# DECISION DOCUMENT FOR SITE 1 TRUMAN ANNEX DISPOSAL AREA AND SITE 8 FLEMING KEY SOUTH LANDFILL NAS KEY WEST FL

9/1/2000

TETRA TECH NUS

# DECISION DOCUMENT
## FOR
# IR 1 AND IR 8

## Naval Air Station
## Key West, Florida

## Southern Division
## Naval Facilities Engineering Command

**Contract Number N62467-94-D-0888**

**Contract Task Order 0007**

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# DECISION DOCUMENT FOR IR 1 AND IR 8

## NAVAL AIR STATION
## KEY WEST, FLORIDA

**COMPREHENSIVE LONG-TERM**
**ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:**
**Southern Division**
**Naval Facilities Engineering Command**
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| | |
|---|---|
| ARAR | Applicable or Relevant and Appropriate Requirement |
| B&RE | Brown and Root Environmental, Inc. |
| BEI | Bechtel Environmental, Inc. |
| BRAC | Base Realignment and Closure |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| COC | Chemical of Concern |
| COPC | Chemical of Potential Concern |
| CSF | Cancer Slope Factor |
| ECC | Ecological Chemical of Concern |
| EPA | United States Environmental Protection Agency |
| EPC | Exposure-Point Concentration |
| ERA | Ecological Risk Assessment |
| ERNA | Environmental Restoration, Navy Account |
| F.A.C. | Florida Administrative Code |
| FDEP | Florida Department of Environmental Protection |
| FFS | Focused Feasibility Study |
| FNAI | Florida Natural Areas Inventory |
| FS | Feasibility Study |
| HHRA | Human Health Risk Assessment |
| HI | Hazard Index |
| HQ | Hazard Quotient |
| ILCR | Incremental Lifetime Cancer Risk |
| IR | Installation Restoration |
| IRA | Interim Remedial Action |
| LUC | Land-Use Control |
| LUCIP | Land-Use Control Implementation Plan |
| mg/kg | Milligram Per Kilogram |
| mg/kg/day | Milligram Per Kilogram Per Day |
| µg/kg | Microgram Per Kilogram |
| µg/L | Microgram Per Liter |
| MOA | Memorandum of Agreement |
| NAS | Naval Air Station |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NPL | National Priorities List |
| PAH | Polynuclear Aromatic Hydrocarbon |
| PCB | Polychlorinated Biphenyl |

| | |
|---|---|
| RAB | Restoration Advisory Board |
| RBC | Risk-Based Concentration |
| RCRA | Resource Conservation and Recovery Act |
| RfD | Reference Dose |
| RFI | RCRA Facility Investigation |
| RI | Remedial Investigation |
| RME | Reasonable Maximum Exposure |
| SARA | Superfund Amendments and Reauthorization Act |
| SSC | Species of Special Concern |
| SI | Site Inspection |
| SVOC | Semi-Volatile Organic Compound |
| TRC | Technical Review Committee |
| TtNUS | Tetra Tech NUS, Inc. |
| U.S.C. | United States Code |
| VOC | Volatile Organic Compound |

# 1.0 THE DECLARATION

## 1.1 SITE NAMES AND LOCATIONS

The following Naval Air Station (NAS) Key West sites are addressed by this Decision Document:

- Truman Annex Refuse Disposal Area - Installation Restoration (IR) 1
- Fleming Key South Landfill - IR 8

The Truman Annex Refuse Disposal Area is located on Key West and the Fleming Key South Landfill is located on Fleming Key.

## 1.2 STATEMENT OF BASIS AND PURPOSE

This combined Decision Document presents the selected remedies for the Installation Restoration Program sites IR 1 and IR 8 at NAS Key West, Florida. The remedial decisions for these sites were made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The selected remedies are based on site data (available for review in the information repository for NAS Key West) and prior decisions made by the NAS Key West Partnering Team made up of representatives from the U.S. Navy, the U.S. Environmental Protection Agency (EPA), and the Florida Department of Environmental Protection (FDEP).

## 1.3 DESCRIPTION OF THE SELECTED REMEDIES

The remedies selected in this Decision Document address the remaining contamination, controls that are required to prevent/minimize exposure, and monitoring that will be performed to identify and prevent potential future adverse impacts to human health and the environment.

### 1.3.1 IR 1 - Truman Annex Refuse Disposal Area

The selected remedy is to provide Land-Use Controls (LUCs) with performance monitoring of groundwater, sediment, and biota quality. The remedy selected for IR 1 addresses contamination remaining in groundwater and sediment following the removal of approximately 4,878 cubic yards of contaminated soil in 1995 as part of an Interim Remedial Action (IRA). The major components of the selected remedy are LUCs (limited site access) and performance monitoring.

### 1.3.2 IR 8 - Fleming Key South Landfill

The selected remedy for the Fleming Key South Landfill (IR 8) is LUCs with performance monitoring of groundwater. The remedy selected for IR 8 addresses contamination remaining in groundwater. The major components of the remedy are LUCs (limited site access) and monitoring of groundwater.

## 1.4 DECLARATION STATEMENT

It has been determined by the Navy, EPA, and FDEP that LUCs with performance monitoring as described in Section 1.3 and further detailed in Section 2.6 will be required at Truman Annex Refuse Disposal Area (IR 1) and Fleming Key South Landfill (IR 8). LUCs are considered to be protective of human health and the environment under current industrial uses at IR 1 and IR 8.

By a separate Memorandum of Agreement (MOA) dated August 31, 1998, with EPA and FDEP, NAS Key West, on behalf of the Department of the Navy, agreed to implement certain base-wide periodic site inspection, condition certification, and agency notification procedures designed to ensure the maintenance by NAS Key West personnel of any site-specific LUCs deemed necessary for future protection of human health and the environment. A fundamental premise underlying execution of that agreement was that, through the Navy's substantial good faith compliance with the procedures called for therein, reasonable assurance would be provided to EPA and FDEP as to the permanency of those remedies which include the use of specific LUCs.

Although the terms and conditions of the MOA are not specifically incorporated or made enforceable herein by reference, it is understood and agreed by the Navy, EPA, and FDEP that the contemplated permanence of the remedies reflected herein shall be dependent upon the Station's substantial good faith compliance with the specific LUCs maintenance commitments reflected therein. Should such compliance not occur or should the MOA be terminated, it is understood that the protectiveness of the remedy may be reconsidered and that additional measures may need to be taken to adequately ensure necessary future protection of human health and the environment.

## 1.5 SIGNATURE AND ACCEPTANCE OF THE REMEDY

Capt. Lawrence S. Cotton, Jr., United States Navy Date
Commanding Officer
Naval Air Station
Key West, Florida

FDEP concurrence of the remedies for IR 1 and IR 8 is documented in Appendix B. FDEP has issued a separate letter of concurrence.

# 2.0 DECISION SUMMARY

## 2.1 SITE NAMES, LOCATIONS, DESCRIPTIONS, AND HISTORICAL INFORMATION

This Decision Document is issued to describe the Department of the Navy's selected remedies for the Truman Annex Refuse Disposal Area (IR 1) and the Fleming Key South Landfill (IR 8) located at NAS Key West, Florida (Figure 2-1).

These sites have been investigated or remediated under the NAS Key West Environmental Restoration, Navy Account (ERNA) program. The histories of these sites have been developed primarily from the Supplemental Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Remedial Investigation (RI) for Eight Sites (B&RE, 1998a) and the Sediment Toxicity Report for Sites IR 1 and 8 (TtNUS, 1999a). Summaries of the site histories are provided in the following paragraphs.

### 2.1.1 IR 1 - Truman Annex Refuse Disposal Area

The Truman Annex Refuse Disposal Area (IR 1) (Figure 2-2) is located at the southwest end of Key West. IR 1 encompasses approximately seven acres and consists primarily of a Navy antenna facility. A chain-link fence surrounds the site and access to IR 1 is strictly controlled. The main sewer outfall line for Key West runs through the property. Treated sewage is pumped into the ocean at an outfall point 3,600 feet southwest of IR 1. From 1952 until the mid-1960s, the Truman Annex Refuse Disposal Area was used for general refuse disposal and open burning. No restrictions were placed on the types of wastes disposed at the site. General refuse, waste paint thinners, and solvents may have been disposed of at the site.

### 2.1.2 IR 8 - Fleming Key South Landfill

The Fleming Key South Landfill covers approximately 45 acres on the southwest portion of Fleming Key (Figure 2-3). The City of Key West Sewage Treatment Plant borders the southeast portion of the site. An ammunition storage area is located along the east boundary of the site. The Gulf of Mexico borders the remainder of the site. A closed canopy of Australian pines covers most of IR 8. The western portion of the site contains piles of metal debris (heavy equipment, desks, marine equipment, etc.).

As many as 8,000 tons per year of unknown waste were reportedly disposed at the landfill between 1962 and 1982. The waste disposal activities of the City of Key West were combined with those of the Navy

from 1968 to 1982 at this site. Waste materials and fill from Sigsbee Key (also known as Dredgers Key) were also disposed of at the site between 1948 and 1951. The open trench disposal method was practiced at IR 8. Trenches were typically 25 feet wide, 10 feet deep, and 500 to 1,000 feet long. Due to seepage from groundwater, the trenches were partially full of sea water when waste disposal occurred. Combustible wastes were taken to the western portion of the site and burned. The ash and unburned wastes were then deposited in the western portion of the landfill.

