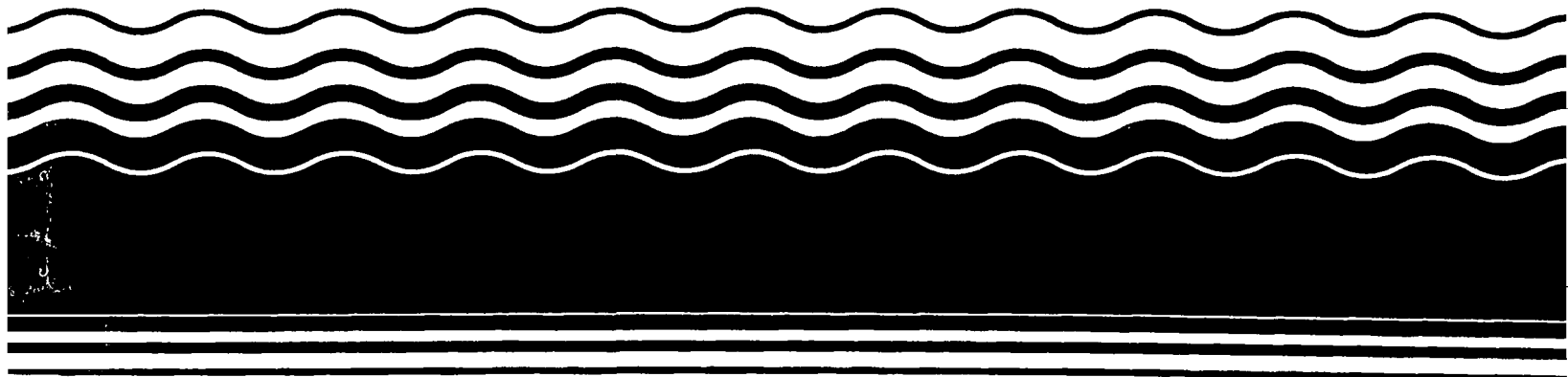


**PB97-963819
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January 1998**

EPA Superfund Record of Decision:

**Naval Security Group Activity
OU 3 (Sites 1 & 3)
Sabana Seca, PR
9/30/1997**



FINAL

**RECORD OF DECISION
SITE 1 - SOUTH STONE ROAD DISPOSAL AREA
SITE 3 - NORTH STONE ROAD DISPOSAL AREA**

**NAVAL SECURITY GROUP ACTIVITY
SABANA SECA, PUERTO RICO**

CONTRACT TASK ORDER 0047

SEPTEMBER 3, 1997

Prepared For:

**DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
*Norfolk, Virginia***

Under the:

**LANTDIV CLEAN Program
Contract N62470-89-D-4814**

Prepared By:

**BAKER ENVIRONMENTAL, INC.
*Coraopolis, Pennsylvania***

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LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirements
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COPC	contaminants of potential concern
CPRC	Caribbean Primate Research Center
CRP	Community Relations Plan
CSF	cancer slope factor
DOD	Department of Defense
ESI	expanded site inspection
FFA	Federal Facilities Agreement
FS	feasibility study
HI	hazard index
HQ	hazard quotient
IAS	Initial Assessment Study
ILCR	incremental lifetime cancer risk
IR	Installation Restoration
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MCL	Federal Maximum Contaminant Level
mg/kg	milligrams per kilogram
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NSGA	Naval Security Group Activity
O&M	operations and maintenance
OU	operable unit
PREQB	Puerto Rico Environmental Quality Board
RA	risk assessment
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund
RBC	risk-based criteria
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RfD	reference dose
RI	remedial investigation
ROD	record of decision
SARA	Superfund Amendment and Reauthorization Act
SI	site inspection

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

TAL	Target Analyte List
TBC	To Be Considered Criteria
TCL	Target Compound List
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
VOCs	volatile organic compounds

DECLARATION

Site Name and Location

Site 1 - South Stone Road Disposal Area
Site 3 - North Stone Road Disposal Area
Naval Security Group Activity, Sabana Seca, Puerto Rico

Statement of Basis and Purpose

This decision document presents the selected remedy for Site 1 and Site 3 at the Naval Security Group Activity (NSGA) Sabana Seca. The remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record file for Site 1, the South Stone Road Disposal Area and Site 3, the North Stone Road Disposal Area.


Description of Selected Remedy

The selected remedy for Site 1 and Site 3 is no action.

Declaration Statement

This Record of Decision (ROD) documents that no action is necessary at Sites 1 and 3 to ensure protection of human health and the environment. Because this remedy will not result in hazardous substances remaining on site above health-based levels, the five-year review will not apply to this action.

In lieu of a Final Close Out Report, this ROD also documents that the U.S. Navy has completed all construction activities for all sites at the NSGA Sabana Seca Site in accordance with *Close Out Procedures for National Priorities List Sites* (OSWER Directive 9320.2-09). No action has been determined to be necessary for Sites 1, 2, 3, and 4; the Navy has cleaned up Sites 5 and 6; and Site 7 will be addressed by the Municipality of Toa Baja, the party responsible for Site 7 contamination. This decision documents that the Navy, U.S. Environmental Protection Agency (USEPA) and Puerto Rico Environmental Quality Board (PREQB) have determined that remedial actions for this site have been successfully implemented and no further response actions are necessary. Therefore, the site now qualifies for inclusion on the Construction Completion List. The PREQB conducted an inspection on May 9, 1997; and, the USEPA conducted an inspection on July 17, 1997, and both agencies concur that all remedial action has been successfully executed by the Navy.


Signature (Commanding Officer, NSGA Sabana Seca)

15 SEP 1997
Date


Signature (Chairman, PR Environmental Quality Board)

15/9/1997
Date


Signature (Regional Administrator, USEPA Region II)

30 Sep. 1997
Date

DECLARACIÓN

Nombre y Ubicación del lugar

Lugar 1 - Area de Disposición *Stone Road Sur*

Lugar 3 - Area de Disposición *Stone Road Norte*

Actividad del Grupo para Seguridad Naval, Sabana Seca, Puerto Rico

Declaración de fundamento y propósito

Este documento de decisión presenta el remedio seleccionado para el Lugar 1 y el Lugar 3 en la Actividad del Grupo para Seguridad Naval, (NSGA, por sus siglas en inglés), Sabana Seca. Se seleccionó este remedio a tenor con la Ley CERCLA (*Comprehensive Environmental Response, Compensation and Liability Act*), según enmendada por la Ley SARA (*Superfund Amendments and Reauthorization Act*) y en la medida en que resulte práctico, por el Plan Nacional de Contingencia para Contaminación con Petróleo y Sustancias Peligrosas (NCP, por sus siglas en inglés). Esta decisión se basa en expediente administrativo sometido para el Lugar 1, el Area de Disposición *Stone Road Sur* y el Lugar 3, el Area de Disposición *Stone Road Norte*.


Descripción del remedio seleccionado

El remedio seleccionado para el Lugar 1 y el Lugar 3 es la de no acción ulterior.

Formulario de Declaración

Este Expediente de Decisión (ROD, por sus siglas en inglés) documenta que no es necesaria acción alguna en los Lugares 1 y 3 a fin de garantizar la protección de la salud humana y el ambiente. Como este remedio no redundará en que se mantengan en el lugar sustancias peligrosas sobre los niveles de riesgo para la salud, el periodo de revisión de cinco años no aplica a esta acción.

En lugar del Informe Final de Cierre, este Expediente de Decisión también documenta que la Marina de Estados Unidos ha completado todas las actividades de construcción para todos los lugares en la NSGA, Sabana Seca a tenor con los *Procedimientos de Cierre para Lugares en la Lista de Prioridades* (Directriz 9320.2-09 de OSWER). No se ha determinado que sea necesario tomar acción alguna para los Lugares 1, 2, 3 y 4. La Marina limpió los Lugares 5 y 6 el Lugar 7 lo atenderá el Municipio de Toa Baja, la parte responsable de la contaminación del Lugar 7. Esta decisión documenta que la Marina, la Agencia Federal de Protección Ambiental (USEPA, por sus siglas en inglés) y la Junta de Calidad Ambiental de Puerto Rico (JCA) han determinado que han implementado con éxito las acciones remediales para este lugar y que no son necesarias acciones ulteriores. Por lo tanto, el lugar ahora califica para inclusión en la Lista de Construcción Completada. La JCA realizó una inspección el 9 de mayo del 1997 y USEPA realizó una inspección el 17 de julio de 1997 y ambas agencias están de acuerdo en que la Marina ha implementado con éxito todas las acciones remediales.


Firma (Comandante, NSGA, Sabana Seca)

15 SEP 1997
Fecha


Firma (Presidente, Junta de Calidad Ambiental de PR)

15 / 9 / 1997
Fecha


Firma (Administrador Regional, USEPA Región II)

30 Sep 1997
Fecha

1.0 SITE NAME, LOCATION, AND DESCRIPTION

This Record of Decision (ROD) is for Operable Unit (OU) -3 Site 1, the South Stone Road Disposal Area, and Site 3, the North Stone Road Disposal Area, both of which are located in the south tract of the Naval Security Group Activity (NSGA) Sabana Seca. Other parts of the NSGA Sabana Seca site are being addressed in separate actions. OU-1 is for Sites 2 and 4, and OU-2 is for Site 6.

The NSGA Sabana Seca provides communications and support for the U.S. Navy and other Department of Defense (DOD) elements. NSGA Sabana Seca is located approximately 14 miles west of the city of San Juan on the island of Puerto Rico. The Naval Base consists of a North and South Tract together occupying over 2,200 acres of land. NSGA Sabana Seca is a site being investigated for environmental contamination under CERCLA and is included on United States Environmental Protection Agency (USEPA's) National Priority List (NPL).

NSGA Sabana Seca was originally a pineapple and grapefruit plantation known as the Stephenson Place. The plantation was procured by the U.S. Navy during World War II. After the war, the property was turned over to the U.S. Army. In 1951, the Navy again assumed control and in 1952, established the U.S. Naval Radio Station, Sabana Seca. In 1971, NSGA Sabana Seca was established as an independent shore activity of the Navy. The facility has been operated as a communications center continuously by the Navy since 1971.

Figure 1 presents a map of the south tract and the locations of Sites 1 and 3 within the south tract. Site 1 is located within the western portion of the south tract approximately 2,000 feet southwest of the intersection of Stone and Bataan Roads. Site 1 is located on the south side of Stone Road adjacent and north of the Caribbean Primate Research Center (CPRC). Site 3 is located in the north-central portion of the south tract. Site 3 is north and adjacent to Stone Road, between Redman Road and Bataan Road. The South Tract is bounded to the north by the village of Sabana Seca, to the east by Route 866, to the south by Route 22, and to the west by the Bayamon and Toa Baja Municipal Landfills and the U.S. Department of Health and Human Services Research Facility.

The water table of the groundwater aquifer supply NSGA Sabana Seca is located approximately 50 to 70 feet below ground surface (bgs). The south tract of NSGA Sabana Seca is serviced by two deep Base supply wells, at depths of 130 feet and 140 feet bgs, and are located in Building 10 and

22, east of the enlisted housing area and north of the officer housing area. The Base water supply wells are located approximately 4,600 feet east of Site 1 and 3,000 feet southeast of Site 3. The groundwater aquifer has not been impacted by on-site activity.

