75	31	104	1,143	301	1,041	243	131	397	54	15	361	150	188	308	4,583	
4.5" 38	1,235	324	290	530	233	91	267	105	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
5"38	1,362	3,289	1,414	1,667	738	892	1,081	439	721	491	849	756	1,209	2,552	1,013	1,193	920	NA	NA	NA	NA	NA	36	NA	NA	9,740	
5"54	3,051	3,498	5,547	6,591	6,116	5,789	7,499	7,749	5,869	6,938	5,940	7,136	5,931	11,596	13,012	11,938	11,121	3,902	3,873	523	774	519	3,065	4,261	7,301	103,699	
16IN	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	19	384	NA	229	58	NA	690								
MK14	8	4	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
MK20*^\	NA	NA	NA	NA	NA	NA	NA	NA	54	154	13	4	9	436	629	448	534	272	541	246	356	169	93	280	451	4,689	
NAPALM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	24	NA	NA	NA	NA	NA	24	
MK77	24	203	0	41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
MK78	0	0	0	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
MK81	12	134	186	242	3	2	52	0	NA	NA	NA	NA	NA	NA	12	27	23	108	8	NA	NA	NA	NA	121	NA	299	
MK82	612	2,164	1,281	4,771	12,538	7,855	3,749	8,467	4,869	8,098	2,350	4,189	1,656	1,187	2,119	1,027	886	1,119	1,021	1,146	1,590	988	1,339	975	1,667	36,226	
MK83	0	34	127	715	826	265	61	288	145	560	346	320	14	167	353	36	76	NA	342	409	489	731	1,133	562	673	6,356	
MK84	0	40	0	144	15	117	70	80	32	38	51	9	NA	689	25	35	19	1	36	52	205	181	173	63	213	1,822	

ATTACHMENT TABLE 1  
 Range Use Data Summary, 1974 – 1998  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Type of Ordnance	FY74	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98	TOTALS
2.75R	NA	1,081	481	48	75	628	1,094	105	1,321	1,786	299	1,305	504	1,110	NA	110	1210	115	11,272							
ZUNI	NA	NA	NA	NA	156	NA	426	173	147	NA	116	201	161	NA	1	NA	NA	1,381								
HELLFIRE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	34	2	NA	NA	NA	NA	36								
MINE^	NA	136	402	193	412	304	416	212	313	330	247	206	139	119	34	192	71	56	3,782							
FLAR^^	NA	373	305	470	697	146	214	95	224	129	35	42	52	3	441	NA	32	NA	3,258							
BDU^	NA	11	13	59	16	NA	25	6	17	NA	NA	NA	NA	NA	NA	NA	NA	NA	147							
20 mm**	NA	61,380	87,561	37,300	44,830	35,650	86,330	119,545	155,900	135,765	88,555	79,524	89,000	128,085	65,506	91,750	84,660	111,900	1,503,241							
25 mm**	NA	NA	NA	NA	NA	NA	NA	4,400	4,150	NA	1,771	1,390	2,040	6,828	14,550	15,105	11,835	62,069								
27 mm**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	677	3,410	NA	4,087								
30 mm**	NA	NA	NA	NA	NA	823	NA	NA	2680	NA	2,840	200	7,640	NA	NA	10,828	12,650	37,661								
40 mm**	NA	3224	1064	270	NA	1182	3730	3826	12582	9428	4,790	4,894	11,883	14,234	12,634	2,748	6,932	12,653	106,074							
60 mm*^	NA	98	527	1002	74	422	521	611	1458	561	715	1,307	573	1,100	744	1,061	1,494	1,833	14,101							
76 mm	NA	12	NA	223	44	70	139	891	442	306	155	470	625	355	468	757	700	641	6,298							
81 mm	NA	2599	1007	1049	288	855	689	2342	1333	620	1,073	471	1,002	639	273	1,199	625	1,364	17,428							
100 mm*^	NA	NA	NA	NA	NA	NA	286	149	101	NA	110	600	256	10	101	89	86	1,788								
105 mm	NA	1343	NA	186	253	538	144	698	464	1088	NA	49	351	NA	NA	397	320	NA	5,831							
120 mm*^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	120	NA	42	NA	72	236								
155 mm	NA	100	177	146	311	165	817	1336	667	1505	515	NA	156	NA	517	223	NA	816	7,451							
AT-4^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	45	290	10	151	70	15	270	851								
LAAW*^	NA	NA	NA	3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3								
.50C^	NA	NA	630	NA	NA	18,000	24,793	116,510	102,350	27,885	48,881	53,805	46,131	38,634	50,846	54,605	80,759	663,829								
7.62^	NA	NA	NA	NA	NA	5,900	24,000	124,130	224,250	48,580	282,200	176,299	384,370	207,680	147,692	491,534	147,712	2,264,347								
5.56^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1,500	7,600	144,235	139,964	99,424	161,070	207,605	761,398								
9 mm^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	17,951	3,480	9,205	30,390	61,026								
.38C^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,450	2,592	NA	3,825	8,867								
12 GAGE^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	174	2,000	200	3427	5,801								
GREN^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	738	292	240	720	1,990								
C4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	235	1,242	63	3,472	7,409.8	12,421.75								
DRAGON*^	NA	NA	23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	23								

ATTACHMENT TABLE 1  
 Range Use Data Summary, 1974 – 1998  
 Vieques Naval Training Range, Vieques, Puerto Rico

Type of Ordnance	FY74	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98	TOTALS	
HELLFIRE^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6	1	7	
SMALS^^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10	NA	NA	NA	NA	10	
TANK*^	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5	
<b>Number of Range Users</b>																											
A/C	NA	NA	NA	NA	NA	NA	NA	NA	2,219	4,411	1,950	2,512	1,416	2,214	2,187	2,709	2,456	2,058	2,346	2,022	2,560	2,090	3,421	2,716	2,901	42,188	
Runs	NA	NA	NA	NA	NA	NA	NA	NA	14,178	21,449	11,320	12,788	7,823	14,917	12,309	15,529	12,482	9,977	12,299	10,315	15,806	9,121	15,990	12,810	12,954	222,067	
Ships	NA	NA	NA	NA	NA	NA	NA	NA	71	75	75	82	80	102	104	127	103	58	73	62	38	50	72	58	70	1,300	
Runs	NA	NA	NA	NA	NA	NA	NA	NA	847	988	810	924	975	1,471	1,368	1,161	1,047	391	675	497	337	595	664	436	703	13,889	
<b>Quantity of Ordnance Dropped</b>																											
No. Live	328	1,290	797	2,972	13,382	8,239	3,595	8,724	17,070	19,515	12,560	13,700	12,862	21,509	25,356	22,646	20,615	8,229	9,065	6,892	5,933	5,409	16,227	21,484	17,152	256,224	
No. Inert	4,325	10,061	9,542	18,942	26,135	17,284	16,482	17,480	9,136	17,756	9,290	7,601	5,350	8,668	7,226	10,921	8,970	8,199	10,295	12,225	12,580	10,140	14,156	7,834	5,857	166,204	
Total	4,653	11,351	10,339	21,914	39,517	25,523	20,077	26,204	26,206	37,271	21,850	21,301	18,212	30,177	32,582	33,567	29,585	16,428	19,360	19,117	18,513	15,549	30,383	29,318	23,009	422,428	
% Live	NA	NA	NA	NA	NA	NA	NA	NA	65.14	52.36	57.48	64.32	70.62	71.28	77.82	67.47	69.68	50.09	46.82	36.05	32.05	34.79	53.41	73.28	74.54	60.66	
% Inert	NA	NA	NA	NA	NA	NA	NA	NA	34.86	47.64	42.52	35.68	29.38	28.72	22.18	32.53	30.32	49.91	53.18	63.95	67.95	65.21	46.59	26.72	25.46	39.34	
<b>Total Weight of Ordnance Dropped</b>																											
No. Live	NA	NA	NA	NA	NA	NA	NA	NA	1,609.10	2,645.60	1071	1513	755.7	1338.2	1438	1,114.30	907.76	474.4	640.52	656.55	928.4	868.4	1,243.3	869.43	1,318.30	19,392.00	
No. Inert	NA	NA	NA	NA	NA	NA	NA	NA	294.97	924.25	466.56	286.73	517.4	437.95	578.47	1,076.80	868.69	875.3	880.18	742.11	737.04	584	921.61	704.21	415.85	11,312.08	
Total	NA	NA	NA	NA	NA	NA	NA	NA	1,904.1	3,569.9	1,537.6	1,799.7	1,273.1	1,776.2	2,016.5	2,191.1	1,776.5	1,349.7	1,520.7	1,398.7	1,665.4	1,452.4	2,164.9	1,573.6	1,734.2	30,704.08	
% Live	NA	NA	NA	NA	NA	NA	NA	NA	84.51	74.11	69.66	84.07	59.36	75.34	71.31	50.86	51.1	35.15	42.12	46.94	55.75	59.79	57.43	55.25	76.02	63.16	
% Inert	NA	NA	NA	NA	NA	NA	NA	NA	15.49	25.89	30.34	15.93	40.64	24.66	28.69	49.14	48.9	64.85	57.88	53.06	44.25	40.21	42.57	44.75	23.98	36.84	
<b>Total Weight of HE in Ordnance Dropped</b>																											
ATG	33.4	147.4	80.3	359.0	1,398.8	868.5	409.5	916.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
NGF	23.7	30.9	31.5	38.3	27.3	31.0	35.2	37.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Total	24	31	32	38	27	31	35	38	549.98	951.08	357.09	514.69	215.65	250.13	396.61	214.55	191.14	136.3	210.83	244.13	375.08	343.88	479.87	301.73	457.73	6,190.47	
% Live	NA	NA	NA	NA	NA	NA	NA	NA	28.88	26.64	23.22	28.6	16.94	14.08	19.67	9.79	10.76	10.1	13.86	17.45	22.52	23.68	22.17	19.17	26.39	20.16	
% Inert	NA	NA	NA	NA	NA	NA	NA	NA	71.12	73.36	76.78	71.4	83.06	85.92	80.33	90.21	89.24	89.9	86.14	82.55	77.48	76.32	77.83	80.83	73.61	79.84	
<b>Number of Days Range Utilized</b>																											
Total	NA	NA	NA	NA	NA	NA	NA	NA	151	194	171	177	171	228	192	220	194	174	213	159	178	160	184	179	197	3,142	
NGF	95	85	88	115	78	101	110	112	113	123	97	93	101	135	117	140	119	69	84	66	43	67	78	45	74	1,564	