## 2.2 PREVIOUS INVESTIGATIONS AND ENFORCEMENT ACTIVITIES

### 2.2.1 Previous Investigations

The following summaries of previous investigations are based on information from the Supplemental RFI/RI (B&RE, 1998a), the Sediment Toxicity Report for Sites IR 1 and 8 (TtNUS, 1999a), and material provided by the NAS Key West Partnering Team.

#### 2.2.1.1 IR 1 - Truman Annex Refuse Disposal Area

Several investigations have been performed at IR 1 since the mid-1980s to identify, confirm, or delineate contamination. In 1986, Geraghty and Miller performed a preliminary investigation at IR 1 (Geraghty and Miller, 1987). Analytical results indicated that metals were present in the groundwater and soil, and that hydrocarbons were present in the groundwater. Based on the results of the preliminary investigation, IT Corporation performed a preliminary RI at IR 1 in 1990 (IT, 1991). The preliminary RI indicated the presence of metals in groundwater and suggested that migration of metals toward the Atlantic Ocean could be occurring. Further investigation was recommended to determine the extent of contamination.

In 1993, IT Corporation performed an RFI/RI that concluded that sediment surrounding the edge of the site had been contaminated with metals, certain pesticides, and polychlorinated biphenyls (PCBs), and that groundwater was contaminated by metals and trace amounts of certain pesticides. Metal contamination in soil at the site also appeared to be extensive. The Final RFI/RI Report prepared by IT Corporation (IT, 1994) recommended additional sampling, the performance of a focused feasibility study (FFS) and an IRA, and conducting a baseline human health risk assessment (HHRA) based on post-IRA sampling data.

Subsequent to the submittal of a Draft Supplemental RFI/RI Workplan by ABB Environmental Services in 1995 (ABB, 1995), a Delineation Study focusing on metals was performed by Bechtel Environmental, Inc. (BEI) at IR 1 to supplement the previous data, determine the extent of lead-contaminated soil, and delineate the limits of required excavation (BEI, 1995). BEI then performed an IRA, excavating lead-

contaminated soil to a depth of 12 to 18 inches at IR 1, and removing 4,878 cubic yards of soil for offsite treatment and disposal. The IRA reduced the highest lead concentration in soil from 35,200 milligrams per kilogram (mg/kg) to 680 mg/kg. Samples were collected from the excavation area to confirm removal of contaminated soil (BEI, 1998).

In the fall of 1996, Brown and Root Environmental (B&RE) performed the Supplemental RFI/RI sampling at IR 1 (B&RE, 1998a). The Supplemental RFI/RI concluded that elevated concentrations of some contaminants remain at IR 1. Metals were detected with high frequencies in soil at IR 1 and also detected in sediment, surface water, and groundwater. Several volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and PCBs were also detected at the site. A baseline HHRA and an ecological risk assessment (ERA) were performed during the Supplemental RFI/RI. A Feasibility Study (FS) was recommended for IR 1 in the Supplemental RFI/RI to evaluate possible site remedies. However, the HHRA revealed only one scenario (residential) with risks above EPA's carcinogenic target risk range and noncarcinogenic threshold. Therefore, the NAS Key West Partnering Team made the decision to perform a Sediment Toxicity Study instead of an FS to more fully characterize ecological risks to benthic organisms at IR 1. The Sediment Toxicity Report for Sites IR 1 and 8 (TtNUS, 1999a) concluded that potential ecological risks to benthic organisms exist in the vicinity of one sediment sample location due to 4,4'-DDT, lead, and possibly copper.

Current activities at IR 1 include repair of the seawall and shoreline where damage was caused by a hurricane. Hurricane Georges, a Category 1 hurricane, passed over Key West on September 25, 1998. The hurricane caused significant damage and erosion to the shoreline at IR 1. The elevation of the shoreline at IR 1 has been increased to match the top of the seawall using boulders and riprap. In addition, the fence along the seawall and signs indicating restricted access will be replaced at IR 1.

#### 2.2.1.2 IR 8 - Fleming Key South Landfill

Geraghty and Miller performed an initial investigation at IR 8 in 1986 involving the installation of five shallow monitoring wells (Geraghty and Miller, 1987). Based on the results of this investigation, a preliminary RI was recommended at IR 8. In 1990, IT Corporation conducted a preliminary RI that included soil and groundwater sampling (IT, 1991). In 1993, an RI was performed for characterization of contamination at the site. The RI indicated that groundwater and sediment appeared to be most extensively impacted by metals. The Final RFI/RI Report prepared by IT Corporation recommended that: receptor identification and tissue analysis be performed to confirm uptake of contaminants; an IRA be performed to prevent further contact between the surface water and the waste materials along the shoreline; a preliminary FS be conducted; and a baseline HHRA be performed based on post-IRA data (IT, 1994).

In 1996, the Supplemental RFI/RI was performed by B&RE (B&RE, 1998a). Metals and pesticides were found to be the most widespread contaminants detected at the site. VOCs were detected in sediment and groundwater. SVOCs were detected in sediment, surface water, and groundwater. PCBs were detected, to a limited extent, in sediment and surface water. A baseline HHRA and ERA were performed at IR 8. Two scenarios (residential and trespasser adolescent) were calculated to be above the HI threshold for noncarcinogenic risk. The results of the ERA concluded that risk at IR 8 were primarily confined to benthic organisms from contamination in sediment. The Supplemental RFI/RI recommended that an FS be conducted at IR 8, and include toxicity tests to determine whether the concentration of chemicals detected in sediments were toxic to benthic organisms.

In February 1997, BEI began installation of a shoreline protection system to establish a stable shoreline along the landfill perimeter to prevent debris from being washed into the harbor by erosion. By August 1997, the shoreline structure had been fully installed (BEI, 1998).

Because of low human health risks, the NAS Key West Partnering Team decided to perform a Sediment Toxicity Study at IR 8 instead of an FS. The bioavailability and toxicity of IR 8 sediment contamination to benthos was not assessed during the ERA. The Sediment Toxicity Report for Sites IR 1 and 8 (TtNUS, 1999a) concluded that potential ecological risks from site-related contaminants at IR 8 appeared to be negligible.

### 2.2.2 Enforcement Actions

No enforcement actions have been taken at IR 1 or IR 8.

### 2.2.3 Highlights of Community Participation

The Navy and NAS Key West have implemented a comprehensive public involvement program for many years. Starting in January 1989, a Technical Review Committee (TRC) met, on average, twice a year to discuss investigative activities at NAS Key West. The TRC was composed mostly of government personnel; however, a few private citizens occasionally attended the meetings.

In the fall of 1995, the Navy converted the TRC into a Restoration Advisory Board (RAB), and five community representatives joined the RAB. The RAB is co-chaired by a community member and a Navy member. RAB meetings are held approximately every four months. The Supplemental RFI/RI for Eight Sites (B&RE, 1998a), the Sediment Toxicity Report for Sites IR 1 and 8 (TtNUS, 1999a), and the Proposed Plans for IR 1 and IR 8 (TtNUS, 2000) were discussed at several RAB meetings.

Community relations activities related to the remedy selection process for IR 1 and IR 8 include the following:

- Documents concerning the investigations and analyses at IR 1 and IR 8 and copies of the Proposed Plans were placed in the Information Repository at the Monroe County Library, Key West, Florida.

- A newspaper announcement on the availability of the documents and the public comment period/meeting date was placed in *The Citizen* on February 27, 2000.

- The Navy established a 60-day public comment period starting February 27, 2000, and ending April 27, 2000, to present the Proposed Plans. No written comments were received during the 60-day public comment period.

- A public meeting was held March 27, 2000, to answer questions concerning the Proposed Plans for IR 1 and IR 8. Approximately 20 people, including federal, state, and local government representatives attended the meeting. Oral comments were received during the public meeting from a member of the community. Responses to these comments are summarized in the Responsiveness Summary (Appendix A).

## 2.3 SCOPE AND ROLE OF RESPONSE ACTION

### 2.3.1 IR 1 - Truman Annex Refuse Disposal Area

The Remedial Action described in this portion of the Decision Document addresses the remaining contamination associated with IR 1, Truman Annex Refuse Disposal Area, as identified in the Proposed Plan (TtNUS, 2000). Past disposal operations at the site are believed to be the source of site contamination.

The IRA at IR 1 removed 4,878 cubic yards of lead-contaminated soil, reducing the highest lead concentration in soil from 35,200 mg/kg to 680 mg/kg. This soil removal eliminated the need for additional remedial action. However, elevated concentrations of some contaminants remain at IR 1; metals were detected at high frequencies in soil. Metals were also detected in sediment, surface water, and groundwater. Several VOCs, SVOCs, pesticides, and PCBs were also detected at the site.

Human health and ecological risks from contamination at IR 1 were calculated in the Supplemental RFI/RI (B&RE, 1998a) and are discussed in Section 2.5 of this document. Risks were calculated for the contamination remaining after the 1995 IRA was performed. The Baseline HHRA identified five risk

scenarios equal to or greater than the FDEP target incremental lifetime cancer risk (ILCR) of one in one million (1.0E-06), but all are within the EPA target risk range. A single risk scenario exceed the noncarcinogenic hazard index (HI) threshold of 1.0 (B&RE, 1998a). In addition, sediment toxicity testing concluded that potential ecological risks to benthic organisms exist at IR 1 (TtNUS, 1999a).