Figure 2 presents a site plan of Site 1 and shows the adjacent property uses. Site 1 covers an area of approximately 2 acres and is bordered on the south and west sides by the CPRC. The Initial Assessment Study (IAS) originally estimated the site to cover 10 acres. The areas to the north and east of Site 1 are undeveloped and heavily vegetated. Stone Road borders the north side of Site 1. The site is currently undeveloped and overgrown with vegetation.

Figure 3 presents a site plan of Site 3 and shows the adjacent property uses. Site 3 covers an area of approximately 11 acres. The IAS originally estimated the site to cover 4.5 acres. The site is bordered by Redman, Stone, and Bataan Roads on the west, south, and east sides, respectively. The area around Site 3 is undeveloped and heavily vegetated. The Base's perimeter fence borders the east side of the site. The site is currently overgrown with vegetation.

The topography at Sites 1 and 3 is relatively flat and heavily vegetated. There is no surface water present at Sites 1 or 3.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Site History

An IAS conducted in 1984 identified and assessed sites posing a potential threat to human health or the environment. The IAS identified seven sites:

- Site 1 - South Stone Road Disposal Area
- Site 2 - Bunker 607 Disposal Area
- Site 3 - North Stone Road Disposal Area
- Site 4 - Pistol Range Disposal Area
- Site 5 - Wenger Road Disposal Area
- Site 6 - Former Pest Control Shop
- Site 7 - Leachate Ponding Area

The locations of these sites are shown on Figure 4.

2.1.1 History - Site 1

According to the IAS report, Site 1 was the Base's landfill in operation from 1951 to 1960. During that time, an estimated 3,300 tons of solid waste, including residential waste, construction debris, scrap metal, appliances, paint cans, and tree clippings were disposed at the site. The Public Works Department collected solid waste twice a week using a dump truck, and deposited the solid waste at Site 1. The solid waste was dumped directly onto the ground and left as mounds. Trenching and daily cover were not employed as part of the disposal operations. No hazardous wastes were reported to have been disposed at Site 1. Site 1 has remained inactive. The Navy has not removed any wastes from Site 1. CERCLA investigation has determined that no action is necessary at this site.

2.1.2 History - Site 2

According to the IAS report, Bunker 607 was intermittently used by the Public Works Department for materials storage from the 1960s to 1979. In 1979, the Public Works Grounds Maintenance Division was ordered to clean out the bunker. Reportedly, approximately 500 one-gallon cans of old paint intended to be used for the on-Base housing were disposed in the vicinity of Bunker 607. CERCLA investigation has determined that no action is necessary at this site.

2.1.3 History - Site 3

According to the IAS report, Site 3 was the Base's landfill in operation from 1960 to 1965. An estimated 1,800 tons of solid waste, including residential waste, construction debris, appliances, scrap metal, scrap wood, and tree clippings were disposed at the site. The Public Works Department collected solid waste twice a week using a dump truck, and deposited the solid waste at Site 3. The solid waste was dumped directly onto the ground and left as mounds. Trenching and daily cover were not employed as part of the disposal operations. No hazardous wastes were reported to have been disposed at Site 3. Site 3 has remained inactive. The Navy has not removed any wastes from Site 3. CERCLA investigation has determined that no action is necessary at this site.

2.1.4 History - Site 4

According to the IAS, Site 4 was used as the Base's landfill from 1965 through possibly 1970. Prior to its first use for solid waste disposal, the area may have been an orchard (based on 1950 and 1962 aerial photography from USEPA). Site 4 is named the Pistol Range Disposal Area because of its proximity to the Base's pistol range.

While used as a disposal area, approximately 1,800 tons of waste including residential waste, construction debris, appliances, scrap metal, and waste oil were reportedly disposed. According to the IAS report, no hazardous wastes were reported to have been disposed at Site 4. No wastes were removed from this site. CERCLA investigation has determined that no action is necessary at this site.

2.1.5 History - Site 5

According to the IAS, this site was reportedly used as a disposal site for mainly inert materials from 1980 through 1983. Materials disposed of at the site consisted of leaves and brush, cuttings, empty drums, tires, wood and pallets, demolition debris, automobiles, mattresses, appliances, office furniture, and other similar materials. During the time period this site was used for disposal, the majority of solid waste was taken off Base for disposal by a contractor. Items disposed of at the site were those items the contractor would not dispose of, primarily because of their size and weight. In 1982, the Environmental Engineering Survey conducted by the Navy recommended that these materials be removed in order to "eliminate a point of habitation for insects, rodents, and other animals, some of which could be disease vectors." This would also eliminate the need to apply for a landfill operation permit.

Cleanup of the site was conducted by the Navy's Transportation Division as an "in-house" operation. Approximately 360 tons of large metal pieces and equipment, abandoned vehicles, appliances, and general Base scrap and trash were removed. In addition, 30 to 40 unsuspected 55-gallon drums of unknown material and two to three transformers were removed. The drums and transformers were disposed of by Base personnel. Soil was removed to 16 feet below-grade, acceptable materials buried, and clean soil replaced to the surrounding land grade. The materials removed were placed in a nearby municipal landfill. Because Site 5 has been cleaned up, it does not pose a threat to

human health or the environment. Therefore, since this site had been previously remediated prior to listing of NSGA Sabana Seca on the NPL, USEPA's July 19, 1994 letter to the Navy determined that no further investigation of Site 5 will be required.

2.1.6 History - Site 6

According to the IAS, Site 6 was operational as a pest control shop from the mid-1950s through 1979. Pesticides were accidentally spilled in and around the building during this time. Pesticides were stored in a small concrete building and on concrete pads adjacent to the building. Pesticides were mixed and application equipment cleaned in a sink outside the building which discharged directly to the ground. Drainage from the site flows north to the eastern perimeter of the Base's picnic/playground area. The pesticides reportedly used or stored at this site in the past included: DDT, lindane, chlordane, Paris Green, 2,4-D, malathion, diazinon, seven, PRAMITOL, and esteron (a mixture of 2,4-D and 2,4,5-T). Paris Green is an arsenic-based insecticide, and PRAMITOL is a non-selective herbicide of the triazine family that is adsorbed by foliage and roots and inhibits photosynthesis.

In October 1987, the materials stored in the pesticide shop were removed and taken to the Base's hazardous storage facility and the building was demolished. The demolition debris including concrete, shingles, etc., were taken to the nearby Bayamon/Toa Baja Municipal Landfill. A clean layer of topsoil was placed on the site, and the area was vegetated. The site was enclosed in a chain-link fence to limit public access. The fence gate was kept locked at all times. Warning signs were posted in English and Spanish. This area along Stone Road is patrolled regularly by military police.

CERCLA investigation has resulted in a protective asphalt cap that has been constructed on this site as documented in a ROD dated, September 20, 1996 and construction completed in April 1997.

2.1.7 History - Site 7

Leachate from the nearby municipal landfill has been observed entering this wet marshy area, which has been designated as Site 7. The municipal landfill, which is located directly adjacent to the Base property, has been in operation since the early 1970s. The Navy excessed this land to the Puerto Rico Land Authority in 1963. The municipal landfill covers approximately 69 acres and has

received the following types of wastes: pharmaceutical, residential, and industrial wastes; old cars; tires; and appliances. NSGA Sabana Seca has used the municipal landfill for the disposal of wastes since approximately 1972.

The municipal landfill is situated in an area of karst topography known as the "haystack" hills. Surface runoff from this area enters the Base. The presence of wastes on top of the karst topography of the municipal landfill creates the potential for contaminant migration via the groundwater. Groundwater from the municipal landfill discharges to the swampy areas of the Base. Because of the possibility of groundwater contamination from leachate migrating onto NSGA Sabana Seca property, the municipal landfill poses a potential threat to human health and the environment.

The Navy has entered into an agreement with the Municipality of Toa Baja, municipal landfill operators and Puerto Rico Environmental Quality Board (PREQB) to mitigate further impact to NSGA Sabana Seca from the municipal landfill and will continue to monitor at Site 7 any contaminant migration from the municipal landfill.

The terms of this agreement are the following: The Municipality of Toa Baja will develop a mechanism to control the leachate migrating onto NSGA Sabana Seca property. In addition, Toa Baja will develop with NSGA Sabana Seca concurrence mechanisms to prevent the erosion at the NSGA Sabana Seca's security road in the corner, where the storm water/leachate runoff from the Bayamon/Toa Baja Landfill's access road discharges onto NSGA Sabana Seca's property. Toa Baja, as owner of the Bayamon/Toa Baja Landfill, will be responsible for funding and implementing the agreed upon action.

The term of this agreement is from December 4, 1996 and will extend through post-closure activities. PREQB will be expected to monitor contamination migration during this time.

2.2 Previous Investigations/Enforcement Activities

2.2.1 Previous Investigations

2.2.1.1 Initial Assessment Study

In 1984, an IAS was conducted for the Base. The purpose of the IAS was to identify and assess sites posing a potential threat to human health or to the environment due to contamination from past hazardous material operations. This IAS involved reviewing historical records and aerial photographs, and conducted on-site inspections and personnel interviews.

The IAS stated that, since no known hazardous waste were reportedly disposed at Site 1 or 3, these sites did not pose a threat to human health or the environment. Therefore, Sites 1 and 3 were not recommended for further investigation at the time of the IAS.

2.2.1.2 Initial Site Inspection

Because of the limited IAS information, the USEPA, the Navy, and the PREQB determined additional studies were needed at Sites 1 and 3. In December 1991, Baker conducted site inspection (SI) field activities. Three groundwater monitoring wells were installed at each site. Groundwater and soil samples were collected and analyzed during two subsequent rounds of sampling (April 1993 and July 1993) at both sites. Nine surface soil samples were collected at Site 1 and analyzed for Target Compound List (TCL) organics and Target Analyte List (TAL) inorganics.

2.2.1.3 Expanded Site Inspection

An expanded site inspection (ESI) was performed for Sites 1 and 3 to confirm background conditions for surface soil and groundwater. The purpose of the ESI was to assess whether unacceptable risks to human health from soil and groundwater (calculated from data collected in the initial SI) were due to actual site conditions that existed from former site operations, or if the constituents detected in the soil and groundwater were present in background and, therefore, unrelated to the site.

As part of the ESI, an additional background monitoring well was installed. Two rounds of groundwater samples and 20 background surface soil samples were collected. The groundwater samples were collected using low-flow purging techniques to reduce turbidity. These background concentrations were compared to the site specific analytical results to identify chemicals of concern to use in a quantitative risk assessment.

2.2.2 Enforcement Activities

2.2.2.1 National Priorities Listing

NSGA Sabana Seca was proposed for inclusion on the National Priorities List on June 24, 1988 and was included on October 4, 1989. The concern about the pesticides at Site 6 was the primary reason NSGA Sabana Seca was proposed for the NPL.

2.2.2.2 Federal Facilities Agreement

On March 19, 1992, the Navy, USEPA, and the PREQB entered into a Federal Facilities Agreement (FFA) for NSGA Sabana Seca. The primary purpose of the FFA was to ensure that environmental impacts associated with past and present activities at the Base were thoroughly investigated and appropriate CERCLA response/Resource Conservation and Recovery Act (RCRA) corrective action alternatives were developed and implemented as necessary to protect public health and the environment. This agreement established roles and responsibilities and improved communication between the Navy, USEPA, and PREQB. It provided for the expeditious completion of all remedial actions necessary to protect the public health, welfare, and the environment consistent with CERCLA/Superfund Amendment and Reauthorization Act (SARA) and the NCP. Under the FFA, SIs were performed for Sites 1 and 3.