ATTACHMENT TABLE 1  
 Range Use Data Summary, 1974 – 1998  
*Vieques Naval Training Range, Vieques, Puerto Rico*

Type of Ordnance	FY74	FY75	FY76	FY77	FY78	FY79	FY80	FY81	FY 82	FY 83	FY 84	FY 85	FY 86	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98	TOTALS
ATG	38	92	92	100	127	121	127	120	86	122	101	121	100	157	132	164	130	134	161	127	155	125	146	133	127	2,221
MINEX	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	6	7	12	26
MLT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	5	6
ETA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	75	75
MARINES	34,225	12,795	11,916	4,156	3,214	2,100	2,356	3,500	NA	2,775	3,125	676	2,624	29,657	56,908	261,080	342,864	83,558	341,069	253,000	593,124	427,530	323,690	744,497	506,865.75	9373,042.75
Small Arms Ranges	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	16	29	26	35	35	141
Troops Trained	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1492	2572	1978	7866	13,908

\* Unknown weight; \*\* Used weight only; ^ Used # only; ^^ Not used  
 NA – Data not available at the time of record searches  
 Total weights are expressed in tons

**APPENDIX B**

# **Level I Reconnaissance Forms**

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**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **G-1** Site use: **Gun Emplacement/ Position**

---

Date: **November 7<sup>th</sup> and 13<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Field artillery position situated along northern EMA coast near Punta Goleta just east of Puerto Negro.**

---

Access Road: Condition: **Road is maintained and in good condition**

---

Distance from main Road: **Gun position area and laydown area are bisected by Engineers road**

---

Site Elevation: **Approximately 87' above msl** Elevation of Secondary Access Road: **Approximately 85' above msl**

---

Size of Area of Concern: **Approximately 3.5 acres**

---

Structures: **None noted**

---

Topography: **Position G-1 sits atop a bluff along the northern coast and slopes gently from north to south and west to east.**

---

Vegetation Type: **Knee high grass and thorny brush** Percent of Vegetation Coverage: **70% grass- 30% thorny brush**

---

Soil Type: **Clayey sand with weathered rock**

---

Soil Stains: **None noted during 10% field reconnaissance**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site with GPS data points, followed by a ground truthing effort that covered approximately 10% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **Approximately 10%**

---

Scrap Metal (Surface): **None noted**

---

Ordnance Fragment/OE Scrap (Surface): **A few small arms ammunition noted during perimeter walk**

---

Impact Craters: **None noted** OB/OD: **None noted**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **Low based on 10% site evaluation with a Schonstedt metal detector**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

---

Notes:

- **Digital photos of site collected**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

Site ID: **G-2** Site use: **Gun Emplacement/Position**

Date: **November 7<sup>th</sup> and 11<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

Site Description: **Large open area used as a gun emplacement/position and lay down area for troops. Position G-2 sits at approximately 25 feet above MSL with elevations ranging from 20 to 40 feet above MSL across the site**

Access Road: **Graded native soil** Condition: **Good, 2 WD sufficient**

Distance from Secondary Road: **GP Road bisects site. Approximately one mile to South Coast Road.**

Site Elevation: **20'– 40' above msl across site** Elevation of Secondary Access Road: **18' above msl**

Size of Area of Concern: **Approximately 6-7 acres**

Structures: **None noted. Six to eight foot earthen berm surrounds position on all four sides**

Topography: **Relatively flat with moderate relief north-eastward at a slope of approx. 7-10°**

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **70% grass - 20% thorny brush**

Soil Type: **Clayey sand**

Soil Stains: **None noted**

Environmental and/or Safety Concerns: **None noted**

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site with GPS data points, followed by a ground truthing effort that covered approximately 15% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

Percentage of Site Investigated: **15%**

Scrap Metal (Surface): **None noted**

Ordnance Fragment/OE Scrap (Surface): **Small arms ammunition and expended shell casings**

Impact Craters: **None noted** OB/OD: **None noted**

Type of Ordnance: **None noted**

Ordnance Density: **None noted**

Anomaly Density: **Low based on 10-15% site evaluation with a Schonstedt metal detector**

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

Notes:

- **Digital photos of site collected**
- **Two water filled depressions noted into the southwest corner of site**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **G-3** Site use: **Gun Emplacement/Position**

---

Date: **November 7<sup>th</sup> and 13<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Fairly large open area formerly used as a gun position. Site is bound by a 6-8' high earthen berm to the North, East and South sides. Smaller 100' x 100' area laydown area noted at the northwest corner of main site area.**

---

Access Road: **Compacted native soil** Condition: **Fair to good – 2 WD sufficient**

---

Distance from Secondary Road: **Secondary access road bisects site / 0.6 miles to primary access road**

---

Site Elevation: **70-85' across site** Elevation of Secondary Access Road: **72' Above msl**

---

Size of Area of Concern: **Approximately 4 acres in size**

---

Structures: **None noted**

---

Topography: **Relief rises gently (10° slope) eastward / north-eastward**

---

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **70% grass – 25% thorny brush**

---

Soil Type: **Clayey sand**

---

Soil Stains: **None noted**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 15% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **15 %**

---

Scrap Metal (Surface): **None noted**

---

Ordnance Fragment/OE Scrap (Surface): **Small arms ammo, wooden ammunition boxes**

---

Impact Craters: **None noted** OB/OD **None noted**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **Very low based on 10-15% Schonstedt survey**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

---

Notes:

- **Two water filled depressions on southern edge of site**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **G-4** Site use: **Gun Emplacement/Position**

---

Date: **November 7<sup>th</sup> and 14<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Large grassy open area for used as a gun position area. Six to eight four earthen berms surround site on all four sides. Site is bisected by access road.**