To address human health risks, LUCs, consisting of limited site access, will be implemented at IR 1. Monitoring of sediment and groundwater will also take place at IR 1, including quarterly collection of approximately eight sediment samples and six groundwater samples. Groundwater samples will be collected from monitoring wells along the southern coast of IR 1, as well as from some interior wells, and analyzed for metals, pesticides, and PCBs. Sediment samples will be collected near sediment toxicity sample locations IR1-4 and IR1-7 and analyzed for metals, pesticides, PCBs, and polynuclear aromatic hydrocarbons (PAHs). Annual biota monitoring, including collection of approximately eight sediment samples for toxicity testing, eight turtle grass samples for tissue analysis, and 12 vase conch samples for tissue analysis, will also take place at IR 1 to monitor risks to ecological receptors. Tissue will be analyzed for metals, pesticides, and PCBs. The NAS Key West Partnering Team will determine the exact numbers of samples and collection locations before the remedy is implemented.

### 2.3.2 IR 8 - Fleming Key South Landfill

The Remedial Action described in this portion of the Decision Document addresses the remaining contamination associated with IR 8, Fleming Key South Landfill, as identified in the Proposed Plan (TtNUS, 2000). Past disposal operations are believed to be the source of site contamination.

In 1997, BEI installed a shoreline protection system at IR 8 to reduce shoreline erosion and protect sediment and surface water from exposure to debris. Metals and pesticides were the most widespread contaminants detected at the site (BEI, 1998).

Human health and ecological risks from contamination at IR 8 were calculated in the Supplemental RFI/RI (B&RE, 1998a) and are discussed in Section 2.5 of this document. The baseline HHRA identified three risk scenarios equal to or greater than the FDEP target ILCR of one in one million (1E-06), but all are within the EPA target risk range. Two risk scenarios exceed the HI threshold of 1.0. Sediment toxicity testing at IR 8 concluded that potential ecological risks from site-related contaminants at IR 8 appear to be negligible (TtNUS, 1999a).

To address human health risks, LUCs consisting of limited site access will be implemented at IR 8. In addition, monitoring of groundwater quality will take place at IR 8. Approximately three samples located

in the interior of IR 8 will be collected quarterly and analyzed for metals, pesticides, and PCBs. The NAS Key West Partnering Team will determine the exact numbers of samples and collection locations before the remedy is implemented.

## 2.4 SUMMARY OF SITE CHARACTERISTICS

The site characterizations for IR 1 and IR 8 were completed in phases. In 1986, a preliminary investigation was performed at NAS Key West by Geraghty and Miller. Based on the results of that investigation, a preliminary RI was performed in 1990 at both IR 1 and IR 8. Following the preliminary RI, an RFI/RI was performed at both sites by IT Corporation. In 1995, an IRA was performed by BEI at IR 1, during which 4,878 cubic yards of lead-contaminated soil were removed (BEI, 1998). B&RE performed the Supplemental RFI/RI in 1996. At IR 8, a shoreline protection system was installed in 1997, establishing a stable shoreline along the landfill perimeter to prevent debris from being washed into the harbor by erosion (BEI, 1998). Sediment toxicity testing was recommended for IR 1 and IR 8 in the Supplemental RFI/RI and was performed in 1998 by Tetra Tech NUS (TtNUS).

### 2.4.1 Sources of Contamination

The potential sources of contamination at IR 1 and IR 8 are presented in the following sections. This information is based primarily on the Supplemental RFI/RI Report for Eight Sites (B&RE, 1998a).

#### 2.4.1.1 IR 1 - Truman Annex Refuse Disposal Area

The source of contamination at IR 1 is the landfill contents (reportedly municipal waste).

#### 2.4.1.2 IR 8 - Fleming Key South Landfill

The source of contamination at IR 1 is the landfill contents (reportedly metal debris).

### 2.4.2 Description of Contamination

The following descriptions of contamination are based on information and screening values from the Supplemental RFI/RI Report (B&RE, 1998a). However, during the Site Inspection (SI) for Nine Base Realignment and Closure (BRAC) Parcels (TtNUS, 1999b), a new set of action levels was adopted by the NAS Key West Partnering Team. Figures in this Decision Document illustrate the comparison of historical data at IR 1 and IR 8 to these updated action levels. A current set of the action levels can be found in the SI Workplan for Ten BRAC Properties (B&RE, 1998b).

Surficial aquifer groundwater at NAS Key West was not evaluated as part of the baseline HHRA because it is nonpotable due to its high salinity. The public water supply obtained from the mainland is officially designated as the only potable source. Therefore, no groundwater chemicals of concern (COCs) were selected during the Supplemental RFI/RI.

#### 2.4.2.1 IR 1 - Truman Annex Refuse Disposal Area

Subsurface Soil

Subsurface soil was sampled at IR 1 in 1993 and 1995. Sixteen SVOCs were detected in one sample, 14 of which were above action levels. In the same sample, two pesticides (4,4'-DDE at 420 micrograms per kilogram [μg/kg] and 4,4'-DDT at 150 μg/kg) and two PCBs (Aroclor-1254 at 3,900 μg/kg and Aroclor-1260 at 2,000 μg/kg) were also detected above action levels. Inorganic compounds were detected in all nine subsurface samples that underwent inorganic analysis. Inorganic compounds were most frequently detected and in excess of screening values in the same sample where SVOCs, pesticides, and PCBs were detected above action levels. In that sample, aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, tin, and vanadium were detected above action levels (IT, 1994). However, none of these detections were at high enough levels to warrant selecting them as COCs during the performance of risk calculations in the Supplemental RFI/RI (B&RE, 1998a).

Surface Soil

Data from the 1995 Delineation Study (BEI, 1995) and the 1996 Confirmatory Study contained in the Project Completion Report (BEI, 1998) were considered in the analysis of IR 1 surface soil contamination. Surface soil samples at IR 1 were analyzed only for inorganics. Aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, vanadium, and zinc exceeded soil screening values. High metal concentrations were most commonly detected in the northwest and southeast portions of the site, although contamination was not limited to these areas. Surface soil COCs selected during the Supplemental RFI/RI included antimony, arsenic, copper, iron, and mercury (B&RE, 1998a). However, since the revision of the NAS Key West action levels, copper and mercury no longer exceed action levels at any surface soil sample location. Therefore, copper and mercury are no longer considered COCs in surface soil at IR 1. Remaining COCs are presented in Table 2-1 with their maximum detected concentrations for the site and residential soil action levels. Although plans for future use of IR 1 do not include residential areas, residential action levels, versus industrial, were compared against contaminant levels to be conservative. Figure 2-4 presents maximum detected

concentrations for remaining COCs exceeding residential soil action levels for each sampling location at IR 1.

Sediment

Sediment was sampled at IR 1 in 1990, 1993, and 1996. In general, metals were the most frequently detected chemicals, although 4,4'-DDT and 4,4'-DDE were also detected at nearly all sample locations. Acetone was the only VOC detected in excess of its action level, with a maximum detected concentration of 150 μg/kg. Several SVOCs exceeded their screening values in sediment samples collected from the southern shoreline. Benzo(a)anthracene, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, phenanthrene, and pyrene were detected at all three 1990 sampling locations. Only two SVOCs were detected in the 1996 investigation; fluoranthene (289 μg/kg) and pyrene (326 μg/kg) were both detected in excess of screening values in a single sample. COCs identified for sediment at IR 1 included arsenic, iron, Aroclor-1254, and Aroclor-1260 (B&RE, 1998a). Maximum detected COC concentrations for each sediment sampling location at IR 8 are shown in Figure 2-5.

In October 1998, samples were collected at IR 1 for a Sediment Toxicity Study (TtNUS, 1999a). Concentrations of most metals detected did not pose a risk to ecological receptors. However, chromium, copper, iron, lead, and zinc were detected in excess of current action levels. Pesticides detected in excess of action levels include 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT. In addition, one PCB (Aroclor-1260) was detected in excess of its action level at four locations. Sediment toxicity testing at IR 1 concluded that potential ecological risks from site-related contaminants at IR 1 appeared to be limited to the vicinity of sample locations IR 1-4 and IR 1-7. Slightly reduced growth of test organisms at IR 1-4 was assumed to be due to the concentration of Aroclor-1260 of 8920 μg/kg in that sample, possibly combined with the concentration of 4,4'-DDE of 119 μg/kg. However, these contaminants do not appear to have accumulated in tissues of aquatic species, based on samples collected in 1996. Overall, potential ecological risks from site-related contaminants in sample IR 1-4 appeared to be negligible. Survival, growth, and reproduction were low in all five replicates of sample IR 1-7, and the tested parameters were significantly reduced relative to background sites. Concentrations of 4,4'-DDT and its metabolites, as well as lead and copper were elevated in this sample. These elevated contaminant concentrations and the consistently poor performance among replicates in the toxicity tests concluded that potential ecological risks due to 4,4'-DDT, lead, and possibly copper existed in the vicinity of sediment sample location IR 1-7 (TtNUS, 1999a). The sediment toxicity results for the COCs identified during the Supplemental RFI/RI are also shown in Figure 2-5. Table 2-1 lists the sediment COCs and their maximum detected concentrations at IR 1 for all sediment sampling events, including the 1998 Sediment Toxicity Study.