2.3 Site Inspections/Remedial Investigation/Leachate Diversion-Feasibility Study

All sampling and analysis, at all the sites at NSGA Sabana Seca were done in accordance with a workplan prepared by the Navy and approved by USEPA and PREQB, and in accordance with the USEPA Region II's CERCLA Quality Assurance Manual.

2.3.1 Site Inspections - Sites 2 and 4 - (OU-1)

Between 1985 and 1994, the 5 acre Pistol Range Disposal Area and the less than 2 acre Bunker 607 Disposal Area were sampled five times. The Navy performed a SI between 1991 and 1994. No contaminants were detected in the groundwater, surface water, soil or sediments above Federal Action levels. The final SI report summarized all site analysis results.

On December 2, 1996, the Navy released the final SI reports. The reports provided an in-depth summary and discussion of site sampling activities and the risk assessment. The reports also concluded that since there was no unacceptable risk to human health or the environment from the contamination of soil, sediment, surface water, or groundwater at either site, no action was necessary.

2.3.2 Remedial Investigation - Site 6 - (OU-2)

Between 1986 and 1993, the less than 1 acre site of the Former Pest Control Shop and adjacent areas were sampled six times. The Navy performed a remedial investigation (RI) between October 1991 and October 1993. Chromium was detected only once in the groundwater above the Federal Maximum Contaminant Level (MCL) at 119 micrograms per liter ($\mu\text{g/L}$). No pesticides were detected in the groundwater and surface water and those pesticides detected in the soil and sediment were below Federal action levels.

Since there are no applicable or relevant and appropriate requirements (ARARs) established for the cleanup of soil, chemical-specific To Be Considered (TBC) criteria were evaluated, instead. A chemical-specific TBC of 500 micrograms per kilogram ($\mu\text{g/kg}$) for gamma-Chlordane was obtained from the RCRA Corrective Action Levels listed in 40 CFR Part 264.521, Appendix A and Appendix C (Proposed Rule). Chlordane is a mixture of chlorinated hydrocarbons consisting of isomers of chlordane and closely related compounds and byproducts. Gamma-chlordane is an isomer of chlordane, so gamma-chlordane makes up a part of chlordane. Therefore, the chlordane listing can be used for gamma-chlordane. In general, the chlordane mixture is comprised mostly of the gamma-chlordane isomer. Therefore, gamma-chlordane is not listed in either Appendix A or Appendix C as gamma-chlordane; gamma-chlordane is listed as chlordane. The final RI/Feasibility Study(FS) report summarized all site analysis results.

On May 2, 1996, the Navy released the final RI/FS report. The report provided an in-depth summary and discussion of site sampling activities, a human health and ecological risk assessment, and an analysis of remedial alternatives. The report also concluded that since there was no unacceptable risk to human health or the environment from the pesticide contamination of soil that has occurred at Site 6, no action was necessary. Nevertheless, the site is adjacent to a playground/picnic area and the enlisted housing area. Therefore, as a reassurance to the public, the Navy conservatively evaluated remedial alternatives that could limit the public's exposure to the minimal contamination that may remain in the soil at Site 6. The RI/FS report provided a detailed analysis of capping; excavation, removal and off-site incineration; and no action remedial alternatives.

2.3.3 Leachate Diversion-Feasibility Study - Site 7

Though the waste stream did not originate from Navy property, the Navy conducted a Leachate Diversion/Feasibility Study to try to address the problem. The FS provided eight alternatives for an interim treatment of the leachate entering Navy property. The alternatives evaluated were considered impractical, including leachate collection, because of the location of NSGA Sabana Seca in a rainforest, with the exception of an engineered wetlands, which would use phytoremediation technologies. A treatability study of the engineered wetland technology was conducted as a result of the FS. The study consisted of constructing a small scale wetland to evaluate the implementability and effectiveness of this technology. Due to unforeseen changes in landfill operations and the hydrology upgradient of the Base, and susceptibility of the engineered wetland technology to drought conditions, the study was canceled. The final FS report summarized all site analysis results.

On December 20, 1996, the Navy released the final FS report. The report provided an in-depth summary and discussion of the eight alternatives, all of which were determined to be impractical as the report has also determined that the leachate flowing onto Navy property at Site 7, a collection area for leachate from an off-Base source, is from the Bayamon Municipal Landfill, the operation of which could not be controlled by the Navy. Therefore, on February 27, 1997, the USEPA notified the Navy that no action was necessary and that a ROD would also not be required at Site 7. The Navy has entered into a Partnering Agreement with the landfill owners and operators, and PREQB to further address landfill leachate at Site 7.

2.4 ROD Findings

2.4.1 Sites 2 and 4 - (OU-1)

The Navy has prepared a No Action ROD for Sites 2 and 4 due to current site conditions, environmental analyses and risk assessments. Though Sites 2 and 4 were formerly used as disposal areas, no evidence exists to suggest that the soil, groundwater, surface water or sediment at either site poses a risk to human health or the environment. Based on cleanup objectives at other Federal, State and Commonwealth hazardous waste sites, this alternative will be protective of human health and the environment.

2.4.2 Site 6 - (OU-2)

On September 20, 1996, the Regional Administrator approved a ROD, which selected an asphalt cap over the areas where pesticides were previously detected in the surface soils above TBC criteria. The fence that is currently around portions of Site 6 will be removed. The area will be cleared and grubbed. An eight inch subbase layer of gravel will be placed in the area to be capped. A four inch layer of asphalt will be placed over the gravel subbase layer. The surface of the cap will be sloped to drain. The area around the cap will be leveled with clean fill, and the site will be revegetated. The cap will also eliminate the potential for any contact, human or environmental, with any remaining minimal pesticide-contaminated soils. Based on cleanup objectives at other Federal, State and Commonwealth hazardous waste sites, as well as recommendations from the U.S. Centers for Disease Control, this alternative will be protective of human health and the environment.

2.5 Remedial Design/Remedial Action - Site 6 - (OU-2)

2.5.1 Design Activities

On February 14, 1996, the Navy submitted the draft Remedial Design (RD). The RD was finalized on May 2, 1996 and approved by the Navy on July 15, 1996. The Navy has paid all of the remedial action costs and will assume responsibility for all of the operation and maintenance (O&M) requirements, as required by CERCLA. The Navy awarded the contract to OHM Remediation Services Corporation. The draft Remedial Action Workplan dated July 15, 1996, was received by

USEPA on October 30, 1996, and approved by USEPA on December 19, 1996. The Remedial Action Workplan was finalized by the Navy on January 14, 1997.

2.5.2 Remedial Construction Activities

The construction project consisted of three primary tasks; site preparation, backfill and compaction of subbase, and asphalt application.

On January 14, 1997, the Navy held a pre-construction meeting at the Base. The remedial action field activities also commenced that day with clearing and grubbing. Preparation of Site 6 included extensive clearing and grubbing activities, the removal of small trees and dense underbrush within the fence, removal of crushed empty drums which formerly held drill soil cuttings, and the removal of three large trees which were located slightly beyond the fenced perimeter but within the proposed cap area. The cleared vegetation, including the felled trees outside of the fenced area, were transported to the Base compost. Drums, which held soil cuttings from previous site inspections, were emptied on site and the contents placed beneath the final cap. Clearing and grubbing of Site 6 was completed on February 5, 1997.

Backfill and compaction activities, which began on February 7, 1997 and ended on March 14, 1997, were delayed due to heavy precipitation. Because of muddy conditions, saturated soil was excavated and replaced with crushed stone backfill, which facilitated the backfill completion while reducing the need for additional, more costly, select soil backfill.

Asphalt and site restoration occurred from April 3 to 11, 1997. A four inch layer of asphalt was applied over approximately 1,900 square yards, on top of the properly compacted subbase (>95% compaction). A total of 180 cubic meters of topsoil was spread around the perimeter of the asphalt cap, seeded and mulched.

On May 27, 1997, the Navy submitted a Remedial Action report to USEPA and PREQB signifying successful completion of construction activities. Due to the contract modifications and weather delays, the total remediation action contract cost (\$261,000) exceeded the original \$198,000 contract, by \$63,000.

A final construction inspection was performed on April 7, 1997, during which the asphalt cap was approved and accepted. The remaining punch list items, consisting of final top soil application, seeding, and mulching, was finalized and approved and accepted by the on-site representative for the Navy on April 14, 1997. The PREQB conducted an inspection on May 9, 1997; and USEPA conducted an inspection on July 17, 1997, and both agencies concur that all remedial action had been successfully executed by the Navy.

2.5.3 Summary of Operations and Maintenance

Site 6 O&M activities to be performed include routine inspections of the asphalt cap, mowing, and maintenance of the perimeter fence. The Navy has assumed all responsibility for O&M. The asphalt cap will require minimal maintenance by the Navy. The life expectancy of an asphalt cap is approximately 20 to 25 years with routine maintenance. A top sealant will be applied periodically to the asphalt surface to prevent deterioration.

2.6 Community Relations Activities

The Navy's community relations staff conducted an active campaign to ensure that the residents were well-informed about the activities at the Base. Community relations activities included: Site Information/Photograph Albums; Site Brochures/Fact Sheets; a Community Relations Plan; Technical Review Committee/Restoration Advisory Board meetings; and Public Awareness Sessions.

2.7 Site Close Out

This No Action ROD, in lieu of a Final Close Out Report, documents that the Navy has completed all construction activities for the NSGA Sabana Seca site in accordance with *Close Out Procedures for National Priorities List Sites* (OSWER Directive 9320.2-09). No action has been determined to be necessary for Sites 1, 2, 3, and 4; the Navy has cleaned up Sites 5 and 6; and Site 7 will be addressed by the Municipality of Toa Baja, the party responsible for Site 7 contamination. This decision documents that the Navy, USEPA and PREQB have determined that remedial actions for this NSGA Sabana Seca site have been successfully implemented and no further response actions are necessary. Therefore, the NSGA Sabana Seca site now qualifies for inclusion on the

Construction Completion List. The PREQB conducted an inspection on May 9, 1997; and, the USEPA conducted an inspection on July 17, 1997, and both agencies concur that all remedial action has been successfully executed by the Navy.

All cleanup actions specified in the ROD for Site 6 have been implemented. The asphalt cap provides further assurance that Site 6 poses no threats to human health or the environment. The only remaining activity to be performed is O&M that the Navy has guaranteed.

USEPA will issue a Notice of Intent to Delete NSGA Sabana Seca site from the NPL.

A bibliography of all reports relevant to the completion of this NSGA Sabana Seca site under the Superfund program is attached. These documents are available by calling the NSGA Sabana Seca Public Affairs Officer at (787) 261-8307.

2.8 Five-Year Review

Because no hazardous substances remain at the site above health-based levels, a five-year review does not apply to the NSGA Sabana Seca site.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The public participation requirements of CERCLA/SARA and the NCP have been met by the following activities.

Restoration Advisory Board (RAB) members, which include representatives from regulatory agencies, the Navy and the local community, have participated in the review of draft documents and have worked together to finalize these documents.