---

Access Road: **Graded native soil** Condition: **Good – 2 WD sufficient**

---

Distance from Main Road: **GP Road bisects site / 0.36 miles to primary access road**

---

Site Elevation: **40 – 50' above msl access site** Elevation of Secondary Access Road: **46' above msl**

---

Size of Area of Concern: **Approximately 6-8 acres**

---

Structures: **None noted**

---

Topography: **Relatively flat with some minor positive elevation rise towards the east.**

---

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **65% grass – 25% thorny brush**

---

Soil Type: **Clayey sand with weathered rock**

---

Soil Stains: **None noted**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 10% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **Approximately 10%**

---

Scrap Metal (Surface): **None noted**

---

Ordnance Fragment/OE Scrap (Surface): **Small arms ammunition**

---

Impact Craters: **None noted** OB/OD **None noted**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **Low based on 10% Schonstedt survey**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

---

Notes:

- **Digital photos collected**
- **Two large ponds in SW Corner**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **G-5** Site use: **Gun Emplacement/Position**

---

Date: **November 7<sup>th</sup> and 13<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Open grassy area used as a gun emplacement/position. Earthen berm surrounds site on all sides. No structures noted during perimeter walk and ground truthing efforts.**

---

Access Road: **Graded Native Soil** Condition: **Fair to good, easy access for 2 WD vehicles**

---

Distance from Secondary Road: **0.14 miles / 0.30 miles to primary access road**

---

Site Elevation: **17' above msl** Elevation of Secondary Access Road: **34' above msl**

---

Size of Area of Concern: **Approximately 3-4 acres**

---

Structures: **None noted. Six to eight foot high berm surrounds site**

---

Topography: **Relatively flat with little relief across the site**

---

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **70% Grass-20% thorny brush**

---

Soil Type: **Clayey sand**

---

Soil Stains: **None noted**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 15% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **Approximately 15%**

---

Scrap Metal (Surface): **None noted**

---

Ordnance Fragment/OE Scrap (Surface): **Small arms ammunition**

---

Impact Craters: **None noted** OB/OD **None noted**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **Low based on 15% Schonstedt survey**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

---

Notes:

- **Digital photos collected**
- **Depression filled with water in SE corner of site**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **G-7** Site use: **Gun Emplacement/Position**

---

Date: **November 5<sup>th</sup> and 11<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Former field artillery position bisected by Engineers Road. Smaller laydown area noted to the southeast of the gun position area. Significant relief changes in both a north-south and east-west across the site. Eight foot earthen berm noted on the eastern and western ends of site.**

---

Access Road: **Graded native soils** Condition: **Fair, with some wash outs. 2 Wheel Drive sufficient**

---

Distance from Main Access Road: **Approximately 1.9 miles to South Coast Road**

---

Site Elevation: **195 –250' (SE to NW)** Elevation of Access Road: **Approximately 210' above MSL**

---

Size of Area of Concern: **Approximately 6-7 acres**

---

Structures: **None noted**

---

Topography: **Rolling hills with moderate rise in elevation on both sides of Engineers Road**

---

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **80% Grass-20% thorny brush**

---

Soil Type: **Clayey sand with weathered rock**

---

Soil Stains: **None noted during ground truthing efforts**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 15% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **Approximately 10 – 15 %**

---

Scrap Metal (Surface): **None noted**

---

Ordnance Fragment/OE Scrap (Surface): **Small arms ammunition**

---

Impact Craters: **None noted** OB/OD: **None noted**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **Low based on 10-15% Schonstedt survey**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation of further action**

---

Notes:

- **Three digital photos collected**
- **Three large holes filled with water noted near the southeast corner of the site**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **G-8** Site use: **Gun Emplacement/Position**

---

Date: **November 5<sup>th</sup> and 11<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Field artillery position bisected by Engineers Road. Open grassy area with rise in relief moving due east from firing positions. This also has a smaller area (100' x 100') on the western side of Engineers Road**

---

Access Road: **Graded native soil** Condition: **Fair, some wash outs, 2 wheel drive sufficient**

---

Distance from main Road: **1.6 miles to South Coast Road**

---

Site Elevation: **148' to 215' above msl** Elevation of Secondary Access Road: **145' above msl**

---

Size of Area of Concern: **Approximately 5-6 acres**

---

Structures: **None noted**

---

Topography: **Rolling hills trending eastward in elevation towards firing direction at SIA.**

---

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **90% grass – 10% thorny brush**

---

Soil Type: **Clayey sand/weathered rock**

---

Soil Stains: **None noted**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 15% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **10-15%**

---

Scrap Metal (Surface): **None noted**

---

Ordnance Fragment/OE Scrap (Surface): **None noted**

---

Impact Craters: **None noted** OB/OD: **None noted**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **Low based on 10-15% Schonstedt survey**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

---

Notes:

- **Digital photos of site collected**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **GP-1** Site use: **Gun Emplacement/Position**

---

Date: **November 8<sup>th</sup> and 14<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Field artillery position for smaller artillery guns and mortars positioned on the eastern most point of observation post 1 overlooking the live impact area.**

---

Access Road: **Graded native soil** Condition: **Fair, 4 WD recommended due to slope of road**

---

Distance from Main Road: **Approximately 0.29 miles to South Coast Road**

---

Site Elevation: **422' above msl** Elevation of Access Road: **12' above msl**

---

Size of Area of Concern: **1/5 Acre**

---

Structures: **OP-1 Facility – concrete pad**

---

Topography: **Part of OP-1 facility, situated on the top of hill overlooking the live impact area.**

---

Vegetation Type: **None** Percent of Vegetation Coverage: **NA**

---

Soil Type: **Concrete slab**

---

Soil Stains: **None noted**

---

Environmental and/or Safety Concerns: **SWMU's 5,8,12 and AOCA are located near GP-1 within the OP-1 compound**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 50% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **50%**

---

Scrap Metal (Surface): **None noted**

---

Ordnance Fragment/OE Scrap (Surface): **None noted**

---

Impact Craters: **None noted** OB/OD: **None noted**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **None noted based on 50% site evaluation with a metal detector**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

---

Notes:

- **Digital photos of site collected**

**Preliminary Range Assessment  
Site Reconnaissance Form**

---

Site ID: **GP-5** Site use: **EOD Ready Service Magazine Area**

---

Date: **November 8<sup>th</sup> and 13<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Location of EOD ready service magazine area formerly used as field artillery emplacement firing east towards LIA.**

---

Access Road: **Graded native soil** Condition: **Fair – 2 wheel drive sufficient**

---

Distance from Access Road: **Approximately 10 ft**

---

Site Elevation: **291 ft above msl** Elevation of Secondary Access Road: **286 ft above msl**

---

Size of Area of Concern: **Approximately 1-1.5 Acres**

---

Structures: **Two fenced-in EOD ready service magazines, 4 telephone poles**

---

Topography: **Leveled off hillside leading down from OP-1**

---

Vegetation Type: **Low grass** Percent of Vegetation Coverage: **Approximately 20%**

---

Soil Type: **Gravelly sand, weathered rock**

---

Soil Stains: **None noted**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site with GPS data points, followed by a ground truthing effort that covered approximately 25% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **Approximately 25%**

---

Scrap Metal (Surface): **None noted**

---

Ordnance Fragment/OE Scrap (Surface): **Ammo boxes, small arms ammunition**

---

Impact Craters: **None noted** OB/OD: **None noted**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **Low based on 25% site evaluation with a Schonstedt metal detector**

---

Explosive Safety Risk: **Moderate, site assessment code of 3 with recommendation for further action**

---

Notes:

- **Digital photos of site collected**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **GP-7 (Air to ground target No. 2)** Site use: **Aircraft Target Site**

---

Date: **November 7<sup>th</sup> and 14<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Aircraft target area number 2, a large open area (approx. 2.5-3 acres) with a number of rubber tire targets and a high surface density of MK-76 practice bombs.**

---

Access Road: **Gravel and compacted fill dirt with some crushed stone** Condition: **Fair, 2 wheel drive sufficient (20 mm and MK-76 noted in access road leading to impact area)**

---

Distance from Main Road: **At northern end of aircraft approach road, 1 mile from South Coast Road**