Surface Water

Surface water was sampled at IR 1 in 1993. Metals and VOCs were the only contaminants detected in surface water at IR 1. VOCs were detected in a single sample, but were below action levels. Two metals, antimony and tin, exceeded screening values with maximum detected concentrations of 270 micrograms per Liter (μg/L) and 134 μg/L, respectively. Only antimony exceeded its screening value at every sample location. No surface water COCs were selected during the Supplemental RFI/RI (B&RE, 1998a).

Groundwater

Groundwater was sampled at IR 1 in 1986, 1990, 1993, and 1996. Inorganics were detected in samples from each investigation. In 1996, both the extent and degree of inorganic contamination were reduced in groundwater. Only five inorganic parameters (antimony, iron, lead, manganese, and selenium) exceeded screening values in 1996. A limited amount of pesticide contamination was detected in sampling investigations prior to the Supplemental RFI/RI. Most of the detected pesticides were found in 1996 samples. Chlordane, heptachlor, 4,4'-DDD, alpha-BHC, gamma-BHC, endosulfan I, and dieldrin were detected above action levels in 1996. Although nine VOCs were detected in groundwater, only benzene (1.6 μg/L), methylene chloride (5.2 μg/L), and trichloroethene (14 μg/L) exceeded screening values (B&RE, 1998a). In 1986, a single SVOC, phenanthrene, was detected in excess of its screening value at a concentration of 14 μg/L. SVOCs were not detected in later investigations. Figure 2-6 presents the maximum concentrations for contaminants detected above current action levels for each sampling location. The maximum detected concentrations for each contaminant detected above its action level in groundwater at IR 1 are listed in Table 2-2, along with the respective sample locations and current action levels.

Shellfish and Plant Tissue

In 1996, shellfish and plant tissue were collected. Aroclor-1260, several pesticides, and several metals were detected in one or more of the lobster and hermit crab tissue samples collected at IR 1. Copper levels were elevated in lobsters, and to a lesser extent crabs, relative to background samples collected. Zinc appeared to be accumulating in crabs, turtle grass, and lobsters (B&RE, 1998a).

#### 2.4.2.2 IR 8 - Fleming Key South Landfill

Subsurface Soil

Subsurface soil was sampled during the RFI/RI in 1993. Metals accounted for most of the chemicals found in the subsurface soil at IR 8. Antimony, arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, thallium, tin, and zinc were detected above action levels. In general, metals were found near the center of the site, west of the ammunition storage area. No VOCs or SVOCs were detected above action levels in subsurface soil at IR 8 (IT, 1994).

Surface Soil

Data from the 1993 RFI/RI and 1996 Supplemental RFI/RI were considered in the analysis of surface soil contamination at IR 8. In 1993, metals and pesticides accounted for most of the chemicals found in the soil at IR 8. No inorganics were detected in excess of screening values in surface soil at IR 8, but several were detected at levels below their screening criteria. A single pesticide, 4,4'-DDT, was detected in excess of its action level in surface soil at 120 µg/kg (IT, 1994). In 1996, 4,4'-DDT was detected in all samples, but exceeded its screening level at only one location. Two other pesticides, 4,4'-DDD and 4,4'-DDE were also detected in surface soil at IR 8, but at levels below screening values. No COCs were selected for surface or subsurface soil at IR 8 during the Supplemental RFI/RI (B&RE, 1998a).

Sediment

Sediment was sampled at IR 8 during the 1990 preliminary RI, the 1993 RFI/RI, and the 1996 Supplemental RFI/RI. One VOC, acetone, was detected in excess of its action level at 72 µg/kg in 1993. Other VOCs detected in sediment at concentrations below their screening values included methylene chloride in 1990 and 1993 and toluene in 1990. SVOCs detected in sediment at IR 8 in excess of screening values included benzo(a)anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene. A number of pesticides were detected in excess of screening values in sediment at IR 8 and included 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, beta-BHC, and delta-BHC. Other pesticides detected in sediment at IR 8 at concentrations below the screening criteria included 2,4-D and endosulfan I. A single PCB, Aroclor-1254, was detected once in excess of its screening value at 26.1 µg/kg. Several inorganics were detected in excess of screening values in sediment at IR 8. Maximum concentrations of inorganics were consistently detected along the northwestern edge of IR 8 and included antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc. Sediment COCs selected during the Supplemental RFI/RI included antimony, arsenic, iron, and thallium (B&RE, 1998a). The maximum detected

concentrations for each sediment COC at each sample location that exceeded current action levels are shown in Figure 2-7.

Sediment toxicity testing was performed in 1998 at IR 8 based on recommendations in the Supplemental RFI/RI. Several metals (aluminum, arsenic, chromium, cobalt, copper, iron, lead, vanadium, and zinc) and pesticides (4,4'-DDD and 4,4'-DDE) were detected above current action levels. However, based on the results of the toxicity tests, potential ecological risks from site-related contaminants were negligible (TtNUS, 1999a). Sediment COC results from this study are also included in Figure 2-7. The maximum detected concentrations for COCs at IR 8 from all sampling events, including the Sediment Toxicity Study, are listed in Table 2-3.

Surface Water

Surface water was sampled at IR 8 during the 1990 RI and the 1993 RFI/RI. Three SVOCs were detected in excess of screening values in surface water at IR 8. Anthracene, bis(2-ethylhexyl)phthalate, and dibenzo(a,h)anthracene were detected at a single sample location. A single PCB, Aroclor-1242, was detected in excess of its screening value once at 1.1 μg/L. A number of inorganics were detected in excess of screening values in surface water. Aluminum, arsenic, cadmium, chromium, copper, iron, manganese, and silver were detected in excess of their screening values at a single sample location. Antimony, lead, tin, and zinc were detected above screening values in more than one sample. Surface water COCs identified in the Supplemental RFI/RI included antimony, arsenic, and iron (B&RE, 1998a). However, antimony is no longer considered a COC in IR 8 surface water due to the update of action levels. The maximum detected concentration of each COC at each sample location is shown in Figure 2-8. Surface water COCs are presented in Table 2-3, along with their maximum detected concentrations for the site and their updated action levels.

Groundwater

Groundwater was sampled at IR 8 during the initial investigation performed in 1986, the 1990 RI, the 1993 RFI/RI, and the 1996 Supplemental RFI/RI. Groundwater contamination beneath the site predominantly consisted of metals. In 1986, VOCs were detected in excess of screening criteria, including methylene chloride, benzene, chlorobenzene, bromodichloromethane, bromoform, chloroform, and dibromochloromethane (Geraghty and Miller, 1987). In 1990, a single VOC, chlorobenzene, was detected once in excess of its screening value at 63 μg/L (IT, 1991). No VOCs were detected in subsequent groundwater sampling events. Two SVOCs have been detected in excess of action levels at IR 8: 1,4-dichlorobenzene and bis(2-ethylhexyl)phthalate. Two pesticides, alpha-BHC and heptachlor, were detected in the 1993 and 1996 groundwater sampling events at 0.17 μg/L and 0.62 μg/L,

respectively. Overall detection of inorganics decreased in frequency and concentration from 1986 to 1996. Aluminum, antimony, arsenic, beryllium, cadmium, copper, iron, lead, manganese, mercury, and thallium have been detected in one or more sampling events since 1986. However, in 1996, antimony was the only inorganic detected in excess of its screening value, with a maximum detected concentration of 42.3 μg/L (B&RE, 1998a). Figure 2-9 illustrates the maximum concentration for each contaminant detected in excess of current action levels at IR 8 for each monitoring well location. Table 2-4 presents all contaminants detected above current action levels in groundwater, the maximum detected concentrations for the site, the locations of the maximum detected concentration, and the appropriate action levels for each contaminant.

Shellfish Tissue

Shellfish were collected in 1996 for tissue analysis. Several pesticides and metals were detected in one or more of the lobster and hermit crab tissue samples collected at IR 8. Chlorobenzilate was detected in two of four lobster tissue samples, exceeding its fish risk-based concentration (RBC). Copper, aldrin, and chlorobenzilate were each detected in one crab tissue sample (B&RE, 1998a).

### 2.4.3 Contaminant Migration

The following summaries of potential contaminant migration pathways are based on information from the Supplemental RFI/RI Report for Eight Sites (B&RE, 1998a).

#### 2.4.3.1 IR 1 - Truman Annex Refuse Disposal Area

The major contaminant source at IR 1 is soil and buried debris in the former disposal area. As discussed earlier, soil from a large portion of the site has been removed and backfilled. Constituents in the soil could have volatilized from surficial material or become airborne via resuspension during disposal activities. Contaminated fugitive dust could have been generated during ground-disturbing activities, such as historical disposal activities, causing possible contaminant dispersion in the surrounding environment and transportation to downwind locations where they could have repartitioned to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition (B&RE, 1998a).