A Community Relations Plan (CRP) for all sites at the Base was prepared in 1991 and is available in English and Spanish. The CRP is part of the community right-to-know process. The primary purpose of the CRP is to provide information and to promote constructive, effective communication between the Base and the surrounding communities.

Although Puerto Rico is a Commonwealth of the United States, a large percentage of the population is not fluent in English; Spanish is the main language of Puerto Rico. Therefore, the Navy had pertinent summary documents translated into Spanish.

The Administrative Record, which contains all documents that form the basis for the selection of a response action, is maintained at the Base library and at the Jaime Fonadella Garriga Public Library in Toa Baja, Puerto Rico. The notice of availability for the Administrative Record for this federal facility was first published on May 12, 1996 and May 13, 1996 in local newspapers. The English version of the public notice was published in the *San Juan Star*; the Spanish version was published in the *Nuevo Dia*.

The ESI Report and the Proposed Plan for these two sites were released to the public (i.e., were placed in the Administrative Record) on June 17, 1997. The public notice indicating once again the availability of the Administrative Record for the facility and specifically indicating the availability of the ESI Report and the Proposed Plan for review was published on June 15, 1997 and June 16, 1997 in local newspapers. The English version of the notice was published in the *San Juan Star*, the Spanish version was published in the *Nuevo Dia*. The Proposed Plan, ROD, the Site Information/Photograph Album, fact sheets and the Administrative Record's introduction are available in English and Spanish.

As indicated in the public notice, a public comment period was held from June 17, 1997 to July 17, 1997. The public comment period provided the public the opportunity to review the Administrative Record and comment on the Proposed Plan. The public notice also requested public attendance to the public awareness session which would be held on July 17, 1997. There was little public interest in the Proposed Plan. The Navy received no requests for a time extension to the public comment period.

On July 17, 1997, the Navy held the public awareness session in lieu of a public meeting even though there had been no public request for a meeting. The public awareness session was held to respond to public questions, if any, and to accept oral or written public comments on the Proposed Plan. Had there been public comments received, a response to these comments would have been included in the Responsiveness Summary section within this ROD. Fact sheets and a Site Information/Photograph Album, both in English and Spanish, were provided during the public

awareness session to help the public understand the sites better. Navy representatives fluent in English and Spanish and knowledgeable on this project were present at the public awareness session to answer questions.

4.0 SCOPE AND ROLE OF THE RESPONSE ACTION

The “No Action” alternative has been selected for Sites 1 and 3. Current site conditions, environmental analyses, and risk assessments indicate that no action is warranted at Site 1 or Site 3. Though Sites 1 and 3 were formerly used as landfills, the risk to human health and the environment is low. No evidence exists to suggest that the soil or groundwater at either site poses a risk to human health or the environment. No further studies will be conducted at these sites. No previous removal or interim remedial actions have been conducted at Sites 1 and 3, and no future remedial actions are proposed at these sites.

5.0 SUMMARY OF SITE CHARACTERISTICS

This section of the ROD presents an overview of the nature and extent of contamination with respect to the known or suspected sources of contamination, types of contamination, and affected media at Sites 1 and 3. Based upon the initial SI, the ESI, and the site history, the source of contamination involves the former use of Sites 1 and 3 as Base landfills. No additional sources of contamination were identified.

5.1 Initial SI Data Results

The analytical results of the initial SI are discussed in the following paragraphs.

5.1.1 Soil Contamination - Site 1

Nine surface soil samples were collected at Site 1 and analyzed for TCL organics and TAL inorganics during two rounds of sampling. Organic compounds were detected in both rounds of sampling. The organic compounds detected in the first round included acetone (0.023J milligrams per kilogram [mg/kg]), methylene chloride (0.004J mg/kg), (the "J" denotes an estimated concentration), di-n-butylphthalate (0.067J mg/kg), and bis(2-ethylhexyl) phthalate (0.110J mg/kg).

Only bis(2-ethylhexyl)phthalate (0.069J mg/kg) was detected in the second round. The organic compounds were also detected in field, equipment rinsate, or laboratory blanks, and therefore were determined to be laboratory or field induced contaminants. Low levels of inorganics were detected above background levels. Some of the inorganics detected included aluminum (2,990 to 21,300 mg/kg), arsenic (2.5 to 14.7 mg/kg), copper (4.9 to 39.6 mg/kg), and mercury (0.12 to 0.45 mg/kg).

5.1.2 Soil Contamination - Site 3

Seven surface soil samples were collected at Site 3 and analyzed for TCL organics and TAL inorganics during two rounds of sampling. The organics chlorobenzene and toluene were detected at maximum concentrations of 0.041J mg/kg and 0.034J mg/kg during Round 1, respectively. The pesticide 4,4'-DDT (0.036 mg/kg) was detected during Round 2. Low levels of inorganics were detected above background levels. Some of the inorganics detected included arsenic (4.0 to 14.5 mg/kg), calcium (19 to 298,000 mg/kg), copper (6.6 to 41.1 mg/kg), nickel (6.2 to 24.8 mg/kg), and vanadium (41.6 to 118 mg/kg).

5.1.3 Groundwater Contamination - Site 1

Groundwater samples were collected at Site 1 from three monitoring wells and were analyzed for TCL organics and TAL inorganics during two rounds of sampling. Chloroform (16 µg/L and 10 µg/L) and carbon tetrachloride (10 µg/L) were the only organic compounds detected in the sampled groundwater. These detected concentrations were compared to the MCLs. MCLs are standards for public water supplies promulgated under the Safe Drinking Water Act. The MCLs for chloroform and carbon tetrachloride are 100 µg/L and 5 µg/L, respectively. The chloroform detected at Site 1 was below the MCL. The carbon tetrachloride detected exceeded the MCL in one well. Inorganics (in the filtered samples) were not detected above MCLs.

5.1.4 Groundwater Contamination- Site 3

Groundwater samples were collected at Site 3 from three monitoring wells and were analyzed for TCL organics and TAL inorganics during two rounds of sampling. Chloroform was the only organic compound detected at concentrations of 4J µg/L to 8J µg/L. These detected concentrations are

below the MCL of 100 µg/L. Filtered samples of groundwater did not contain any inorganics above MCLs.

5.2 ESI Data Results

The analytical results of the ESI are discussed in the following paragraphs.

5.2.1 Background Soil Contamination - Sites 1 and 3

The background surface soil samples contained inorganics and pesticides. The inorganics were generally below the concentrations detected in the site-specific background soil samples from Sites 1 and 3. Aluminum, arsenic, chromium (as chromium VI), copper, thallium, and vanadium were detected at levels above the range of background concentrations at Site 1 and Site 3. Mercury and selenium were detected at levels above background concentrations at Site 1. Nickel was detected at levels above background concentrations at Site 3. The pesticides aldrin, heptachlor epoxide, 4,4'-DDT, 4,4'-DDE, endrin, endrin aldehyde, endrin ketone, alpha-chlordane, and gamma-chlordane were detected in the background surface soil samples. 4,4'-DDT was the only pesticide detected in the site-specific samples (initial SI for Site 3).

5.2.2 Background Groundwater Contamination - Sites 1 and 3

Chloroform and carbon tetrachloride were the only organic compounds detected in the groundwater. These compounds were detected at concentrations below their MCLs. Groundwater analyzed for total inorganics contained aluminum, arsenic, barium, manganese, and mercury at low concentrations. The dissolved inorganic analyses of groundwater showed the presence of aluminum, barium, and manganese. The concentrations of dissolved and total inorganics were similar due to the utilization of low flow purging techniques. The total and dissolved inorganics were below MCL levels.

6.0 SUMMARY OF SITE RISKS

As part of the SI, a qualitative risk assessment (RA) was performed to determine the potential effects on human health as a result of exposure to contaminants of potential concern (COPCs). As part of

the ESI, a quantitative RA was performed for each site. The following subsections briefly describe the results of the RAs. The SI and the ESI reports contain more extensive information pertaining to the RAs.

6.1 Initial SI Qualitative Risk Assessment

6.1.1 Qualitative RA - Site 1

The chloroform detected in the Site 1 groundwater during Rounds 1 and 2 did not exceed its MCL value. Carbon tetrachloride was detected in one well during both rounds of sampling and did exceed its MCL value. Given the sporadic occurrence of carbon tetrachloride (only detected in one well), the potential for human health effects was determined to be negligible.

Volatile and semivolatile organic constituents were detected in Round 1 and Round 2 soil samples. The phthalate esters di-n-butylphthalate, bis(2-ethylhexyl)phthalate and diethylphthalate were detected in quality control samples, as were the volatile organics acetone and methylene chloride. These chemicals are common laboratory contaminants (USEPA, 1989), therefore, Site 1 soils were not considered further in the RA.

6.1.2 Qualitative RA - Site 3

Chloroform was detected in the groundwater from Site 3 during Rounds 1 and 2. The concentrations detected were below the MCL. Therefore, the qualitative RA concluded that there was no threat to human health or the environment due to chloroform.

Chlorobenzene, toluene, and 4,4'-DDT were detected at low levels in the soil at Site 3 during one round of sampling. The presence of these chemicals was not confirmed by the other round of sampling. The levels detected were below the risk-based criteria (RBC) values. RBC values are risk-based conservative benchmarks developed by USEPA Region III for comparing results of analytical data. Therefore, the RA concluded that there was no threat to human health or the environment from these chemicals.

6.2 ESI Quantitative Risk Assessment

Because of additional questions on the results of the qualitative RA, a quantitative RA was conducted for Sites 1 and 3 to evaluate the potential human health risks associated with exposure to surface soil and groundwater at Sites 1 and 3. The quantitative RA was conducted in accordance with the Risk Assessment Guidance for Superfund (RAGS), Part A, Human Health Evaluation Manual (USEPA, 1989). The results of the quantitative RA for each site are discussed below.

The soil COPCs retained for evaluation in the RA included arsenic, beryllium, chromium, manganese, and vanadium for the soil at Sites 1 and 3. COPCs retained for the Site 1 groundwater included carbon tetrachloride, chloroform, and arsenic. The COPCs retained for the Site 3 groundwater included chloroform, heptachlor epoxide, and arsenic. Tables 1 and 2 contain a summary of the COPCs for soil and groundwater, respectively.

The quantitative RA considered the most likely routes for potential exposure for both current and future exposure scenarios. To calculate the risks, the incremental lifetime cancer risks (ILCRs) were calculated for different scenarios (see Table 3). The ILCR is a number that represents the potential cancer risk that is above the background cancer risk to unexposed individuals. Potential carcinogenic risks were evaluated using the cancer slope factors (CSFs) developed by USEPA (see Table 4) for the COPCs. CSFs have been developed for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. A CSF is multiplied by the estimated chemical intake to generate an upper-bound estimate of the excess lifetime cancer risk associated with exposure to the compound at that intake level. A number called the hazard quotient (HQ) is used to determine the non-carcinogenic effects of chemical exposure. The hazard index (HI) is obtained by adding the HQs for all chemicals, within a medium, that impact a particular receptor population (see Table 5). The HI number is compared to unity (1.0).

The HI is a representation of the chronic daily intake divided by a safe or reference dose (RfD). RfD (see Table 4) is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of adverse effects during a lifetime. Ratios less than one indicate that non-carcinogenic health effects are unlikely. Ratios greater than one indicate the potential for the occurrence of adverse non-carcinogenic health effects.