---

Site Elevation: **104' above msl** Elevation of Secondary Access Road: **Approximately 92' above msl**

---

Size of Area of Concern: **Approximately 2.5 – 3 acres**

---

Structures: **No structures noted, numerous painted tires used for targets and remains of a fuel tank that appears to also be used as a target. Earthen berm surrounds site on all sides except for entrance area.**

---

Topography: **Flat area likely re-worked to create the target area that sits atop one of the numerous hills in the vicinity.**

---

Vegetation Type: **Low grass (maintained)** Percent of Vegetation Coverage: **85% grass**

---

Soil Type: **Clayey sand with weathered rock**

---

Soil Stains: **None noted**

---

Environmental and/or Safety Concerns: **May not all be practice bombs**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site with GPS data points, followed by a ground truthing effort that covered approximately 15% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **Approximately 15%**

---

Scrap Metal (Surface): **Heavy density (MK-76 fin assemblies)**

---

Ordnance Fragment/OE Scrap (Surface): **Heavy density on surface**

---

Impact Craters: **Practice bomb impact areas barely visible** OB/OD: **None noted**

---

Type of Ordnance: **MK-76 practice bombs in target area, 20mm noted in access road**

---

Ordnance Density: **Heavy**

---

Anomaly Density: **Heavy**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

---

Notes:

- **Digital photographs of site collected**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **GP-9** Site use: **Navigational aid for aircraft and gun position**

---

Date: **November 8<sup>th</sup> and 14<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Site sits atop one of numerous hills in the area and appears to be used as a navigational aid for aircraft approaching for training operations.**

---

Access Road: **Poor, 4 wheel drive required due to steepness of slope and weathered rock**

---

Distance from main Road: **Approximately 0.68 miles, 0.19 miles to the secondary access road.**

---

Site Elevation: **Approximately 200' above msl** Elevation of Secondary Access Road: **Approximately 75' above msl**

---

Size of Area of Concern: **Approximately 2 acres**

---

Structures: **8 ft by 20 ft Conex box with large painted cross used as navigational aid**

---

Topography: **Top of hill, area is relatively flat with some minor relief southward. Re-worked to accommodate activities.**

---

Vegetation Type: **Ankle high grass, some thorny brush** Percent of Vegetation Coverage: **80% grass – 20% Thorny brush**

---

Soil Type: **Clayey sand and weathered rock**

---

Soil Stains: **None noted in area evaluated**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site using GPS, followed by a ground truthing effort that covered approximately 10% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **Approximately 10%**

---

Scrap Metal (Surface): **None noted**

---

Ordnance Fragment/OE Scrap (Surface): **Base plate from 750 lb. general use bomb noted in access road to site**

---

Impact Craters: **None noted** OB/OD: **None noted**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **Low (some metal targets picked up during 10% Schonstedt evaluation)**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

---

Notes:

- **Digital photos of site collected**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **OP-5** Site use: **Observation Post and Former Gun Emplacement**

---

Date: **November 8, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **This is currently an observation post but evidence exists that this area has been used as a gun position for mortars and small artillery guns. OP-5 is located Just east of OP-1**

---

Access Road: **Graded native soil** Condition: **Fair 2 wheel drive OK for the time being**

---

Distance from Secondary Road: **Approximately 0.14 miles**

---

Site Elevation: **Approximately 302' above msl** Elevation of Access Road: **Approximately 260' above msl**

---

Size of Area of Concern: **Approximately 1.5 – 2 acres**

---

Structures: **15' x 12' concrete observation bldg. with video cameras that document aircraft training operations. Remnants of a concrete bunker also noted.**

---

Topography: **Top of hill, relatively flat (graded for use) with little relief noted across site.**

---

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **60% grass and thorny brush**

---

Soil Type: **Sand, weathered rock**

---

Soil Stains: **None noted**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 20% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **20%**

---

Scrap Metal (Surface): **Heavy with discarded ammunition cans**

---

Ordnance Fragment/OE Scrap (Surface): **Projectile bomb parts, small arms ammunition**

---

Impact Craters: **None noted** OB/OD: **None noted**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **Moderate to heavy based on 20% Schonstedt evaluation**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

---

Notes:

- **Digital photos of site collected**

# Preliminary Range Assessment

## Level I Reconnaissance Form

Site ID: **PI-9** Site use: **Former Munitions Loading/Offloading Area**

Date: **November 5<sup>th</sup> and 11<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

Site Description: **Open water area along "Puerto Ferro" inlet at the end of a gravel access road.**

**Thorny brush and mangroves dominate both sides of access road leading to waters edge.**

Access Road: **Well graded dirt and weathered rock road. Condition: Good, 2 wheel drive sufficient**

Distance from main Road: **1.32 miles from main camp Garcia gate**

Site Elevation: **at MSL** Elevation of Secondary Access Road: **41 ft above MSL at main gate**

Size of Area of Concern: **350 ft by 180 ft (approximately 1.5 acres)**

Structures: **Remnants of concrete landing pier noted along water, significant number (>100) of artillery casings noted in water.**

Topography: **Relatively flat with a 35-40' escarpment bordering the site to the south**

Vegetation Type: **Primarily mangroves and thorny brush** Percent of Vegetation Coverage: **55-60%**

Soil Type: **Clayey sand with varying degrees of limestone outcrops**

Soil Stains: **Staining noted in debris piles**

Environmental and/or Safety Concerns: **Significant debris piles with ORS on both sides of access road, remainder of pile contents unknown.**

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 40% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

Percentage of Site Investigated: **Approximately 40%**

Scrap Metal (Surface): **Steel artillery casings, ammo car, cartridge casings**

Ordnance Fragment/OE Scrap (Surface): **120 mm steel artillery casings, cartridge casings, ammo cans**

Impact Craters: **None Noted** OB/OD: **None noted**

Type of Ordnance: **No live ordnance noted**

Ordnance Density: **None noted**

Anomaly Density: **Heavy based on 40% Schonstedt survey**

Explosive Safety Risk: **Risk assessment code scoring incomplete**

Notes:

- **Digital photos of site collected**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

Site ID: **Range 1** Site use: **Small Arms Range**

Date: **November 6<sup>th</sup> and 11<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

Site Description: **Open grassy area with drainage gully that bisects site east to west.**

**Elevation rises significantly to the north and south (observation tower) from the low lying gully.**

Access Road: **Graded native soil** Condition: **Fair – 2 wheel drive sufficient**

Distance from Secondary Road: **Approximately 0.28 Miles, 0.43 Miles from Gun Emplacement G-8**

Site Elevation: **200 ft above msl @ observation tower, 135 ft above msl in gully to 160 ft above msl at northern end of site.**

Elevation of Secondary Access Road: **175 ft above msl**

Size of Area of Concern: **Approximately 3-3.5 Acres**

Structures: **One range control tower noted**

Topography: **Rolling hills with approx. 50 ft rise in elevation northward from gully, with an approx. 20° slope.**

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **75% grass, 20% thorny brush**

Soil Type: **Clayey sand with weathered rock**

Soil Stains: **None noted**

Environmental and/or Safety Concerns: **None noted**

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 15% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

Percentage of Site Investigated: **15%**

Scrap Metal (Surface): **None noted**

Ordnance Fragment/OE Scrap (Surface): **Small arms ammunition / Grenade clip**

Impact Craters: **None noted** OB/OD: **None noted**

Type of Ordnance: **None noted**

Ordnance Density: **None noted**

Anomaly Density: **Low based on 10-15% site evaluation with a Schonstedt metal detector**

Explosive Safety Risk: **Low, risk assessment code of 4 with recommendation for further action**

Notes:

- **Digital photos collected**
- **One piece of fence post noted**
- **Standing water noted in gully**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

Site ID: **Range 2** Site use: **Small Arms Range**

Date: **November 6 and 11<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

Site Description: **Rolling hills with significant downward relief heading northward in the order of a 200' drop. Observation tower is high point of site. Some historical re-working of land noted in main open area.**

Access Road: **Graded native soil/ruts in road from wash outs, significant slope**