However, volatilization, wind erosion, and overland runoff from the disposal area no longer exist to an appreciable degree, since surface soil from most of the disposal area was excavated. After excavation, the remediated area was backfilled and resodded. As a result, the site is covered with turfgrass. For these reasons, the surface soil migration pathway has been somewhat diminished. Runoff prior to the IRA probably carried surface soil contaminants into ocean surface water and sediments. In addition,

offsite sediments carried along the shoreline into IR 1 by sediment transport through wave action may be another possible source of contaminants detected in sediments. Migration of contaminants from groundwater to ocean surface water and sediments is also a major migration route at IR 1 (B&RE, 1998a). Finally, the addition of rip-rap and backfill material along the shoreline at IR 1 during 2000 has greatly reduced the potential for erosion and possible contaminant migration.

#### 2.4.3.2 IR 8 - Fleming Key South Landfill

The contaminant source at IR 8 consists of the former landfill. The contaminant release pathways include volatilization, wind erosion, overland runoff, and infiltration of contaminants. Constituents in soil could volatilize from surficial material or become airborne via wind erosion. Contaminated fugitive dust can be generated during ground-disturbing activities, such as construction or excavation. The contaminants could then be dispersed in the surrounding environment and transported to downwind locations where they could repartition to surface soil, surface water, or sediment through gravitational settling, precipitation, and deposition. However, the landfill is heavily vegetated, primarily by Australian pines, minimizing the airborne contaminant transport pathway (B&RE, 1998a).

Precipitation runoff can carry contaminants to nearby surface water and sediments in Man of War Harbor and the Gulf of Mexico. However, the shoreline protection system installed in 1997 established a stable shoreline along the landfill perimeter to prevent debris being washed into the harbor by erosion. Infiltrating precipitation can cause contamination in subsurface soil and groundwater. After reaching the water table, contaminants can be carried with the flow of groundwater to downgradient locations. Groundwater under the landfill is shallow and is connected hydrologically to surface water at the shoreline. Contaminants transported in groundwater to surface water can be deposited subsequently in sediment or surface water, and can potentially accumulate in the tissues of aquatic organisms. In addition, offsite sediments carried along the shoreline into IR 8 by sediment transported through wave action may be another source of contamination in the sediment (B&RE, 1998a).

## 2.5 SUMMARY OF SITE RISKS

The human health and ecological risks associated with exposure to contaminated media at IR 1 and IR 8 were evaluated in the Supplemental RFI/RI Report for Eight Sites (B&RE, 1998a). An element in all the risk evaluations is that groundwater in the shallow aquifer is not a current source of drinking water and will not be used as one in the future for NAS Key West. In addition, IR 1 and IR 8 are NAS Key West properties with restricted access and residential use of the properties is not envisioned in the future.

### 2.5.1 Human Health Risks

Exposure Pathways and Potential Receptors

Future resident, trespasser (adult and adolescent), maintenance worker, excavation worker, and occupational worker were evaluated as potential receptors in the quantitative human risk assessment. The resident and excavation worker were evaluated for future conditions only. However, IR 1 and IR 8 are located on a restricted access military base and residential development of the property is very unlikely. The remaining receptors are considered for current conditions.

Exposure Assessment

COCs that were evaluated and their maximum exposure-point concentrations (EPCs) are presented in Table 2-5. EPCs are used to determine potential human health risks.

Toxicity Assessment

Cancer Slope Factors (CSFs) have been developed by EPA's Carcinogenic Assessment Group for estimating ILCRs associated with the exposure to potentially carcinogenic chemicals.

CSFs, which are unitless, are multiplied by the estimated intake of a potential carcinogen (in milligrams per kilogram per day [mg/kg/day]) to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CSFs. This approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays, using animal-to-human extrapolation and uncertainty factors.

EPA has developed Reference Doses (RfDs) associated with potential adverse health effects for chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in mg/kg/day are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies, using uncertainty factors. These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects. Tables 2-6 and 2-7 present the cumulative carcinogenic and noncarcinogenic risks calculated for IR 1 and IR 8, respectively.

Risk Characterization

ILCRs are determined by multiplying the chemical intake level by its cancer potency factor. These risks are expressed as probabilities in scientific notation (e.g., 1.0E-06). For example, an ILCR of 1.0E-06 for the specific exposure conditions at a site indicates that, at most, an individual has a one-in-one-million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime.

The noncarcinogenic effect of a single contaminant in a single medium is expressed as the Hazard Quotient (HQ), the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's RfD. The overall HI is generated by adding the HQs for all contaminants within a medium, or across all media to which given population may reasonably be exposed to. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium, or across media.

#### 2.5.1.1 IR 1 - Truman Annex Refuse Disposal Area

**Future Resident.** The cumulative ILCR under a reasonable maximum exposure (RME) scenario is 1.3E-04, which is above the EPA target risk range of 1.0E-06 to 1.0E-04 and the FDEP target risk of 1.0E-06. The dermal exposure route for surface soil and sediment contributes most to the cumulative carcinogenic risk for the potential future resident. The noncarcinogenic HI associated with chemicals remaining at IR 1 is 3.5, which is above the threshold of 1.0. The principal chemicals contributing to this risk are antimony, copper, and iron in surface soil, arsenic in surface soil and sediment, and Aroclor-1254 in sediment.

**Trespasser Adult.** The cumulative ILCR under an RME scenario is 1.2E-05, which is within the EPA target risk range of 1.0E-06 to 1.0E-04 and above the FDEP target risk of 1.0E-06. The noncarcinogenic HI associated with chemicals remaining at IR 1 is .092, which is below the threshold of 1.0.

**Trespasser Adolescent.** The cumulative ILCR under an RME scenario is 1.1E-05, which is within the EPA target risk range of 1.0E-06 to 1.0E-04 and above the FDEP target risk of 1.0E-06. The noncarcinogenic HI associated with chemicals remaining at IR 1 is 0.16, which is below the threshold of 1.0.

**Maintenance Worker.** The cumulative ILCR under an RME scenario is 8.8E-07, which is below the EPA target risk range of 1.0E-06 to 1.0E-04 and the FDEP target risk of 1.0E-06. The noncarcinogenic HI associated with chemicals remaining at IR 1 is 0.017, which is below the threshold of 1.0.

**Excavation Worker.** The cumulative ILCR under an RME scenario is 1.2E-06, which is within the EPA target risk range of 1.0E-06 to 1.0E-04 and slightly above to the FDEP target risk of 1.0E-06. The noncarcinogenic HI associated with chemicals remaining at IR 1 is 0.34, which is below the threshold of 1.0.

**Occupational Worker.** The cumulative ILCR under an RME scenario is 7.4E-06, which is within the EPA target risk range of 1.0E-06 to 1.0E-04 and greater than the FDEP target risk of 1.0E-06. The noncarcinogenic HI associated with chemicals remaining at IR 1 is 0.15, which is below the threshold of 1.0.

#### 2.5.1.2 IR 8 - Fleming Key South Landfill

**Future Resident.** The cumulative ILCR under an RME scenario is 1.0E-04, which is at the upper limit of the EPA target risk range of 1.0E-06 to 1.0E-04 and above the FDEP target risk of 1.0E-06. The ingestion and dermal exposure routes contribute most to the cumulative carcinogenic risk for the future resident. The principal chemical contributing to the carcinogenic risk is arsenic in sediment and surface water. The noncarcinogenic HI associated with chemicals remaining at IR 8 is 16.0, which is well above the threshold of 1.0. The ingestion and dermal exposure routes associated with sediment and surface water contribute most to the noncarcinogenic risk for the future resident. The principal chemicals contributing to this risk are arsenic, antimony, iron, and thallium in sediment and arsenic, antimony, and iron in surface water.

**Trespasser Adult.** The cumulative ILCR under an RME scenario is 9.8E-06, which is within the EPA target risk range of 1.0E-06 to 1.0E-04 and above the FDEP target risk of 1.0E-06. The noncarcinogenic HI associated with chemicals remaining at IR 8 is 0.66, which is below the threshold of 1.0.

**Trespasser Adolescent.** The cumulative ILCR under an RME scenario is 1.0E-05, which is within the EPA target risk range of 1.0E-06 to 1.0E-04 and above the FDEP target risk of 1.0E-06. The noncarcinogenic HI associated with chemicals remaining at IR 8 is 1.3, which is nearly equal to the threshold of 1.0.

**Maintenance Worker.** The ILCR and HI for the Maintenance Worker were not calculated, because no chemicals of potential concern (COPCs) exist in the applicable medium (surface soil) at IR 8.

**Excavation Worker.** The cumulative ILCR under an RME scenario is 1.4E-07, which is below the EPA target risk range of 1.0E-06 to 1.0E-04 and the FDEP target risk of 1.0E-06. The noncarcinogenic HI associated with chemicals remaining at IR 8 is 0.021, which is below the threshold of 1.0.

**Occupational Worker.** The ILCR and HI for the Occupational Worker were not calculated, because no COPCs exist in the applicable medium (surface soil) at IR 8.