The human receptors in the vicinity of Sites 1 and 3 include both on-Base and off-Base personnel. This includes resident adults, resident children, and on-site workers. The Base housing areas are approximately 3,500 feet from Site 1 and 1,700 feet from Site 3. The distance to the nearest potable water well is approximately 2,500 feet from Site 3 at the Department of Health and Human Services CPRC. The closest off-Base residence is in the village of Sabana Seca, approximately 1 mile to the northeast of both sites. The potential receptors evaluated in the quantitative RA included on-site workers, present and future adult and child trespassers, on-site future adult and younger child residents, and current on-site adult and younger child residents. See Table 6 for the exposure pathways.

The quantitative RA presented the following conclusions with respect to carcinogenic and non-carcinogenic risks.

Carcinogenic Risk

- For both Site 1 and Site 3 soil, the ingestion ILCRs for the on-site worker, adult trespasser, child trespasser, adult future on-site resident, and the child future on-site resident fell within the USEPA's target risk range of 10^{-4} to 10^{-6} (see Table 3).
- For both Site 1 and Site 3 groundwater, the ILCRs for ingestion of organics and filtered or unfiltered inorganics in groundwater for the residential adult, residential child, and on-site worker fell within the USEPA's target risk range (see Table 3).

Non-carcinogenic Risk

- As shown on Table 5, for Site 1 and Site 3 soil, the HI values for incidental ingestion by on-site workers, adult trespassers, older child trespassers, and future on-site adult residents were less than one indicating no adverse health effects. The total HI for the future on-site resident younger child slightly exceeded unity. Arsenic was a major contributor to the total HI number. None of the individual contaminants that contributed to the total HI are likely to cause adverse health effects.

- For both Site 1 and Site 3 groundwater, none of the scenarios evaluated resulted in HI values that exceeded one, indicating no adverse health effects (see Table 5).

In conclusion, no adverse health effects could be attributed to the contaminants detected in the soil or groundwater at Site 1 or Site 3. One scenario, the future on-site resident younger child with incidental exposure to surface soil, did generate a non-carcinogenic risk. A major contributor to this risk is arsenic which is a naturally occurring element in soil and was detected in the background samples. The individual risk due to arsenic did not exceed one, but when this risk was coupled with the risks from the additional COPCs, the HI exceeded one. However, the COPCs are non-additive since they do not affect similar target organs. Therefore, the RAs concluded that the analytes are not likely to cause adverse health effects to human receptors.

6.3 Uncertainty Analysis

Biological and environmental systems are not directly comparable to associated scientific disciplines such as chemistry and mathematics, due to the natural variability of living systems. A RA is based upon a mixture of sciences with varying levels of certainty, and the final estimation of the RA is only as certain as the least certain component in the estimate. The results of the RA are presented in terms of the potential for adverse effects based upon a number of very conservative assumptions. The tendency to be conservative is an effort to err on the side of the protection of health. The risks are indicators of possible risk, not a true measurement of actual risk. The human health risk evaluation is intended to contribute to the decision-making process and the management of NSGA Sabana Seca by interpreting the significance of the observed contamination.

Uncertainties are encountered throughout the process of performing a RA. The exposure modeling can produce divergent results unless standardized assumptions are used and the possible variation in others are clearly understood. Similarly, toxicological assumptions, such as extrapolating from chronic animal studies to human populations also introduce a great deal of uncertainty into the risk assessment. This section discusses sources of uncertainty inherent in the following elements of the baseline human health RA performed for Sites 1 and 3:

- Hazard assessment and analytical data (environmental chemistry sampling and analysis; misidentification or failure to be all-inclusive in chemical identification).

- Exposure assessment (choice of models and input parameters and fate and transport modeling).
- Toxicity assessment (choice of models or evaluation of toxicological data in dose-response quantification).
- Risk characterization (assumptions concerning exposure scenarios and population quantification).

The variation of any factor used in the calculation of the exposure concentration will have an impact on the total carcinogenic and noncarcinogenic risk. Uncertainties associated with this RA are presented in Table 7 and discussed in the following paragraphs.

6.3.1 Analytical Data and Selection of COPCs

The development of a RA depends on the reliability of uncertainties with the analytical data available to the risk assessor. Analytical data are limited by the precision and accuracy of the methods of analysis. Analytical data are not absolute numbers and variability in sample results is inherent. The amount of variability in analytical results depends upon the sample media and the presence of interfering compounds. In addition, the number of sampling points can also directly affect the reliability of a risk evaluation. However, the potential effects on the overestimation or underestimation of risks is considered to be low.

The contaminant concentration in each medium to which a human receptor could potentially be exposed was estimated by using the maximum detected concentration for each data set. This means that, in general, an attempt was made to err on the side of health-protectiveness.

Analytical results for surface soil and groundwater samples obtained during the ESI were subjected to an independent third party data validation. TCL organics and TAL inorganic data were qualified "J" (estimated) for a number of quality control reasons, therefore, in some instances the maximum concentrations used could be biased high. This was considered to be an acceptable bias, in this case, since conservative risk scenarios were desired for evaluation.

Inorganics were detected in groundwater samples collected from shallow monitoring wells at both sites. A limited number of these analytes exceeded federal groundwater quality standards. The distribution of detected inorganics in groundwater followed no discernible pattern that would indicate a likely source. Additionally, inorganic levels in soil were not elevated to the point where soil would be believed to be considered as the source of groundwater contamination. The concentrations of detected inorganics is higher in the unfiltered (total) samples than in the filtered (dissolved) samples. This indicates that the inorganics detected in groundwater samples at Sites 1 and 3 may be due predominantly to the presence of soil particles entrained in the groundwater samples and may not be attributable to site operations. Arsenic was nonetheless retained as a chemical of potential concern for both sites in the baseline risk assessment.

Similarly, the presence of chloroform may be from a source not associated with Sites 1 and 3, because chloroform was also found in another monitoring well, upgradient from these sites.

6.3.2 Exposure Assessment

In performing exposure assessments, uncertainties arise from two main sources, estimating the transport and fate of a compound in the environment including the estimate for release and transport within a particular environmental medium, and, the estimation of chemical intakes resulting from contact by a receptor with a particular medium. However, the use of the maximum detected soil concentrations in estimating the chronic daily intake, reduces the potential for underestimating exposure at these sites. To estimate an intake, certain assumptions must be made about exposure events, exposure durations, and the corresponding assimilation of constituents by the receptor. Exposure factors have been generated by the scientific community and have undergone review by the USEPA. The USEPA has published an Exposure Factors Handbook which contains the best and latest values. Regardless of the validity of these exposure factors, they have been derived from a range of values generated by studies of limited numbers of individuals. In all instances values used in this risk assessment, scientific judgements, and conservative assumptions agree with those of the USEPA. Conservative assumptions, designed as not to underestimate daily intakes, were employed throughout this risk assessment and are adequately protective of human health.

6.3.3 Toxicity Assessment

In formulating quantitative estimates of the toxicity of varying dosage of a compound to human receptors, uncertainties arise from two sources. First, data on human exposure and the subsequent effects are usually insufficient, if they are available at all. Human exposure data usually lack adequate concentration estimations and suffer from inherent temporal variability. Therefore, animal studies are often used and new uncertainties arise from the process of extrapolating animal results to humans. Second, to obtain observable effects with a manageable number of experimental subjects, high doses of a compound are often used. In this situation, a high dose means that high exposures are used in the experiment with respect to most environmental exposures. Therefore, when applying the results of the animal experiment to the human condition, the effects at the high doses must be extrapolated to approximate effects at lower doses.

In extrapolating effects from high doses in animals to low doses in people, scientific judgment and conservative assumptions are employed. In selecting animal studies for use in dose-response calculations, the following factors are considered:

- Studies are preferred where the animal closely mimics human pharmacokinetics.
- Studies are preferred where dose intake most closely mimics the intake route and duration for humans.
- Studies are preferred which demonstrate the most sensitive response to the compound in question.

Promulgated CSF values represent the 95th percent upper confidence limit (UCL) value derived using the linear multistage statistical model so as to not underestimate carcinogenic potential.

The use of conservative assumptions in the use of maximum detected concentration results in quantitative indices of toxicity that are not expected to underestimate potential toxic effects, but may overestimate these effects by an order of magnitude or more. This conservatism could be further compounded by the use of multiple data bases which contain toxicological indices no longer on line in the Integrated Risk Information System.

For compounds believed to cause threshold effects (i.e. noncarcinogens) safety factors are employed in the extrapolation of effects from animals to humans and from high doses to low doses.

The use of conservative assumptions results in quantitative indices of toxicity that are not expected to underestimate potential toxic effects, but may overestimate these effects by an order of magnitude or more.

6.3.4 Risk Characterization

Uncertainties associated with risk characterization include the assumption of chemical additivity and the inability to predict synergistic or antagonistic interactions between COPCs. These uncertainties are inherent in any inferential risk assessment. USEPA promulgated inputs to the quantitative risk assessment and toxicological indices are calculated to be protective of the human receptor and to err conservatively, so as to not underestimate the potential human health risks.

The baseline human health RA has been conducted with the understanding that there are significant limitations in the data. In particular, these limitations relate to the small sample data set available for consideration.

6.4 Ecological Risk Assessment

The area around Sites 1 and 3 is heavily vegetated. Limestone hills, known as haystack hills, and sinkholes are at least 2,500 feet southwest of Sites 1 and 3. The haystack hills are inhabited by the Puerto Rican Boa, the White-crowned Pigeon, and various plant species that are listed as endangered/threatened species. No ecological RA was conducted at either site because these types of assessments are not included in Federal guidance for conducting SIs.

7.0 DESCRIPTION OF THE “NO ACTION” ALTERNATIVE

The selected remedial action for Sites 1 and 3 is “no action”. No adverse health effects could be attributed to the contaminants detected in the soil or groundwater at Site 1 or Site 3, therefore, no further action is deemed appropriate. “No action” involves taking no further investigative or

remedial actions at the sites and leaving them as they currently are. There are no costs associated with the "no action" alternative.

8.0 RESPONSIVENESS SUMMARY

8.1 Overview

A public comment period was held from June 17, 1997 through July 17, 1997. A public awareness session, in lieu of a public meeting, was held on July 17, 1997. No public comments were received.

8.2 Community Preferences

A record review of the NSGA Sabana Seca files indicates that the community involvement centers mainly on social nature, including the community outreach programs and Base/community clubs. Generally, there are two communities at Sabana Seca: the Base, English speaking community and the surrounding Spanish speaking community. The Base has actively pursued participation from both communities.

For all sites at the Base, community relations activities to date are summarized below:

- Prepared a Community Relations Plan in English and Spanish.
- Prepared Site Information/Photograph Albums in English and Spanish during the public awareness sessions.
- Prepared Fact Sheets in English and Spanish during the public awareness sessions.
- Established the Administrative Record/information repository at two locations (one location was on-Base and one location was off-Base).
- Held Technical Review Committee/Restoration Advisory Board meetings to review the status of the remedial activities on the Base.

- Released Proposed Plans in English and Spanish for public review.

8.3 Summary of Comments Received During the Public Comment Period and Agency Responses

No comments were received during the public comment period, and no comments were received from those who attended the public awareness session. A representative from USEPA and PREQB attended the public awareness session.