Condition: **Poor, 4 wheel drive recommended**

Distance from Secondary Road: **Approximately 0.35 miles, approximately 0.79 miles from G8**

Site Elevation: **225' above msl @ observation tower** Elevation of Secondary Road: **Approximately 171' above msl**

Size of Area of Concern: **Approximately 10-12 acres**

Structures: **One range control tower**

Topography: **Significant elevation variation from range control tower northward**

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **90% grass and thorny brush**

Soil Type: **Clayey sand with weathered rock**

Soil Stains: **None noted**

Environmental and/or Safety Concerns: **None noted**

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 10% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

Percentage of Site Investigated: **Approximately 10%**

Scrap Metal (Surface): **None noted**

Ordnance Fragment/OE Scrap (Surface): **Small arms ammunition**

Impact Craters: **None noted** OB/OD: **None noted**

Type of Ordnance: **None noted**

Ordnance Density: **None noted**

Anomaly Density: **Low based 10% site evaluation with a Schonstedt metal detector**

Explosive Safety Risk: **Low, risk assessment code of 4 with recommendation of further action**

Notes:

- **Access road leads down slope (40%) to northern end of site**
- **Digital photos collected**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

Site ID: **Range 3** Site use: **40 mm Rifle Grenade Range**

Date: **November 6<sup>th</sup> and 11<sup>th</sup>, 2001** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

Site Description: **Large open area with significant rise in relief northward towards firing berm which surround site on all four sides.**

Access Road: **Graded native soil** Condition: **Good, 2 wheel drive sufficient**

Distance from Main Road: **Approximately 0.17 miles to Ranges 3 and 4**

Site Elevation: **70' above msl @ range control tower**

Elevation of Secondary Access Road: **Approximately 75' above msl**

Size of Area of Concern: **Approximately 10-12 acres**

Structures: **Concrete range control tower, 3 wooden barricades, 7 telephone pole stumps.**

Topography: **Site is at southern flank of 250' hill, elevation rises from 70' @ control tower to 120' above msl at northern berm.**

Vegetation Type: **Grass and thorny brush**

Percent of Vegetation Coverage: **75-80% grass and thorny brush**

Soil Type: **Clayey sand with weathered rock**

Soil Stains: **None noted**

Environmental and/or Safety Concerns: **None noted**

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 15% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

Percentage of Site Investigated: **15%**

Scrap Metal (Surface): **None noted**

Ordnance Fragment/OE Scrap (Surface): **Small arms ammunition, 40 mm projectiles**

Impact Craters: **None noted** OB/OD: **None noted**

Type of Ordnance: **40 mm**

Ordnance Density: **Low**

Anomaly Density: **Low based on 10-15% Schonstedt survey**

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

Notes:

- **Digital photos collected**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **Range 4** Site use: **Anti-armor/Anti-personnel Live Fire Rocket Range**

---

Date: **November 6<sup>th</sup> and 13<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Large open area characterized by significant drop in elevation northward from range control tower. Center of open area is the lowest lying area of site. Eight foot berm surrounds site on three sides.**

---

Access Road: **Graded native soil with significant weathered rock in road**

---

Condition: **Fair, 2 wheel drive OK, some wash out ruts in road**

---

Distance from Main Road: **0.17 miles from North Coast Road**

---

Site Elevation: **79 ft above msl at observation tower, 15ft at bottom, 50 ft at northern berm**

---

Elevation of Secondary Access Road: **75 ft above MSL**

---

Size of Area of Concern: **Approximately 12-13 acres**

---

Structures: **Concrete range control tower, large aircraft parts used for targets, 75 mm artillery guns used for targets**

---

Topography: **Gently sloping hills leading down to ocean, approx. 20° slope northward from tower towards ocean.**

---

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **75-80% grass and thorny brush**

---

Soil Type: **Clayey sand with small rock outcrops (<5%)**

---

Soil Stains: **None noted**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 15% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **15%**

---

Scrap Metal (Surface): **Moderate (around targets)**

---

Ordnance Fragment/OE Scrap (Surface): **Moderate to high (ORS)**

---

Impact Craters: **2 ponds at low point of site** OB/OD: **None noted**

---

Type of Ordnance: **Rocket motor parts, semi-armor piercing (SAP) rounds**

---

Ordnance Density: **Moderate in northern end (target area) of site**

---

Anomaly Density: **Moderate to high in northern half, low on southern end based on 10-15% Schonstedt survey**

---

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

---

Notes:

- **Digital photos collected**

# Preliminary Range Assessment

## Level 1 Site Reconnaissance Form

Site ID: **Range 5** Site use: **Grenade Range**

Date: **November 6<sup>th</sup> and 11<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

Site Description: **Small open area bermed on all four sides. East–West orientation used as a hand throwing grenade range based on size of site and concrete grenade throwing bunkers observed during perimeter walk.**

Access Road: **Graded native soil** Condition: **Fair, 2 wheel drive sufficient**

Distance from Main Road: **1.26 Miles to G-8, 600 ft from North Coast Road**

Site Elevation: **95 ft to 118 ft above msl in low lying area** Elevation of Access Road: **85' above msl**

Size of Area of Concern: **Approximately 1.5 Acres**

Structures: **4 bay grenade throwing bunker (concrete)**

Topography: **On the southern flank of an approximate 250 foot high hill. Site relief drops approx. 50' west to east, towards grenade throwing area.**

Vegetation Type: **Grass and thorny brush** Percent of Vegetation Coverage: **95% grass**

Soil Type: **Clayey sand with weathered rock**

Soil Stains: **None noted**

Environmental and/or Safety Concerns: **None noted**

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 25% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

Percentage of Site Investigated: **25%**

Scrap Metal (Surface): **None noted**

Ordnance Fragment/OE Scrap (Surface): **Grenade spoons**

Impact Craters: **None noted** OB/OD: **None noted**

Type of Ordnance: **None noted**

Ordnance Density: **None noted**

Anomaly Density: **Low based on 25% Schonstedt survey**

Explosive Safety Risk: **Moderate, risk assessment code of 3 with recommendation for further action**

Notes:

- **Some scarring where grenade impacts possibly occurred**
- **Digital photos collected**

**Preliminary Range Assessment  
Level 1 Site Reconnaissance Form**

---

Site ID: **Range 6** Site use: **Open Demolition Training Area with small Arms Range**

---

Date: **November 7<sup>th</sup> and 13<sup>th</sup>, 2002** Reconnaissance Team: **F. Ferreira, G. Webb, G. Del Rio**

---

Site Description: **Open area along coast just west of the Purple Beach area. Site is relatively flat with minimal relief in all directions. A series of moderately sized sand dunes bound the site to the north.**

---

Access Road: **Graded dirt road with a number of bumps and overgrown with thorny brush**

---

Condition: **Fair, 2 wheel drive sufficient**

---

Distance from Secondary Road: **Approximately 450 feet to North Coast Road**

---

Site Elevation: **3-6' above msl** Elevation of North Coast Road: **Approximately 15' above msl**

---

Size of Area of Concern: **Approximately 2-3 acres**

---

Structures: **Remnants of foundation noted that was used as the safety bunker during open detonation training operations.**

---

Topography: **Gentle northward slope (2-3°) towards ocean**

---

Vegetation Type: **Grass w/young thorny mesquite brush, sea oats and red mangrove noted along coast line**

---

Percent of Vegetation Coverage: **65-70%**

---

Soil Type: **Beach sand (depositional)**

---

Soil Stains: **None noted**

---

Environmental and/or Safety Concerns: **None noted**

---

Survey/Investigation Methods: **Initial perimeter walk with UXO avoidance support to map boundaries of site, followed by a ground truthing effort that covered approximately 15% of the site using the aid of a Schonstedt metal detector to evaluate subsurface anomaly density.**

---

Percentage of Site Investigated: **Approximately 15%**

---

Scrap Metal (Surface): **Old wheel axle noted**

---

Ordnance Fragment/OE Scrap (Surface): **M60 fuze lighter noted**

---

Impact Craters: **None noted** OB/OD: **Four open detonation pits: 2 @ 15' dia / 2 @ 8' dia and approximately 3 feet deep.**