### 2.5.2 Environmental Evaluation

#### 2.5.2.1 IR 1 - Truman Annex Refuse Disposal Area

Terrestrial habitat within the former disposal area consists mostly of mowed turf grass that is enclosed by a chain link fence and essentially devoid of all native vegetation. Prior to landfall of Hurricane Georges on September 25, 1998, a 15-foot strip of weeds and a few Australian pines were present between the chain link fence and riprap along the shoreline. However, Hurricane Georges caused massive erosion of much of the area between the riprap and the fence. Repair activities have since been conducted, restoring the shoreline to its original elevation using, boulders and riprap to match the top of the seawall. Due to its overall lack of vegetation (other than turf grass), the site is probably used by few terrestrial receptors. However, birds probably forage occasionally in grassy areas on the site. There are no freshwater resources at the site (B&RE, 1998a).

A diverse assemblage of marine life was observed within the near-shore vicinity of IR 1 during the sampling activities of September 1996. Common plants included turtle grass (*Thalassia testudinum*), sea fan (*Gorgonia* spp.), sea plume (*pseudopterogorgia* spp.), and sea whip (*Leptogorgia* spp.). Observed animal life included spiny lobster (*Panulirus argus*), queen conch (*Strombus gigas*), hawkwing conch (*Strombus raninus*), Caribbean vase conch (*Vasum muicatum*), green moray eel (*Gymnotorax funebris*), hermit crabs, tarpon (*Megalops atlanticus*), barracuda (*Sphyraena barracuda*), and several other fish. Spiny lobster, Caribbean vase conch, giant hermit crab (*Petrochirus diogenes*), and turtle grass were collected from the near-shore vicinity of the site for tissue analysis (B&RE, 1998a).

Ecological receptors listed as threatened, endangered, or of special concern that could potentially be exposed to site-related contamination included the brown pelican, osprey, least tern, roseate tern, and sea turtles. An osprey nest was reported to exist approximately 600 yards northwest of the site in 1992 (IT, 1994). The roofs of several buildings approximately 500 yards northwest of the site were used as nesting sites by least terns and roseate terns (Florida Natural Areas Inventory [FNAI], 1994). A sandy beach approximately 200 feet northwest of IR 1 was used for nesting by Atlantic loggerhead turtles (*Caretta caretta*) in 1991 (IT, 1994). There are no known bald eagle nests in the vicinity, but eagles could potentially forage in nearshore waters (B&RE, 1998a).

Terrestrial animals may be exposed to IR 1 contaminants through the ingestion of contaminated food items. In addition, animals can incidentally ingest soil while grooming fur, preening feathers, digging,

grazing close to the soil, or feeding on items that are covered with soil (such as roots and tubers). Exposure to contaminants in the soil via dermal contact can occur, but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize the transfer of contaminants across dermal tissue. Volatile constituents could be present in some site soils, soil-bound contaminant resuspension can occur, and combustion can release contaminants into the air at IR 1. However, inhalation does not represent a significant exposure pathway because this investigation assumes that air contaminant concentrations are quite low, even for burrowing wildlife. In addition, inhalation ecotoxicity data for chronic exposure are lacking. Hence, the air pathway was not considered for ecological receptors (B&RE, 1998a).

In the Phase I ERA conducted by IT Corporation during the 1993 RFI/RI, several inorganics and organics were identified as sediment and groundwater ecological contaminants of concern (ECCs). Antimony was the only surface water ECC. The assessment concluded that the greatest potential risk to aquatic organisms from inorganics was through direct contact via groundwater discharges and, to a much lesser extent, contact with contaminated sediment. Several metals and organics were considered to be capable of bioaccumulating sufficiently in fish to pose potential risks to piscivores. The Phase I ERA also identified several metals and organics as soil ECCs. Consumption of antimony, cadmium, copper, lead, zinc, Aroclor-1254, and Aroclor-1260 in vegetation was determined to pose potential risk to terrestrial receptors that forage on plants. However, the study concluded that, due to highly compacted soils, sparse vegetation, man-made structures, and a chain-link fence surrounding the site, IR 1 surface soil posed minimal risks to terrestrial receptors. The overall conclusion of the ERA was that moderate-to-high potential risks were present from several ECCs in various media, primarily aquatic, and that additional ecological investigations were warranted to more fully characterize ecological risks (IT, 1994).

The Phase II ERA conducted by B&RE in 1996 during the Supplemental RFI/RI found that elevated concentrations of copper, lead, and zinc were present in sediment, suggesting potential risks to benthic receptors. Runoff appeared to be the primary migration pathway. Some of the pesticides present in elevated concentrations in sediment (endosulfan I, dieldrin, and gamma-BHC) were elevated in groundwater samples collected close to the shore, suggesting migration of these contaminants via groundwater discharge. However, elevated concentrations of several pesticides and Aroclor-1260 in sediment were not detected in groundwater. Supplemental RFI/RI soil sampling did not include organic analyses and it was therefore unclear if IR 1 soils were the source of these compounds in sediment. Since organics did not appear to be significantly accumulating in biota, potential risks from these compounds appeared to be limited to benthic organisms (B&RE, 1998a).

Organic compounds chosen as final ECCs in sediment consisted of 4,4'-DDT, dieldrin, endrin, endosulfan I, gamma-BHC (and some daughter products of these pesticides), as well as the PCB Aroclor-1260. Final

ECCs in groundwater consisted of endosulfan I, dieldrin, and gamma-BHC. Metals chosen as ECCs in soil and sediment consisted of copper, lead, and zinc. Since the use of the site by terrestrial receptors was minimal, these metals did not pose a potential risk to terrestrial receptors; however, they were considered soil ECCs due to their potential for migration (via runoff) to aquatic habitats near IR 1 (B&RE, 1998a). For this reason, sediment toxicity testing was performed in 1998. The results of this testing are discussed in Section 2.4.2.1. The Sediment Toxicity Report (TtNUS, 1999a) concluded that potential ecological risks from site contaminants at IR 1 did exist in the vicinity of one sample location.

#### 2.5.2.2 IR 8 - Fleming Key South Landfill

IR 8 is a 45-acre inactive landfill located on Fleming Key. The landfill area is a small peninsula on the western side of the Key, with Man of War Harbor and the Gulf of Mexico located immediately adjacent to the peninsula. The former landfill is covered by a thick monoculture of Australian pine, which provides an extensive but poor habitat for terrestrial receptors. Groundcover is sparse beneath the Australian pines. Brazilian pepper and weedy species such as sandbur (*Cenchrus tribuloides*) and *Cyperus* spp grow in areas where sufficient sunlight can reach the ground. These areas are limited primarily to narrow dirt access roads within the site. There are no mangroves along the rocky shoreline at IR 8; instead, Australian pines extend seaward to the top of a low bluff along the shore. The bluff varies in height from 2 to 10 feet and is composed primarily of debris from past waste disposal at the site. There is no surface freshwater at IR 8. Because most of the site is covered by Australian pines, the site provides poor habitat for terrestrial species. Nevertheless, a few species of reptiles, arboreal birds, and avian receptors use the site. Mammals such as raccoons, opossums, and cotton rats probably use the site, as well as exotic rodents such as the black rat and house mouse. The lack of shallow water along most of the shoreline precludes extensive foraging by wading piscivorous birds, except for approximately 20 feet of the shore (B&RE, 1998a).

The shoreline and near-shore areas provide excellent aquatic habitat for a variety of marine organisms. Turtle grass is abundant and is the dominant aquatic vegetation in near-shore waters of IR 8. Aquatic marine life observed here during sampling activities in August and September 1996 included queen conch, milk conch (*Strombus costatus*), stone crab, spiny spider crab, true tulip (*Fasciolaria tulipa*), spiny lobsters, and several species of fish. Lobster, stone crab, spiny spider crab, true tulip, milk conch, and turtle grass were collected from the nearshore vicinity of the site for tissue analysis (B&RE, 1998a).

Ecological receptors listed as threatened, endangered, or of special concern that could potentially be exposed to site-related contaminants are probably limited to red rat snakes, brown pelicans, ospreys, and wading birds such as the little blue heron, snowy egret, tricolored heron, and reddish egret, all of which are state-listed Species of Special Concern (SSC). An osprey nest was located at the southern tip of

Fleming Key, approximately 1,600 feet southeast of IR 8 (FNAI, 1994). Indigo snakes, (state-and-federally-listed as threatened) could potentially inhabit some on-site areas, although habitat for this species is of marginal quality at IR 8. The Lower Keys Marsh Rabbit is not known to exist on Fleming Key; habitat preferred by this species does not exist on or near the site. There are no sandy beaches favored as nesting habitat for sea turtles on the Key. There are no known eagle nests on or near Fleming Key, but bald eagles could occasionally forage in near-shore waters (B&RE, 1998a).

The Phase I ERA conducted by IT Corporation identified several metals in groundwater as ECCs, as well as a number of inorganic ECCs in surface water and sediment. The study concluded that the greatest risk to aquatic receptors was from direct contact with groundwater discharges, surface water, and sediment. Only a few organics were identified as groundwater ECCs, and no surface water or sediment organic ECCs were identified. Some metals and organics were considered to be capable of sufficiently bioaccumulating in fish, which would pose a risk to piscivores. A few metals were identified as soil ECCs, and zinc bioaccumulating in vegetation was considered to pose risks to herbivores. The Phase I study concluded that contaminants in IR 8 media posed potential risks to ecological receptors and that additional ecological investigations were warranted to more fully characterize risks (IT, 1994).