9.0 BIBLIOGRAPHY

This bibliography presents a listing of all of the documents that were prepared as part of the Installation Restoration (IR) program at NSGA Sabana Seca. The documents are listed by site in chronological order.

NSGA Sabana Seca - Basewide

- Initial Assessment Study of Naval Security Group Activity, Sabana Seca and Naval Communications Station, Puerto Rico. Greenleaf, Telesca/Ecology and Environment. September 1984.
- Remedial Investigation - Interim Report to Determine Dispersion and Migration of Specific Chemicals, NSGA Sabana Seca, Puerto Rico. Draft. Hunter/ESE, Inc. January 1989.
- Final Work Plan, Remedial Investigation/Feasibility Study for the Naval Security Group Activity, Sabana Seca, Puerto Rico. Versar, Inc. August 1991.
- Site Information/Photograph Album, Naval Security Group Activity, Sabana Seca, Puerto Rico. Draft. Baker Environmental, Inc. May 31, 1996.
- Site Information/Photograph Album, Naval Security Group Activity, Sabana Seca, Puerto Rico. Draft Final. Baker Environmental, Inc., July 15, 1997.

Sites 1 and 3

- Work Plan Addendum for Sites 1 and 3. Site Inspection. NSGA Sabana Seca. Final. Baker Environmental, Inc. February 1993.
- Site Inspection Report for Site 1 South Stone Road Disposal Area. Naval Security Group Activity. Sabana Seca. Puerto Rico. Draft Final. Baker Environmental, Inc., October 1994.
- Site Inspection Report for Site 3 North Stone Road Disposal Area. Naval Security Group Activity. Sabana Seca. Puerto Rico. Draft Final. Baker Environmental, Inc., October 1994.
- Work Plan Addendum for Sites 1 and 3 Expanded Site Inspection. NSGA Sabana Seca. Final. Baker Environmental, Inc., March 1996.
- Expanded Site Inspection for Sites 1 and 3. Naval Security Group Activity. Sabana Seca. Puerto Rico. Final. Baker Environmental, Inc., March 1997.
- Superfund Proposed Plan. Site 1 - South Stone Disposal Area. Site 3 - North Stone Road Disposal Area. U.S. Naval Security Group Activity. Sabana Seca. Puerto Rico. Final. Baker Environmental, Inc., June 1997.
- Record of Decision. Site 1 - South Stone Disposal Area. Site 3 - North Stone Road Disposal Area. U.S. Naval Security Group Activity. Sabana Seca. Puerto Rico. Final. Baker Environmental, Inc.

Sites 2 and 4

- Site Investigation/Risk Assessment Report. Bunker 607 Area (Site 2). Naval Security Group Activity. Sabana Seca. Puerto Rico. Final. Versar, Inc. December 1996.

- Site Investigation/Risk Assessment Report, Pistol Range Disposal Area/Leachate Ponding Area, Site 4/7, Naval Security Group Activity, Sabana Seca, Puerto Rico. Final: Versar, Inc. December 1996.
- Superfund Proposed Plan, Site 2 - Bunker 607 Disposal Area, Site 4 - Pistol Range Disposal Area, U.S. Naval Security Group Activity, Sabana Seca, Puerto Rico. Final: Baker Environmental, Inc. June 1997.
- Record of Decision, Site 2 - Bunker 607 Disposal Area, Site 4 - Pistol Range Disposal Area, U.S. Naval Security Group Activity, Sabana Seca, Puerto Rico. Final: Baker Environmental, Inc.

Site 5

- USEPA issued No Further Response Action Planned concurrence letter. July 1994.

Site 6

- Superfund Proposed Plan, Site 6 - Former Pest Control Shop, U.S. Naval Security Group Activity, Sabana Seca, Puerto Rico. Baker Environmental, Inc., March 1996.
- Remedial Investigation/Feasibility Study, Pest Control Shop, Site 6, Naval Security Group Activity, Sabana Seca, Puerto Rico. Versar, Inc., May 1996.
- Final Design, Installation of Asphalt Cap, Site 6, Former Pest Control Shop, U.S. Naval Security Group Activity, Sabana Seca, Puerto Rico. Baker Environmental, Inc., May 1996 (signed July 1996).
- Record of Decision, Site 6, Former Pest Control Shop, Naval Security Group Activity, Sabana Seca, Puerto Rico. Final: Baker Environmental, Inc., September 1996.

- Work Plan for Installation of Asphalt Cap, Site 6, Former Pest Control Shop, NSGA Sabana Seca. Final. OHM, Incorporated. January 1997.
- Remedial Action Report for Asphalt Cap at Site 6, Former Pest Control Shop, NSGA Sabana Seca. Final. OHM, Inc. August 1997.

Site 7

- Leachate Diversion/Feasibility Study, Naval Security Group Activity, Sabana Seca, Puerto Rico. Final. Baker Environmental, Inc. December 1996.
- USEPA issued No Further Response Action Planned concurrence letter, February 1997.

TABLES

TABLE 1

**CONTAMINANTS OF POTENTIAL CONCERN FOR THE HUMAN HEALTH RISK ASSESSMENT
SURFACE SOIL DATA SUMMARY
RANGE OF INORGANIC POSITIVE DETECTIONS
FOR BACKGROUND, SITES 1 AND 3
NAVAL SECURITY GROUP ACTIVITY
SABANA SECA, PUERTO RICO**

Inorganic Analytes	Range of Background Concentrations (mg/kg)	Site 1 Range of Positive Detections (mg/kg)	Site 3 Range of Positive Detections (mg/kg)
Aluminum	876-8,290	2,990-21,300	6,410-14,300
Antimony	0.21L-1.8L	ND	ND
Arsenic	1.0-7.8	2.5-14.7	4.0-14.5
Barium	2.1-49.8	2.0-12.9	5.6-35.2
Beryllium	0.11-0.57	0.22-0.27	0.24-0.45
Cadmium	0.14-0.94	ND	ND
Calcium+	422-243,000	349-3,480	019-298,000
Chromium (as Chromium VI)	2.8-35.6	7.9-83.1	12.7-43
Cobalt	1.2-15.6	2.0-5.5	3.1-9.2
Copper	5.2-32.9	4.9-39.6	6.6-41.1
Iron+	1,910-20,000	4,050-25,700	6,330-26,500
Lead	1.6-116	3.8-21.2	2.1-25.3
Magnesium+	98.1-4,970	125-1,120	198-4,060
Manganese	20.8-1,940	27.7-205	17.7-295
Mercury	0.11-0.31	0.12-0.45	ND
Nickel	1.6-15.7	5.2-11	6.2-24.8
Potassium+	45.8-1.27	74.5-211	117-362
Selenium	0.24-1.2	0.47-1.6	0.59-1.2
Silver	1.3-2.8	ND	ND
Sodium+	12.6-327	43.1-82.8	80.7-208
Thallium	0.1-0.31	0.48	0.47
Vanadium	10.5-60.4	23.8-139	41.6-118
Zinc	6.7-80.9	7.9-74	11-57.6
Cyanide	0.3-1.2	ND	ND

Note: Shading indicates occurrences of background exceeding corresponding sample concentrations measured at both sites.

Mg/kg = milligrams per kilogram

ND = not detected

TABLE 2
CONTAMINANTS OF POTENTIAL CONCERN
FOR THE HUMAN HEALTH RISK ASSESSMENT
GROUNDWATER DATA SUMMARY
ESI, ROUND 4⁽¹⁾
SITES 1 AND 3
NAVAL SECURITY GROUP ACTIVITY
SABANA SECA, PUERTO RICO

Constituent ⁽²⁾	Range of Background Concentrations ⁽³⁾ (µg/L)	Range of Positive Detections (Low-flow purge sampling method)			
		Site 1		Site 3	
		Total (µg/L)	Dissolved (µg/L)	Total (µg/L)	Dissolved (µg/L)
Volatiles:					
Carbon tetrachloride (5)	ND	4J	NA	ND	NA
Chloroform (100)	ND	9J - 10	NA	3J - 7J	NA
Toluene (1,000)	4J	ND	NA	ND	NA
Pesticides:					
Heptachlor epoxide(0.2)	0.06NJ	ND	NA	0.06NJ	NA
Inorganics:					
Aluminum (--)	141 - 376	117 - 637	98.9 - 131	107 - 141	102 - 141
Arsenic (50)	2	1.2	1.7	1.1 - 1.9	ND
Barium (2,000)	25.2 - 42.6	16.2 - 19.9	15.2 - 18.1	16.2 - 23.7	13.9 - 21.7
Calcium+ (--)	101,000 - 115,000	83,800 - 106,000	81,700 - 103,000	78,800 - 105,000	77,600 - 103,000
Iron+ (--)	1,490	1,460	ND	ND	ND
Magnesium+ (--)	5,160 - 5,200	3,760 - 6,450	3,730 - 6,320	3,690 - 5,300	3,820 - 5,190
Manganese (--)	55.2 - 292	10.9B - 50.4	11.4 - 27.5	55.5	63.4
Mercury (2)	6.4 ⁽⁴⁾	0.21	ND	ND	ND
Potassium+ (--)	2,040 - 1,560	1,410 - 1,790	1,310 - 1,890	ND	926 - 1,510
Selenium (50)	ND	ND	2.3J	ND	1.1J
Sodium+ (--)	15,500 - 37,200	16,300 - 33,000	16,600 - 32,100	13,000 - 30,400	13,400 - 30,500

Notes:

⁽¹⁾ Rounds 3 and 4 data similar; Round 4 presented since it is the most recent data.

⁽²⁾ Values in parentheses represent Federal MCLs (µg/L). Exceedences of MCL are shaded. (--) indicates no MCLs are available.

⁽³⁾ Dissolved concentrations not presented, but are similar to totals due to low flow techniques.

⁽⁴⁾ Location S3BW01(Bataan Rd.); detected also during round 3 at 6.5 µg/L.

NA - Not applicable

ND - Not detected

+ - Essential nutrient

J - Estimated value

N - Tentative identification; consider present.

B - Reported value is less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit.