---

Type of Ordnance: **None noted**

---

Ordnance Density: **None noted**

---

Anomaly Density: **Low to Moderate based on 15% Schonstedt survey**

---

Explosive Safety Risk: **Low, risk assessment code of 4 with recommendation for further action**

---

Notes:

- **Digital photos of site collected**
- **Area is likely to flood during high storm season and the surf action would modify the northern boundaries of the site**

**APPENDIX C**

# **Photographic Log**

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APPENDIX C

PHOTOGRAPH NO. 1



*RANGE 1 – View from range control tower looking north towards target area*

APPENDIX C  
PHOTOGRAPH NO. 2



*RANGE 2 - View from range control tower looking north to target area*

APPENDIX C

PHOTOGRAPH NO. 3



*RANGE 3 – View from Range Control Tower looking north to target areas*

APPENDIX C

PHOTOGRAPH NO. 4



*RANGE 4 – View from Range Control Tower looking north towards target areas*

APPENDIX C

PHOTOGRAPH NO. 5



*RANGE 4 – View from firing position towards target area*

APPENDIX C

PHOTOGRAPH NO. 6



*RANGE 5 - View from grenade throwing bunkers east towards throwing area*

APPENDIX C

PHOTOGRAPH NO. 7



*RANGE 5 - View looking north towards concrete grenade throwing bunkers*

APPENDIX C

PHOTOGRAPH NO. 8



*RANGE 6 - Photo illustrating one of four open detonation pits*

APPENDIX C

PHOTOGRAPH NO. 9



*PI-9 – Photo depicting steel artillery casings noted in water abutting site*

APPENDIX C

PHOTOGRAPH NO. 10



*PI-9 - Photo illustrating steel artillery casings on ramp leading up from water*

APPENDIX C

PHOTOGRAPH NO. 11



*G-1 - View from firing points east towards impact areas*

APPENDIX C

PHOTOGRAPH NO. 12



*G-2 - View east from firing points towards impact areas*

APPENDIX C

PHOTOGRAPH NO. 13



*G-3 - View east from firing points towards impact areas*

APPENDIX C

PHOTOGRAPH NO. 14



*G-4 - View east towards impact areas from firing positions*

APPENDIX C

PHOTOGRAPH NO. 15



*G-5 - View east from firing position towards target area*

APPENDIX C

PHOTOGRAPH NO. 16



*GP-7 (AIR -TO-GROUND TARGET #2) - View of open area with tires used for targets*

APPENDIX C

PHOTOGRAPH NO. 17



*G-7 - View east towards target area*

APPENDIX C

PHOTOGRAPH NO. 18



*G-8 - View from points east towards impact areas*

**APPENDIX D**

# **Personnel Interview Sheets**

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CH2M HILL  
RECORD OF INTERVIEW

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**Interviewee:** Charles Wilcox, USMC Retired

**Date and Location:** February 28, 2003

**Interviewer:** Gary Webb, Ordnance and Explosive Safety Officer,  
CH2M HILL

*Note: This record was not transcribed from a recorded conversation. It was reconstructed from interview notes, so the conversation is paraphrased.*

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*When did you work on Camp Garcia, Vieques Puerto Rico?*

1948, 1952, 1956, 1958

*What was your position?*

NCO, USMC, worked in communications and then Marine Force Recon.

*What activities were you involved with? Demolition? Training?*

Mostly conducted training activities and exercises. Conducted Amphibious landings ashore (Red Beach) and fired weapons on the ranges. EOD conducted demolition

*What types of ordnance or military munitions were used?*

Various weapons were fired small arms, 75mm, 3.5" rockets, 60mm and 81mm mortars and 4.2" mortars.

*Where (on the base) did activities take place?*

Various locations with each exercise, fired 3.5" rockets on Range 4. Other weapons from west to east from what he recalls.

*Do you know of any gun positions, target areas or direction of fire?*

He was familiar with the map that I provided and recognized only Range 4 where they fired 3.5" rockets toward the north and seaward.

*Do you have any knowledge of any CWM being used on Camp Garcia?*

None.

Do you know of any ordnance burial sites?

No, training exercises were well organized and duds were destroyed.

Were there any special events involving training, weapons, ordnance or explosives?

Not that he can remember. He did remember that when training was conducted they were accountable for all rounds fired. If a barrage of rounds was fired and all rounds did not explode the firing was stopped until EOD could locate and dispose of unexploded round.

Mr. Wilcox is a retired Marine who lives in the Northeast and was visiting Vieques friends. He retired from the Marine Corps after 25 years service in 1968.

CH2M HILL  
RECORD OF INTERVIEW

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**Interviewee:** Peggy Brinley, Ordnance Range Control Officer, Camp Lejuene, NC  
Duane Richardson, Ordnance Range Office, Bldg 54, Camp Lejuene, NC

**Date and Location:** January 13, 2003

**Interviewer:** Gary Webb, Ordnance and Explosive Safety Officer,  
CH2M HILL

*Note: This record was not transcribed from a recorded conversation. It was reconstructed from interview notes, so the conversation is paraphrased.*

---

I met with Duane and Peggy at the Camp Lejuene weapons office to review any archive or current information they might hold on Vieques. Nothing was found and I was directed to meet with the base historian (Rene Hawthorn)

CH2M HILL  
RECORD OF INTERVIEW

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**Interviewee:** Rene Hawthorn, Base Historian, Bldg 1, HDQTRS, Camp Lejune, NC

**Date and Location:** January 13, 2003

**Interviewer:** Gary Webb, Ordnance and Explosive Safety Officer,  
CH2M HILL

*Note: This record was not transcribed from a recorded conversation. It was reconstructed from interview notes, so the conversation is paraphrased.*

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I met with the base historian, Rene Hawthorn, She had conducted a search for any historical information on USMC activities on Vieques but held nothing in her office. She directed me to AFTWTF, Naval Station Roosevelt Roads, Puerto Rico.

CH2M HILL  
RECORD OF INTERVIEW

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**Interviewee:** GSGT, Marz, USMC, EOD unit, Camp Lejune, NC

**Date and Location:** January 14, 2003

**Interviewer:** Gary Webb, Ordnance and Explosive Safety Officer,  
CH2M HILL

*Note: This record was not transcribed from a recorded conversation. It was reconstructed from interview notes, so the conversation is paraphrased.*

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I met with the members from the Marine EOD unit to review any information they held on Vieques activities and training. They searched their files and said they had nothing not even a map. They had not been back on Vieques training, since the live bombing had stopped.

CH2M HILL  
RECORD OF INTERVIEW

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**Interviewee:** LCDR Gary Unger, Inner Range Officer, AFTWTF, Naval Station Roosevelt Roads, Puerto Rico.

**Date and Location:** February 11, 2003

**Interviewer:** Gary Webb, Ordnance and Explosive Safety Officer,  
CH2M HILL

*Note: This record was not transcribed from a recorded conversation. It was reconstructed from interview notes, so the conversation is paraphrased.*

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Other interviewees present at interview, Gary Anderson, Assistant Range Officer, Bud Denehy, Range Safety Officer.

*When did you work on Camp Garcia, Vieques Puerto Rico?*

During the last 2 years as Inner Range Officer. LCDR Unger was involved in all of the training exercises.

*What activities were you involved with?*

Scheduling and range control during training exercises.

*What types of ordnance or military munitions were used?*

Various as listed in the archive data and range reports.

*Do you have any knowledge of any CWM being used on Camp Garcia?*

No knowledge or record of any CWM.

Do you know of any ordnance burial sites?

No, They were not familiar with activities at PI-9.

*Were there any special events involving training, weapons, ordnance or explosives?*

The former Range Officer disposed of all files on hand over two years old, Archive data was on hand for quite some time but had been destroyed, sent back to the US and some copies of range activities had been provided to the ROICC office on NSRR.