The Phase II ERA conducted by B&RE in 1996 concluded that copper, lead, and zinc in groundwater appeared to pose the most significant risks to aquatic receptors via groundwater discharge and subsequent deposition in sediments at the shoreline. Copper and lead were also groundwater ECCs in the Phase I assessment. Contaminants detected in surface water did not appear to pose significant potential risks to aquatic receptors. Copper, lead, and zinc appeared to pose significant potential risks in sediment and, as mentioned above, may be migrating to the shoreline via groundwater. Slightly elevated concentrations of several organics, primarily organochlorine pesticides and PAHs, exceeded sediment thresholds, but HQ values were low, frequencies of detection were low, or the contaminants did not appear to originate from IR 8 soil or groundwater. Potential risks to soil invertebrates and terrestrial plants were also low (B&RE, 1998a).

Copper, lead, and zinc were elevated in IR 8 crabs, relative to background crabs collected for the assessment, and these three metals were ecological COPCs in surface water and sediment. In lobsters, only copper was slightly elevated relative to background lobsters. Several metals were elevated in conchs from IR 8, relative to background conchs. Of these inorganics, copper, lead, and zinc appeared to have originated from IR 8, mainly from groundwater discharge. However, most concentrations of these inorganic contaminants in IR 8 biota did not appear to be significantly elevated in comparison to concentrations of these metals reported in the literature for similar organisms from other background areas. Inorganics did not appear to be accumulating in turtle grass collected from IR 8. Organics did not

appear to be bioaccumulating in any biota collected, with the exception of nominal accumulation of chlorobenzilate in milk conchs (B&RE, 1998a).

The results of foodchain modeling indicated that potential risks to terrestrial mammals from IR 8-related contaminants were insignificant. In addition, potential risks to the kestrel were also insignificant. Since these receptors included a representative mammalian carnivore, mammalian herbivore, and avian carnivore, potential risks to other similar species were probably low (B&RE, 1998a).

The results of modeling, in concert with the aquatic investigations, indicated that potential ecological risks at IR 8 were primarily confined to risks to benthic organisms from copper, lead, and zinc in sediment. These three metals were classified as sediment ECCs. Groundwater discharge of copper, lead, and zinc appeared to be the dominant pathway. However, the bioavailability and toxicity of IR 8 sediment contaminants to benthos was not assessed during the ERA. For this reason, the Sediment Toxicity Study was performed in 1998. The results of the sediment toxicity study are presented in Section 2.4.2.2. The sediment toxicity study concluded that potential ecological risks from site-related contaminants at IR 8 were negligible (TtNUS, 1999a).

## 2.6 THE SELECTED REMEDIES

The remedies selected in this Decision Document address sites IR 1 and IR 8. Based on available information and the current understanding of site conditions by the NAS Key West Partnering Team, each of the remedies was selected to provide the best balance of the nine NCP evaluation criteria. In particular, the selected remedies meet the following NCP threshold criteria:

- Protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements (ARARs)

### 2.6.1 IR 1 - Truman Annex Refuse Disposal Area

The selected remedy for IR 1 is LUCs (limited site access) with monitoring of groundwater, sediment, and biota quality.

### 2.6.2 IR 8 - Fleming Key South Landfill

The selected remedy for IR 8 is LUCs (limited site access) with monitoring of groundwater quality.

### 2.6.3 Memorandum of Agreement

By separate Memorandum of Agreement (MOA) dated 31 August 1998, with EPA and FDEP, NAS Key West (on behalf of the Department of the Navy) agreed to implement base-wide, certain periodic site inspection, condition certification, and agency notification procedures designed to ensure the maintenance by Station personnel of any site-specific LUCs deemed necessary for future protection of human health and the environment. A fundamental premise underlying execution of that agreement was that through the Navy's substantial good-faith compliance with the procedures called for therein, reasonable assurances would be provided to U.S. EPA and FDEP as to the permanency of those remedies which included the use of specific LUCs.

Although the terms and conditions of the MOA are not specifically incorporated or made enforceable herein by reference, it is understood and agreed by the Navy, U.S. EPA and FDEP that the contemplated permanence of the remedy reflected herein shall be dependent upon the Station's substantial good-faith compliance with the specific LUC maintenance commitments reflected therein. Should such compliance not occur or should the MOA be terminated, it is understood that the protectiveness of the remedy concurred in may be reconsidered and that additional measures may need to be taken to adequately ensure necessary future protection of human health and the environment.

## 2.7 STATUTORY DETERMINATIONS

Remedial Actions must meet the statutory requirements of Section 121 of CERCLA (42 U.S.C. 9621) as discussed below, although NAS Key West is not a National Priorities List (NPL) site.

Remedial Actions must achieve the statutory requirements of four evaluation criteria. In order to be eligible for selection in accordance with the NCP, the four criteria must be met by the Remedial Action. Those criteria are: be protective of human health and the environment; comply with ARARs; be cost effective; and utilize permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practicable. Potential ARARs are listed in Table 2-8. In addition, this section addresses the statutory preference for treatment as provided in CERCLA Section 121.

The following discussion summarizes the statutory requirements that are met by the selected remedies.

### 2.7.1 Protection of Human Health and the Environment

The selected remedies implement measures to control sources of contamination and exposure of humans or the environment to residual contamination as is necessary to protect human health and the

environment. This includes permanent notification of groundwater use restrictions in local land records, in order to control exposure of humans to possible residual contamination in groundwater at IR 1 and IR 8.

LUCs at IR 1 and IR 8 will include limited site access to reduce the possibility of exposure to human receptors. For each site, a Land-Use Control Implementation Plan (LUCIP) will be developed as part of the remedial action. The LUCIP will include, when applicable, details on access controls, requirements for signs along the perimeter of the site, restrictions on shallow groundwater use, a description of the LUCs in the Base Master Plan, periodic inspection and re-evaluation of LUCs, annual certification that LUCs are in place, notification to the EPA and FDEP regulators when the Navy anticipates any major changes in land-use restrictions, public notice, and a deed notification.

The Navy shall institute the LUCs within 90 days of completion of each remedy at IR 1 and IR 8. The Base Master Plan shall note the areas as restricted for residential development, restricted for shallow groundwater use, and site access shall be limited. A notation will be filed in the property file maintained at SouthDiv indicating the extent of the areas governed by LUCs and the fact that solid wastes are present. Within 90 days after completion of each remedy, the Navy shall produce a survey plat, prepared by a State of Florida land surveyor, indicating the location and dimensions of each site. The plat shall contain a note, prominently displayed, which states the owner's future obligation to restrict disturbance (excavation or construction) of the property. In addition, post-closure use of the property shall prohibit residential use.

### 2.7.2 Compliance with ARARs

Surface soil contamination at IR 1 remains in excess of residential action levels. However, IR 1 is a restricted-access military installation and residential use is not anticipated. LUCs will be implemented at IR 1 to enforce limited site access. Sediment toxicity testing at IR 1 concluded that risks to ecological receptors may exist in the area of one sediment sample location. Sediment in this area, as well as in other areas, will be monitored quarterly and sediment toxicity testing performed annually to ensure that the remedy is protective of the environment. Groundwater at NAS Key West is nonpotable. Drinking water for Key West is supplied from the mainland. Although contamination does remain in both IR 1 and IR 8 groundwater above ARARs, LUCs at both sites will restrict groundwater use; and quarterly sampling of groundwater will monitor contaminant levels.

### 2.7.3 Implementability

LUCs are an implementable remedy. IR 1 and IR 8 are located on a restricted-access military base. Limiting site access for IR 1 and IR 8 is readily implementable, as is monitoring of the applicable media at each site.

### 2.7.4 Cost Effectiveness

The LUCs are cost-effective because IR 1 and IR 8 are located on a restricted-access military base. Minimal costs are associated with performance monitoring at these sites.

### 2.7.5 Permanent Solution or Alternative Treatment Technology

The remedies at IR 1 and IR 8 utilize permanent solutions. Alternative treatment technologies were not appropriate for IR 1 and IR 8 because treatment was not needed; LUCs will be effective in protecting human health and the environment.

### 2.7.6 CERCLA Preference for Treatment

Treatment was not considered an appropriate remedy for IR 1 and IR8. The only risk scenario for both sites having noncarcinogenic risks above acceptable levels was for exposure of an hypothetical future resident. Likewise, carcinogenic risks for both sites were below or within EPA's target risks range, except for the future resident scenario. Both IR 1 and IR 8 are located on a restricted-access military base and residential development of these sites is not foreseen.

### 2.7.7 CERCLA Five-Year Review

Because these remedies will result in chemicals above action levels remaining on-site, a review will be conducted within five years after commencement of the remedial actions to ensure that the remedies continue to provide adequate protection of human health and the environment.

**TABLE 2-1**

**MAXIMUM DETECTED CONCENTRATIONS FOR COCS AT IR 1
NAS KEY WEST, FLORIDA**

| Location | Chemical of Concern | Maximum Detected Value | Action Level |
|---|---|---|---|
| **SURFACE SOIL** | | | |
| Inorganics (mg/kg) | | | |
| I1S12(C) | Antimony | 203 | 26 |
| I1E8 | Arsenic | 44.7 | 2.66 |
| I1E22(C) | Iron | 45,200 | 23,000 |
| **SEDIMENT** | | | |
| Inorganics (mg/kg) | | | |
| I1SS-4 | Arsenic | 12.1 | 7.2 |
| I1SS-4 | Iron | 32,600 | 2398 |
| PCBs (µg/kg) | | | |
| I1SS-2 | Aroclor-1254 | 669 | 22.7 |
| I1SS-1 | Aroclor-1260 | 18,260 | 22.7 |

All maximum values are post-IRA.