µg/L - micrograms per liter

TABLE 3

**SUMMARY OF INCREMENTAL LIFETIME CANCER RISKS
INGESTION EXPOSURES TO SURFACE SOIL COPCs
TRESPASSERS, ON-SITE WORKERS, AND FUTURE ON-SITE RESIDENTS
SITE 1 AND 3
NAVAL SECURITY GROUP ACTIVITY
SABANA SECA, PUERTO RICO**

	On-site Workers	Local Resident Trespassers		Future On-site Residents	
		Adult	Older Child	Adult	Young Child
Site 1	4.1E-06	4.7E-07	2.7E-07	1.4E-05	2.5E-05
Site 3	4.1E-06	4.8E-07	2.7E-07	1.4E-05	2.6E-05

**SUMMARY OF INCREMENTAL LIFETIME CANCER RISKS
INGESTION EXPOSURE TO ORGANIC AND UNFILTERED AND
FILTERED INORGANIC GROUNDWATER COPCs
FUTURE ADULT AND YOUNG CHILD RESIDENTS
SITE 1 AND 3
NAVAL SECURITY GROUP ACTIVITY
SABANA SECA, PUERTO RICO**

Site	Residential Adult		Residential Young Child	
	Unfiltered Groundwater	Filtered Groundwater	Unfiltered Groundwater	Filtered Groundwater
Site 1	2.8E-05	3.7E-05	1.3E-05	1.7E-05
Site 3	4.0E-05	6.9E-06	1.9E-05	3.2E-06

**SUMMARY OF INCREMENTAL LIFETIME CANCER RISKS
INGESTION EXPOSURES TO ORGANIC AND UNFILTERED AND
FILTERED INORGANIC GROUNDWATER COPCs
CURRENT ADULT AND YOUNG CHILD RESIDENTS, ON-SITE WORKERS
SITE 1 AND 3
NAVAL SECURITY GROUP ACTIVITY
SABANA SECA, PUERTO RICO**

Site	Residential Adult		Residential Young Child		On-site Workers	
	Unfiltered Groundwater	Filtered Groundwater	Unfiltered Groundwater	Filtered Groundwater	Unfiltered Groundwater	Filtered Groundwater
Site 1	3.7E-06	4.9E-06	8.7E-06	1.1E-05	8.3E-06	1.1E-05
Site 3	5.4E-06	9.2E-07	1.3E-05	2.2E-06	1.2E-05	2.1E-06

TABLE 4
TOXICITY VALUES - RfD AND SLOPE FACTORS
SITES 1 AND 3
TOXICITY FACTORS FOR CHEMICALS OF POTENTIAL CONCERN
NAVAL SECURITY GROUP ACTIVITY
SABANA SECA, PUERTO RICO

Chemical	Oral CSF (mg/kg/day) ⁻¹	Tumor Types (carcinogens)	Oral RfD (mg/kg/day)	Critical Effects (Systemic Toxicants)	USEPA Weight-of- Evidence
Carbon Tetrachloride	$1.3 \times 10^{-1(1)}$	Liver tumors	$7.0 \times 10^{-4(1)}$	Central nervous system (CNS), kidney and liver effects	B2
Chloroform	$6.1 \times 10^{-3(1)}$	Renal tumors	$1.0 \times 10^{-2(1)}$	CNS, liver, kidney and cardiovascular effects	B2
Heptachlor Epoxide	9.1 ⁽¹⁾	Liver tumors	$1.3 \times 10^{-5(1)}$	Increased liver weight	B2
Arsenic	1.5 ⁽²⁾	Liver, kidney, lung, bladder and skin tumors	0.0003 ⁽²⁾	Liver, cardiovascular, CNS, and tissue respiration effects. Also, keratosis and hyperpigmentation.	A
Beryllium	4.3 ⁽²⁾	Lung tumors	0.005 ⁽²⁾	Respiratory effects and berylliosis.	B2
Chromium	NA	NA	$5.0 \times 10^{-3(1)}$	Renal tubular necrosis and hepatic effects.	D
Manganese	NA	NA	0.023 ⁽²⁾	CNS effects.	D
Vanadium	NA	NA	$7.0 \times 10^{-3(1)}$	Gastrointestinal disturbances and discoloration of the mouth and tongue.	D

Notes:

⁽¹⁾ USEPA, 1996a. USEPA Region III Risk-Based Concentration Table, January - June 1996.

⁽²⁾ USEPA, 1996b. Integrated Risk Information System (IRIS).

NA = Not Available
mg/kg/day = milligrams per kilogram per day
CSF = cancer slope factor
RfD = reference dose

TABLE 5

**SUMMARY OF HAZARD INDICES
 INGESTION EXPOSURE TO SURFACE SOIL COPCs
 TRESPASSERS, ON-SITE WORKERS AND FUTURE ON-SITE RESIDENTS
 SITE 1 AND 3
 NAVAL SECURITY GROUP ACTIVITY
 SABANA SECA, PUERTO RICO**

Site	On-site Workers	Local Resident Trespassers		Future On-site Residents	
		Adult	Older Child	Adult	Young Child
Site 1	0.05	<0.01	0.01	0.13	1.2
Site 3	0.04	<0.01	0.01	0.12	1.1

**SUMMARY OF HAZARD INDICES
 INGESTION EXPOSURE TO ORGANIC AND UNFILTERED AND
 FILTERED INORGANIC GROUNDWATER COPCs
 FUTURE ADULT AND YOUNG CHILD RESIDENTS
 SITE 1 AND 3
 NAVAL SECURITY GROUP ACTIVITY
 SABANA SECA, PUERTO RICO**

Site	Residential Adult		Residential Young Child	
	Unfiltered Groundwater	Filtered Groundwater	Unfiltered Groundwater	Filtered Groundwater
Site 1	0.29	0.34	0.68	0.79
Site 3	0.32	0.15	0.74	0.34

**SUMMARY OF HAZARD INDICES
 INGESTION EXPOSURES TO ORGANIC AND UNFILTERED AND
 FILTERED INORGANIC GROUNDWATER COPCs
 CURRENT ADULT AND YOUNG CHILD RESIDENTS, ON-SITE WORKERS
 SITE 1 AND 3
 NAVAL SECURITY GROUP ACTIVITY
 SABANA SECA, PUERTO RICO**

Site	Residential Adult		Residential Young Child		On-site Workers	
	Unfiltered Groundwater	Filtered Groundwater	Unfiltered Groundwater	Filtered Groundwater	Unfiltered Groundwater	Filtered Groundwater
Site 1	0.29	0.34	0.68	0.79	0.1	0.12
Site 3	0.32	0.15	0.74	0.34	0.11	0.05

TABLE 6

**EXPOSURE PATHWAYS
EXPOSURE INPUT PARAMETERS FOR CURRENT AND FUTURE RESIDENT ADULTS AND CHILDREN
POTENTIALLY EXPOSED TO SURFACE SOIL AND GROUNDWATER COPCs AT
SITES 1 AND 3
NAVAL SECURITY GROUP ACTIVITY
SABANA SECA, PUERTO RICO**

Input Parameter	Media	Units	Future Receptor		Current Receptor		Comments/ References
			Child	Adult	Child	Adult	
ED, Exposure Duration	Groundwater	year	6	30	4	4	USEPA, 1991 and Professional Judgement
	Soil	year	6	30	--	--	USEPA, 1991
EF, Exposure Frequency	Groundwater	day/year	350	350	350	350	USEPA, 1991
	Soil	day/year	350	350	--	--	USEPA, 1991
IR, Ingestion Rate	Groundwater	L/day	1	2	1	2	USEPA, 1991
	Soil	mg/day	200	100	--	--	USEPA, 1991
AT, Averaging Time AT _{nc} , noncarcinogenic	Groundwater	day	2,190	10,950	1,460	1,460	USEPA, 1989 and Professional Judgement
	Soil	day	2,190	10,950	--	--	USEPA, 1989
AT _c , carcinogenic	Soil/Groundwater	day	25,550	25,550	25,550	25,550	USEPA, 1989
BW, Body Weight	Soil/Groundwater	kg	15 ⁽¹⁾	70	15 ⁽¹⁾	70	USEPA, 1989

References:

USEPA, 1989. Risk Assessment Guidance for Superfund Volume I - Human Health Evaluation Manual (Part A) Interim Final.

USEPA, 1991. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual Supplemental Guidance. "Standard Default Exposure Factors." Interim Final.

Notes: ⁽¹⁾ Body weight for younger child of age 0 to 6 years.

TABLE 7

**SUMMARY OF UNCERTAINTIES IN THE RESULTS OF THE
HUMAN HEALTH RISK ASSESSMENT
SITES 1 AND 3
NAVAL SECURITY GROUP ACTIVITY
SABANA SECA, PUERTO RICO**

Uncertainty	Potential Magnitude for Over-Estimation of Risks	Potential Magnitude for Under-Estimation of Risks	Potential Magnitude for Over or Under- Estimation of Risks
<u>Hazard Assessment and Analytical Data</u>			
Sufficient samples may not have been taken to characterize the media being evaluated.			Moderate
Systematic or random errors in the chemical analysis may yield erroneous data.			Low
The use of the maximum detected concentration in the estimation of the CDI/DAD.	Moderate		
<u>Exposure Assessment</u>			
The standard assumptions regarding body weight, exposure period, life expectancy, population characteristics, and lifestyle may not be representative of the actual exposure situations.			Low
<u>Toxicological Assessment</u>			
Toxicological indices derived from high dose animal studies, extrapolated to low dose human exposure.	Moderate		
<u>Risk Characterization</u>			
Assumption of additivity in the quantitation of cancer risks without consideration of synergism, antagonism, promotion, and initiation.			Moderate
Assumption of additivity in the estimation of systemic health effects without consideration of synergism, antagonism, etc.			Low
Additivity of carcinogenic risks by individual exposure pathways (ingestion and dermal).			Low

Notes:

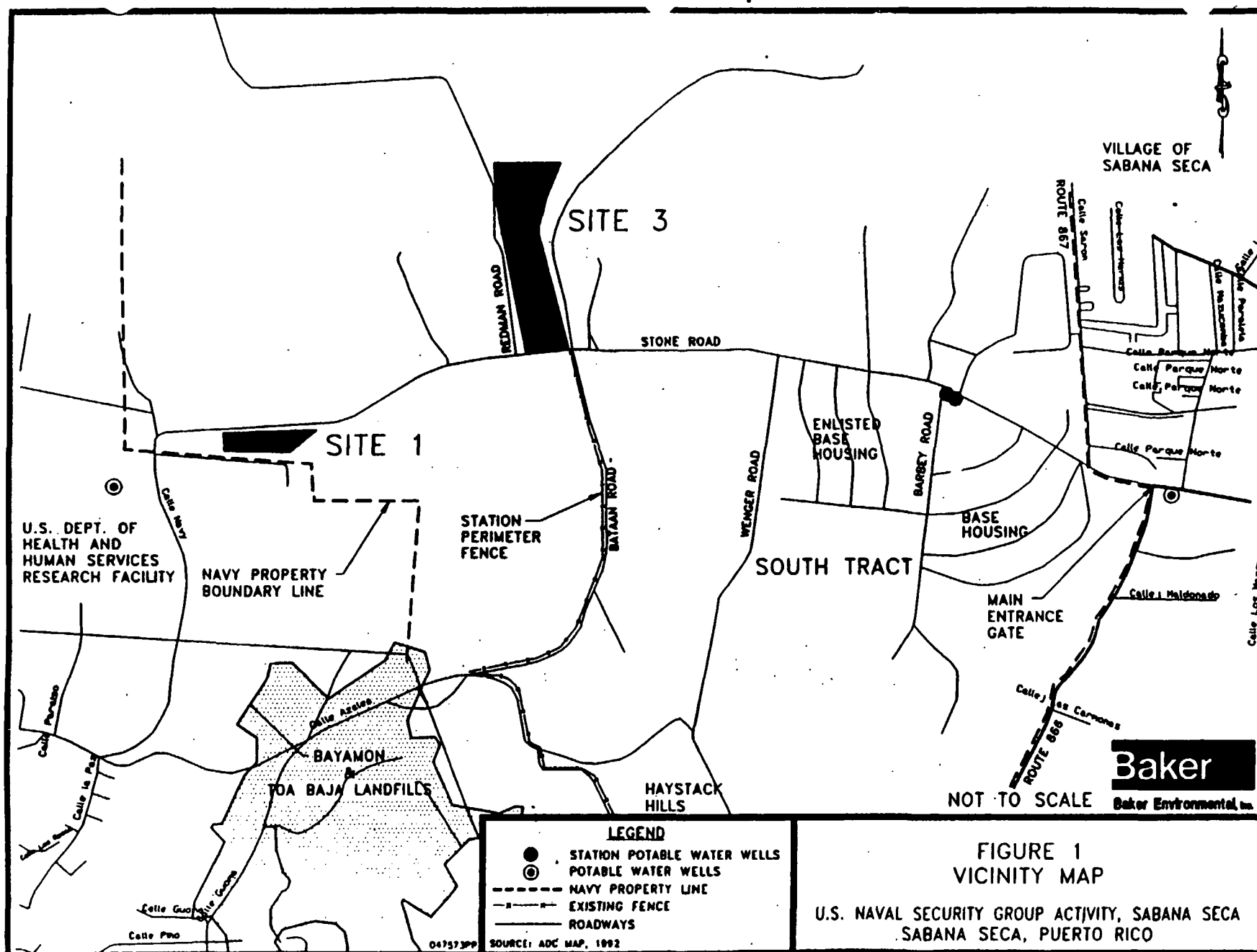
Low - Assumptions categorized as "low" may effect risk estimates by less than one order of magnitude.