CH2M HILL  
RECORD OF INTERVIEW

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**Interviewee:** CWO2 Todd Enders, Assistant Officer In Charge (AOIC), Explosive Ordnance Disposal (EOD) Detachment Roosevelt Roads

**Date and Location:** February 11, 2003

**Interviewer:** Gary Webb, Ordnance and Explosive Safety Officer,  
CH2M HILL

*Note: This record was not transcribed from a recorded conversation. It was reconstructed from interview notes, so the conversation is paraphrased.*

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*When did you work on Camp Garcia, Vieques Puerto Rico?*

October 1991- October 1994  
November 2002- Present

*What was your position?*

91-94 Leading Chief Petty Officer EOD Det  
Presently AOIC EOD Det

*What activities were you involved with? Demolition? Training?*

Range refurbishment, UXO removal and disposal. Demolition and training  
What types of ordnance or military munitions were used?

*Where (on the base) did activities take place?*

The Majority of their work was conducted on the Live Impact Area (LIA)

*Who was involved in the activities?*

Members of the EOD Detachment

*Do you know of any gun positions, target areas or direction of fire?*

Only those indicated on the current maps

*Do you have any knowledge of any CWM being used on Camp Garcia?*

No

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*Do you know of any ordnance burial sites?*

No

*Were there any special events involving training, weapons, ordnance or explosives?*

There was one incident in 1991 or 1992 where 7 bombs were dropped outside of the LIA in the SIA. Six of the Seven bombs exploded on impact but the seventh did not detonate and was not found.

The suspect dud was in the area of the rifle ranges.

CH2M HILL  
RECORD OF INTERVIEW

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**Interviewee:** **Hector Rosario**

**Date and Location:** February 28, 2003

**Interviewer:** Gary Webb, Ordnance and Explosive Safety Officer,  
CH2M HILL

*Note: This record was not transcribed from a recorded conversation. It was reconstructed from interview notes, so the conversation is paraphrased.*

---

When did you work on Camp Garcia, Vieques Puerto Rico? *OP-1 Cerro Matias*

What was your position? *TCS (Target Control Specialist)*

What activities were you involved with? *Demolition? Training? Tomahawk recovery team. Training with EOD personnel on identification of live ordnance and type.*

What types of ordnance or military munitions were used? *M20, M82, M83, M84, M1 British, BDU48, M76, 20MM, 40MM, 60MM, 81MM, 16 inch guns, 5/54, 5/38 round, 105,155 howitzers, 2.75 rockets, 5 inch Zuni rockets, TOE rockets, DRAGON, LAW rocket launcher, M 203 grenade launcher and small caliber rounds.*

Where (on the base) did activities take place? *Live Impact Area. (LIA )*

Who was involved in the activities? *All OP-1 personnel*

Do you know of any gun positions, target areas or direction of fire? *Yes there are several gun positions in the Eastern Maneuvering Area (EMA), 90 % of the time the direction of fire was from South to North from a 015 to 030 heading.*

Do you have any knowledge of any CWM being used on Camp Garcia? *No*

Do you know of any ordnance burial sites? *No*

Were there any special events involving training, weapons, ordnance or explosives? *There were several training involving technical warfare EW type. No special weapons were used that I'm aware of.*

**APPENDIX E**

**Aerial Photographic Analysis of the EMA and  
Surface Impact Area (ERI, Inc.)**

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ERI-72-001  
March 2003

3<sup>rd</sup> DRAFT ADDENDUM REPORT

AERIAL PHOTOGRAPHIC ANALYSIS  
EASTERN MANEUVER AREA AND SURFACE IMPACT AREA

Vieques Island, Puerto Rico

Prepared for

Department of the Navy  
Under the LANTDIV CLEAN II Program  
Through CH2MHill Subcontract No. 63537  
Prime Contract No. N62470-95-6007

Prepared by

Environmental Research, Inc.  
5267 John Marshall Hwy., Suite C  
Linden, Virginia 22642

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## **FIGURES**

**DRAFT ADDENDUM - Aerial Photographic Analysis Findings, March 2003**  
1937-1994, hard copy map and compact disc

## 1.0 INTRODUCTION

Environmental Research, Inc. (ERI) was tasked to analyze historical aerial photography to support CH2M Hill in an ongoing Phase 1 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of the Atlantic Fleet Weapons Training Facility (AFWTF) on Vieques Island, Puerto Rico. This addendum report documents activity regarding known ranges, impact areas, gun positions and observation points within the Eastern Maneuver Area and the Surface Impact Area as illustrated on a CH2MHill map titled *Figure 1, OE/UXO Sites Eastern Vieques*.<sup>1</sup> This report also documents activity noted at additional sites, which were identified by ERI during the analysis of aerial photography spanning the period 1959 to 1994. The numbering system used to identify the additional sites was designated with the consecutive number following the last number used to designate ranges, gun positions and observation points as shown on Figure 1. A detailed description of former field artillery and mortar sites identified on aerial photography of the Eastern Maneuver Area (EMA) and Surface Impact Area (SIA) on Vieques Island is included in the Analysis Section of this report. The aerial addendum map and compact disc accompanying this report display the findings from the analysis and include environmental findings from the previous report completed in August 2000. The Reference Section (4.0) provides the list of aerial photographs, maps and collateral data used to prepare this report.

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<sup>1</sup> As requested by the Navy and CH2MHill, this addendum report does not include analysis of features within the Live Impact Area located at the far eastern side of Vieques.

## 2.0 QUALIFICATIONS AND EXPERIENCE

As the lead analyst conducting the analysis for this addendum report, Linley A. Malcom has 33 years experience as an imagery analyst dealing with military forces issues. Mr. Malcom retired from the Central Intelligence Agency (CIA) in 2000 after 30 years service. During his CIA career, he developed methodologies and conducted in-depth studies of foreign military forces; developed techniques for analysis of internal security forces; produced current intelligence; and mentored numerous junior and mid-level imagery analysts. From 1985 to 2000 he served as a Senior Imagery Analyst, and in this position he conducted and guided analysis on military forces issues. For the past three years he has been involved with analysis of industrial and military-related topics at ERI. Mr. Malcom holds a B.B.A. degree in Economic Geography from the University of Georgia.

Mary Sitton performed the aerial photographic and editorial quality control analysis for this report. Mary Sitton has nineteen years experience in aerial photographic research, acquisition and analysis, focusing on military and industrial operations and environmental conditions. She is currently President of ERI, an aerial photography analysis firm based in Linden, VA, which specializes in analysis of aerial photography for environmental investigations and litigation support. In this capacity, Ms. Sitton provides analysis services on projects involving environmental remediation and investigation to a variety of federal, state, local and private agencies. Prior to her involvement with ERI, Ms. Sitton worked as an independent environmental consultant for the U.S. Department of Justice and as an onsite imagery analyst/geologist contractor for the U.S. Environmental Protection Agency's Environmental Photographic Interpretation Center (EPIC). To date, she has completed approximately 180 military and industrial aerial analysis projects and has performed quality control on numerous others. Ms. Sitton holds Bachelor of Science degrees in Geology and Business Management from Radford University.

### 3.0 METHODOLOGY

The aerial photograph analysis was conducted by viewing stereo frames of film transparencies and prints, backlit on a light table, through a zoom stereoscope. Stereoscopic viewing creates a three-dimensional effect which, when combined with viewing at various magnifications, enables the analyst to identify signatures associated with different features and environmental conditions. The term "signature" refers to a combination of visible characteristics (such as tone, shadow, texture, size, shape, pattern and association) that permit a specific object or condition to be recognized on aerial photography. The analysis was reviewed by at least one other senior imagery analyst to ensure completeness and consistency. This quality control step is standard practice in the field of photo interpretation.

Mosaics were made from the aerial photography. Findings from the analysis were digitized and included as a data layer onto the mosaics. The findings can be viewed on the accompanying compact disc and hard copy map and used in combination with this narrative report.

#### 4.0 AERIAL ANALYSIS

The following are descriptions of former field artillery and mortar sites identified from analysis of aerial photography of the Eastern Maneuver Area (EMA) and Surface Impact (SIA) on Vieques Island. Small-arms and crew-served weapons ranges (R), impact/target areas (IMT/TA), gun positions (G or GP) and observations points (OP) were delineated. Gun positions were likely used for dry-fire and/or live-fire, exercises. The direction of fire was generally eastward toward the impact area. The aerial addendum map and the compact disc provided with the report illustrate the site locations and date, or dates, when the sites were visible. The locations of the majority of gun positions and impact areas identified on the aerial photography changed over time; therefore, many of the areas have revegetated and are no longer visible. An asterisk denotes ranges, gun positions, observation points and target areas that correspond to the approximate location of those shown on the location map provided by CH2MHill titled *Figure 1 OE/UXO Sites, Eastern Vieques, Puerto Rico.*<sup>2</sup> All other sites were identified from analysis of aerial photography. Analysis of aerial photography revealed that the size of the impact area within the SIA was significantly larger than depicted on Figure 1.