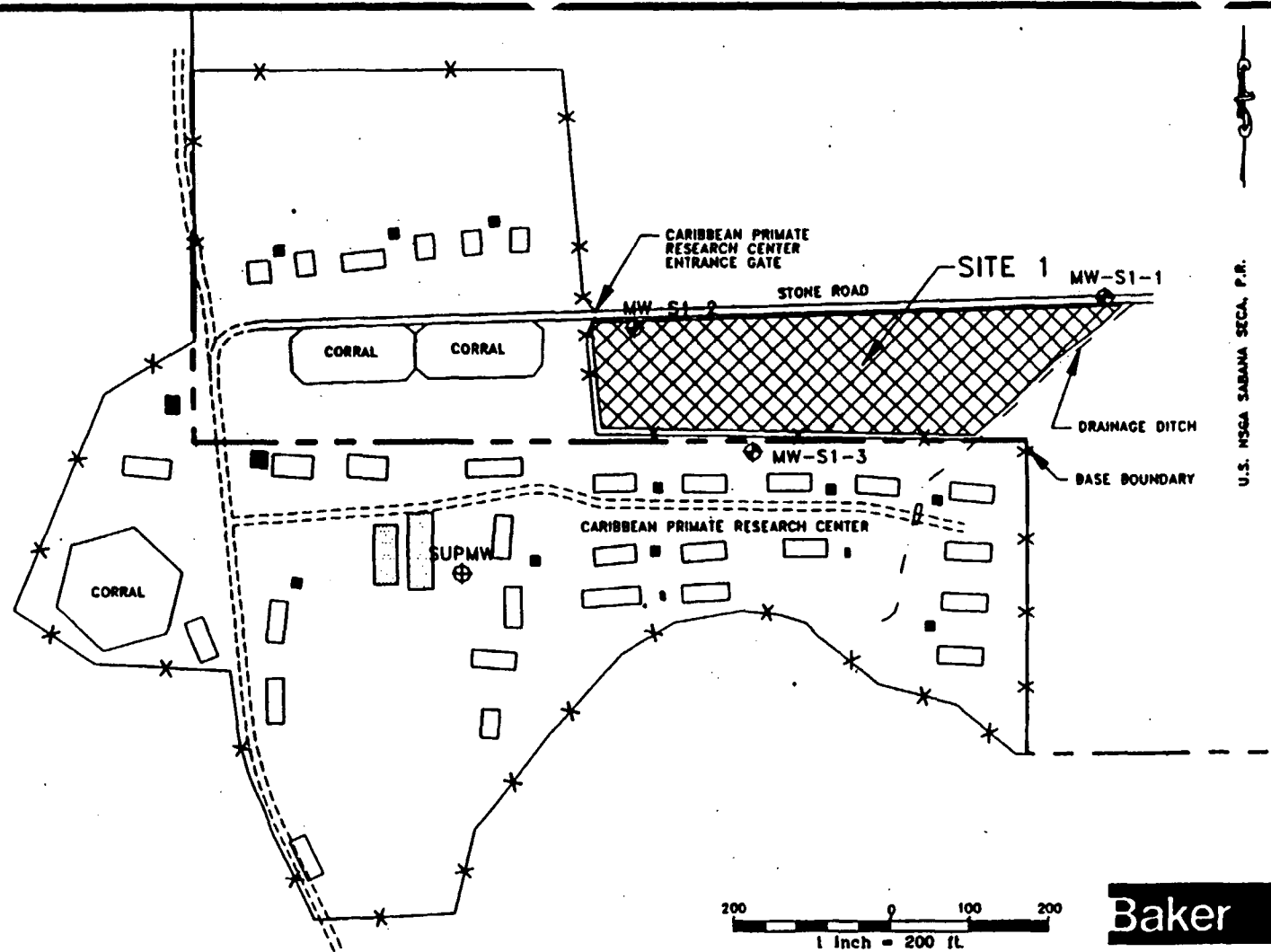
Moderate - Assumptions categorized as "moderate" may effect estimates of risk by between one and two orders of magnitude.

High - Assumptions categorized as "high" may effect estimates of risk by more than two orders of magnitude.

Source: Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). (USEPA, 1989).

FIGURES





U.S. NSGA SABANA SECA, P.R.

200 0 100 200
1 inch = 200 ft

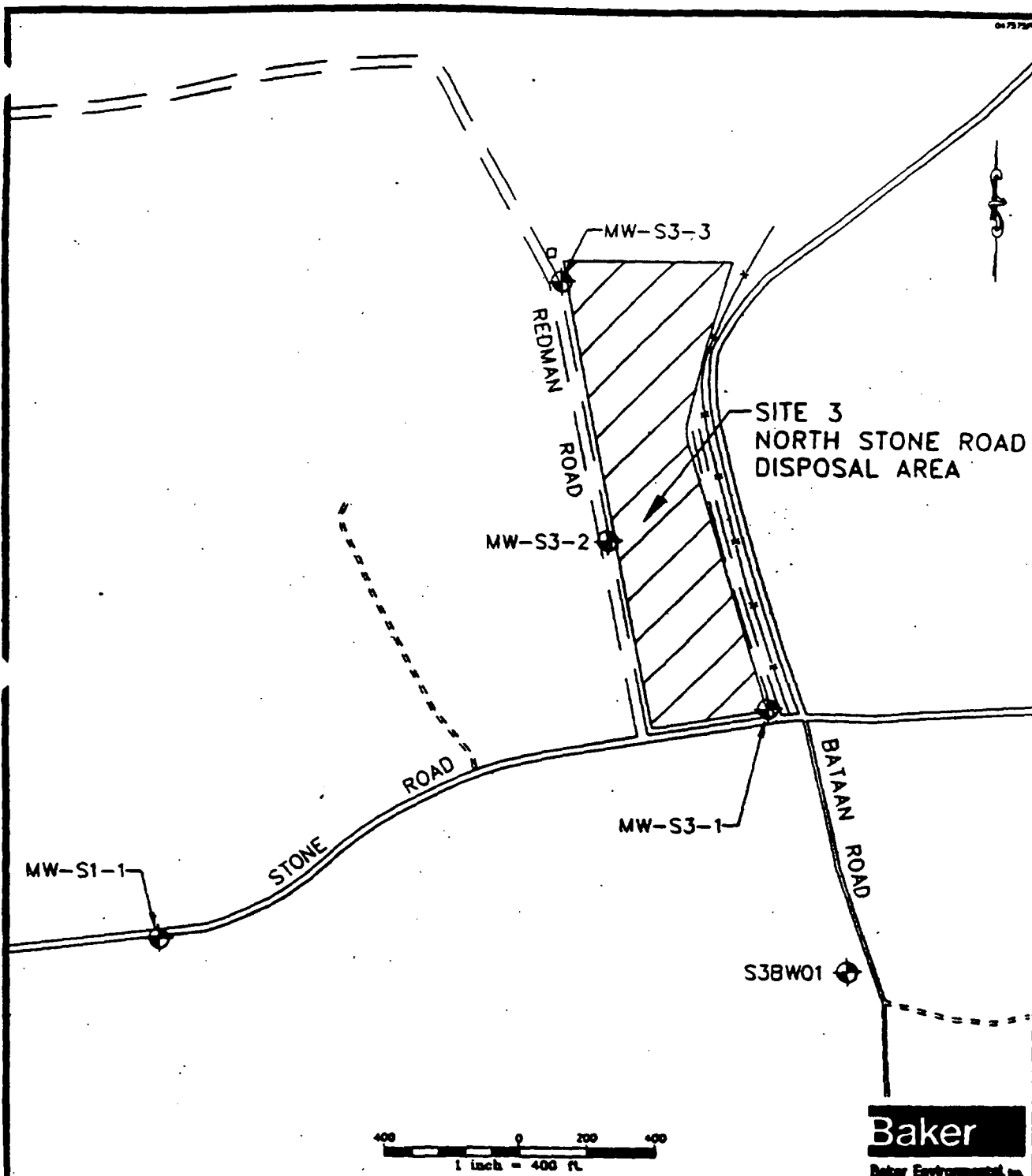
Baker
Baker Environmental, Inc.

LEGEND

- DIRT ROAD
- ⊠ - APPROXIMATE AREA OF SITE
- x-x- FENCE LINE
- MW-S1-3 - MONITORING WELL LOCATION
- ⊕ - SEPTIC TANKS
- SUPMW - SUPPLY WELL

FIGURE 2
SITE PLAN
SITE 1

U.S. NAVAL SECURITY GROUP ACTIVITY, SABANA SECA
SABANA SECA, PUERTO RICO



LEGEND

MW-S3-1



WELL LOCATION



APPROXIMATE AREA OF SITE



FENCE LINE

SOURCE: HOGGARD/EURE ASSOCIATES, APRIL 1993

FIGURE 3 SITE PLAN SITE 3

U.S. NAVAL SECURITY GROUP ACTIVITY, SABANA SECA
SABANA SECA, PUERTO RICO

ROD FACT SHEET

SITE

Name : Naval Security Group Activity
Location/State : Sabana Seca, Puerto Rico
EPA Region : II
HRS Score (date): 34.28, 6-24-88
Site ID # : PR4170027383

ROD

Date Signed: 9-30-97
Remedy/ies: No Action
Operating Unit Number: OU-3 (Sites 1&3).
Capital cost: NA
Construction Completion: NA
O & M: NA
Present worth: NA

LEAD

Remedial/Enforcement: Remedial
EPA/State/PRP: PRP, Federal Facility
Primary contact(phone): Paul G. Ingrisano, (212) 637-4337
Secondary contact(phone): Robert Wing (212) 637-4332
Main PRP(s): U.S. Navy
PRP Contact(phone): Linda Saksvig, (757) 322-4793

WASTE

Type (metals, PCB, etc.): Sites 1&3, Solid Waste.
Medium (soil, g.w., etc.): Sites 1&3, soil & groundwater.
Origin: Site 1, 2 acre landfill; Site 3, 11 acre landfill.
Est. quantity (cu.yd., gal., # drums, etc.): Site 1, 3,300 tons;
Site 3, 1,800 tons.