##### Eastern Maneuver Area (EMA)

Aerial photography showed a large bunker, possibly used for C3 and observation during exercises on the island, on a hilltop northeast of Camp Garcia within the EMA. This hill appears to be one of the highest points on the island.

**\*Range 1**, the westernmost, appeared to have a single impact/target area; the direction of fire was northward.

**\*Range 2** apparently was used for weapons of various ranges over the years; as a consequence, the aerial photography showed evidence of several impact/target areas. The direction of fire was northward. Aerial photography from 1994 showed that a probable live-grenade range had been constructed at the south end of Range 2.

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<sup>2</sup> An attempt was made to use the same numbers as illustrated on Figure 1 for ranges, gun positions, and observation points; however, analysis of aerial photography did not, in all cases, align with the exact location as shown on Figure 1.

**\*Range 3** was probably used for pistols and/or other short-range weapons. Although the orientation of the range changed over the years, the impact/target area remained in approximately the same location. The direction of fire was generally northeastward.

**\*Range 4** apparently consisted of three separate ranges at various times; consequently, there were several different impact/target areas. According to CH2MHill (personal conversation) Range 4A and 4B located east and west of Range 4 were likely associated with Range 4. The direction of fire was generally northward.

**\*Range 5** was used for short-range weapons and had at least two impact/target areas. The direction of fire was northward.

**\*Range 6** was on a beach east of, and separated from, the other ranges. This range area may have included an assault course (possibly for close combat) and several impact/target areas.

**Range 7** was used for longer-range, probably crew-served weapons, and had numerous impact/target areas. The direction of fire was northward.

**Range 8** and associated impact area was a small arms range visible in 1994.

**Range 9** and associated impact area was a small arms range visible in 1994.

**\*G-1** Field artillery site with five revetted gun positions.

**\*G-2** Field artillery site with four revetted gun positions.

**\*G-3** Field artillery site with six revetted gun positions.

**\*G-4** Field artillery site with four revetted gun positions.

**\*G-5** Field artillery site with three revetted gun positions.

**\*G-6** Two adjoining field artillery sites, each with six revetted gun positions; stages of revegetation indicate sites were built at different times.

**\*G-7** Field artillery/mortar site with six revetted weapon positions.

**\*G-8** Field artillery site with four revetted gun positions.

**G-9** Field artillery site with three revetted gun positions.

**G-10** Two adjoining field artillery sites, each with six revetted gun positions; stages of revegetation indicates sites were built at different times.

- G-11** Field artillery/mortar site with three revetted weapon positions; two of the positions had been obliterated by grading as of March 1967.
- G-12** Field artillery/mortar site with nine revetted weapon positions.
- G-13** Field artillery site with six revetted gun positions.
- G-14** Mortar site with three revetted weapon positions.
- G-15** Probable mortar site with at least six revetted weapon positions.
- G-16** Two adjoining field artillery sites, one with six revetted gun positions (three of which had been obliterated by grading), and the other site with four positions.
- G-17** Field artillery site with six revetted gun positions.
- G-18** Mortar site with three revetted weapon positions.
- G-19** Field artillery/mortar site with four revetted weapon positions.
- G-20** Field artillery site with six revetted gun positions.
- G-21** (Sec Surface Impact Area).
- G-22** Single, unrevetted field artillery/mortar position.
- G-23** Field artillery/mortar site with three revetted weapon positions.
- G-24** Field artillery/mortar site with three revetted weapon positions.
- G-25** Mortar site with six revetted weapon positions.
- G-26** Field artillery/mortar site with six revetted weapon positions.
- G-27** Field artillery site with four revetted gun positions.
- G-28** Field artillery/mortar site with six revetted weapon positions.
- G-29** Field artillery/mortar site with four revetted weapon positions; three of the positions had been obliterated by grading as of March 1967.
- G-30** Field artillery site with six revetted gun positions.
- G-31** Field artillery site with six revetted gun positions.

**G-32** Field artillery site with six revetted gun positions.

**G-33** Field artillery/mortar site with six revetted weapon positions.

**G-34** Mortar site with eight revetted weapon positions.

**G-35** Mortar site with eight revetted weapon positions.

**\*GP-7** is on the northeastern side of the EMA, on a slope facing the Impact Area. In 1967, the actual position (for a single gun) was a short distance west of the 1962 position.

**\*OP-7** is a small structure/tower on a hilltop a short distance northwest of GP-7.

**\*GP-9** is on the east-central side of the EMA, on a slope facing the Impact Area.

**\*OP-9** is a small structure/tower on a hilltop a short distance southwest of GP-9.

**OP-10**, in 1962, was a clearing on a hilltop, approximately midway between OP-7 and OP-9; this clearing was revegetated by 1967.

**OP-11**, a cleared area on a slope facing the Impact Area, probably was used as an observation point and a gun position at various times.

**G-20** Field artillery site with six revetted gun positions.

### **Surface Impact Area (SIA)**

Numerous craters caused by mortar and artillery fire, as well as by naval gunfire, were identifiable within the SIA. Aerial bomb craters (BC) were also visible at several locations within the SIA and just west of the SIA boundary. Munitions craters were noted within this area throughout the study period; however, they were most clearly visible on the 1962 photography. This area is labeled as IMT and delineated within the hashed polygon shown on attached aerial base map dated 1994.

**\*GP-1** is a leveled area on a hilltop at the southeastern corner of the Impact Area. A light-toned, I-shaped marker on the ground may indicate the point at which a gun is to be positioned.

**\*OP-1** is on a leveled area, on the same hilltop as GP-1, but at a slightly higher elevation. A probable housing trailer and a small gable-roofed structure occupy this area.

**\*GP-5** is a leveled area on a hilltop on the east-central side of the Impact Area; an I-shaped marker, similar to the one at GP-1, is on the ground in this area.

**\*OP-5** is probably a small, revetted, rectangular area (possibly the remnants of a structure) immediately north of GP-5 and at a slightly higher elevation.

**OP-12**, a structure at the northeastern corner of the Impact Area, may have served as an observation point; it was dilapidated by 1967.

**OP-13**, a structure/tower at the northeastern corner of the Impact Area, probably served as an observation point; its roof was missing by 1967.

**G-21** Mortar site with three revetted weapon positions.

## 4.0 REFERENCES

### AERIAL PHOTOGRAPHY

Agency	Date	Code	Scale	Film Type	Roll	Frames
NARA <sup>3</sup>	03-01-59	VIE1/3	1:30K	B/W	-	22-28
NOS <sup>4</sup>	02-07-62	62S	1:10K	CC	-	9783-9797
NOS	02-18-62	62S	1:10K	CC	-	597-599, 610-620, 664-670
FSA <sup>5</sup>	01-17-64	ELT	1:20K	B/W	13DD	139-146, 148-159
FSA	03-18-67	ELT	1:20K	B/W	22DD	186-197
NAVY	Circa mid-1970	-	1:24K	CC	-	21-26, 83-96, 113-130
NAVY/ USGS <sup>6</sup>	01-28-85	84-329	1:24K	CIR	1 2	8-17 32-40
FSA	11-24-94	-	1:40K	B/W	1093	7-9, 21-27, 37-39

### MAPS

Figure 1, OE/UXO Sites, Eastern Vieques, Puerto Rico, CH2MHill, Draft October 2002

Isla de Vieques, P.R., 1:30,000-scale USGS topographic map, 1982

<sup>3</sup> National Archives & Records Administration

<sup>4</sup> National Ocean Service

<sup>5</sup> Farm Service Agency, U.S. Department of Agriculture

<sup>6</sup> U.S. Geological Survey, U.S. Department of the Interior