**TABLE 2-2**

**MAXIMUM DETECTED CONCENTRATIONS FOR GROUNDWATER AT IR 1
NAS KEY WEST, FLORIDA**

| Location | Parameter | Maximum Detected Value | Action Level |
|---|---|---|---|
| Inorganics (µg/L) | | | |
| I1MW1-3 | Aluminum | 46500 | 37000 |
| I1MW-5 | Antimony | 563 | 6 |
| I1MW-2 | Arsenic | 62.2 | 50 |
| I1MW1-2 | Cadmium | 54.5 | 5 |
| I1MW1-3 | Chromium | 657 | 100 |
| I1MW1-3 | Copper | 10200 | 1500 |
| I1MW1-2 | Iron | 155000 | 11000 |
| I1MW1-2 | Lead | 5700 | 15 |
| I1MW1-2 | Manganese | 2940 | 840 |
| I1KWM-02 | Mercury | 640 | 2 |
| I1MW1-2 | Nickel | 303 | 100 |
| I1MW1-1 | Selenium | 54.6 | 50 |
| I1MW1-2 | Zinc | 15200 | 11000 |
| Organics (µg/L) | | | |
| I1MW1-2 | 4,4'-DDD | 1.3 | 0.28 |
| I1MW1-3 | Alpha-BHC | 0.015 | 0.011 |
| I1MW1-2 | Alpha-chlordane | 2.1 | 0.052 |
| I1KWM-02 | Benzene | 1.6 | 1 |
| I1MW1-2 | Beta-BHC | 1.4 | 0.037 |
| I1MW-5 | Dieldrin | 0.023 | 0.0042 |
| I1MW1-1 | Endosulfan sulfate | 0.027 | NA |
| I1MW1-2 | gamma-chlordane | 1.3 | 0.052 |
| I1MW1-2 | Heptachlor | 1 | 0.4 |
| I1MW1-2 | Heptachlor epoxide | 0.65 | 0.2 |
| I1KWM-03 | Methylene chloride | 5.2 | 5 |
| I1KWM-02 | Phenanthrene | 14 | NA |
| I1KWM-04 | Trichloroethene | 14 | 3 |

NA = Not applicable. No action level has been selected for this chemical and medium.

**TABLE 2-3**

**MAXIMUM DETECTED CONCENTRATIONS FOR COCS AT IR 8**
**NAS KEY WEST, FLORIDA**

| Location | Chemical of Concern | Maximum Detected Value | Action Level |
|---|---|---|---|
| **IR 8 SEDIMENT** | | | |
| Inorganics (mg/kg) | | | |
| I8S-3 | Antimony | 20.7 | 12 |
| I8S-2 | Arsenic | 43.5 | 7.2 |
| IR8-4 | Iron | 52,750 | 2398 |
| I8S-2 | Thallium | 168 | NA |
| **IR 8 SURFACE WATER** | | | |
| Inorganics (µg/L) | | | |
| I8SS-9(IT) | Antimony | 220 | 4300 |
| I8SW-1 | Arsenic | 57.3 | 50 |
| I8SW-1 | Iron | 305,000 | 300 |

NA = Not Applicable. No action level has been selected for this chemical and medium.

**TABLE 2-4**

**MAXIMUM DETECTED CONCENTRATIONS FOR GROUNDWATER AT IR 8
NAS KEY WEST, FLORIDA**

| Location | Parameter | Maximum Detected Value | Action Level |
|---|---|---|---|
| Inorganics (µg/L) | | | |
| I8MW8-2 | Aluminum | 72,000 | 37000 |
| I8MW1-2 | Antimony | 236 | 6 |
| I8MW8-6 | Arsenic | 104 | 50 |
| I8MW8-6 | Cadmium | 26.4 | 5 |
| I8KWM-14 | Copper | 1,780 | 1500 |
| I8MW8-6 | Iron | 57,200 | 11000 |
| I8MW8-3 | Lead | 1,870 | 15 |
| I8KWM-13 | Mercury | 620 | 2 |
| I8MW-9 | Thallium | 11.6 | 4.62 |
| Organics (µg/L) | | | |
| I8MW8-6 | alpha-BHC | 0.17 | 0.011 |
| I8KWM-13 | Benzene | 1.8 | 1 |
| I8MW8-6 | Bis(2-ethylhexyl)phthalate | 16.5 | 6 |
| I8MW8-1 | Heptachlor | 0.62 | 0.4 |
| I8KWM-16 | Methylene chloride | 6 | 5 |

**TABLE 2-5**

**HUMAN HEALTH CHEMICALS OF CONCERN AND REPRESENTATIVE CONCENTRATIONS BY SITE
NAS KEY WEST, FLORIDA**

| Chemical of Concern | Representative Concentration |
|---|---|
| **IR 1 Surface Soil** | |
| Inorganics (mg/kg) | |
| Antimony | 32.8 |
| Arsenic | 3.32 |
| Iron | 6250 |
| **IR 1 Sediment** | |
| Inorganics (mg/kg) | |
| Arsenic | 6.81 |
| Iron | 32100 |
| Organics (µg/kg) | |
| Aroclor-1254 | 669 |
| Aroclor-1260 | 18300 |
| **IR 8 Sediment** | |
| Inorganics (mg/kg) | |
| Antimony | 11 |
| Arsenic | 13.3 |
| Iron | 27,100 |
| Thallium | 168 |
| **IR 8 Surface Water** | |
| Inorganics (µg/L) | |
| Antimony | 220 |
| Arsenic | 57.3 |
| Iron | 305,000 |

Ninety-five percent upper confidence limits (UCLs) were used as representative concentrations for reasonable maximum exposure (RME) and central tendency evaluation.

## TABLE 2-6

## CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE RISKS AT IR 1
## NAS KEY WEST, FLORIDA

| Exposure Route | Resident | Trespasser Adult | Trespasser Adolescent | Maintenance Worker | Excavation Worker | Occupational Worker |
|---|---|---|---|---|---|---|
| **INCREMENTAL CANCER RISK** | | | | | | |
| **Surface Soil** | | | | | | |
| Incidental Ingestion | 8.4E-06 | 1.4E-07 | 1.7E-07 | 1.1E-07 | NA | 9.3E-07 |
| Dermal Contact | 3.0E-05 | 1.2E-06 | 1.1E-06 | 7.7E-07 | NA | 6.4E-06 |
| Inhalation of Fugitive Dust | 1.0E-11 | 6.5E-14 | 4.7E-14 | 8.6E-14 | NA | 1.8E-12 |
| Subtotal | 3.8E-05 | 1.3E-06 | 1.2E-06 | 8.8E-07 | NA | 7.4E-06 |
| **Subsurface Soil** | | | | | | |
| Incidental Ingestion | NA | NA | NA | NA | 2.2E-07 | NA |
| Dermal Contact | NA | NA | NA | NA | 1.0E-06 | NA |
| Inhalation of Fugitive Dust | NA | NA | NA | NA | 5.8E-13 | NA |
| Subtotal | NA | NA | NA | NA | 1.2E-06 | NA |
| **Sediment** | | | | | | |
| Incidental Ingestion | 2.2E-05 | 1.3E-06 | 1.6E-06 | NA | NA | NA |
| Dermal Contact | 6.7E-05 | 9.1E-06 | 8.3E-06 | NA | NA | NA |
| Subtotal | 8.9E-05 | 1.0E-05 | 9.9E-06 | NA | NA | NA |
| **Surface Water** | | | | | | |
| Incidental Ingestion | ** | ** | ** | NA | NA | NA |
| Dermal Contact | ** | ** | ** | NA | NA | NA |
| Subtotal | ** | ** | ** | NA | NA | NA |
| **Shellfish*** ** | | | | | | |
| Ingestion | 1.4E-05 | NA | NA | NA | NA | NA |
| Subtotal | 1.4E-05 | NA | NA | NA | NA | NA |
| **TOTAL** | 1.3E-04 | 1.2E-05 | 1.1E-05 | 8.8E-07 | 1.2E-06 | 7.4E-06 |
| **HAZARD INDEX** | | | | | | |
| **Surface Soil** | | | | | | |
| Incidental Ingestion | 2.3E+00 | 1.7E-02 | 3.7E-02 | 9.9E-03 | NA | 8.7E-02 |
| Dermal Contact | 3.2E-01 | 1.4E-02 | 2.2E-02 | 7.0E-03 | NA | 5.9E-02 |
| Inhalation of Fugitive Dust | 2.5E-07 | 9.2E-10 | 1.1E-09 | 9.2E-10 | NA | 1.9E-08 |
| Subtotal | 2.6E+00 | 3.1E-02 | 5.9E-02 | 1.7E-02 | NA | 1.5E-01 |
| **Subsurface Soil** | | | | | | |
| Incidential Ingestion | NA | NA | NA | NA | 4.5E-02 | NA |
| Dermal Contact | NA | NA | NA | NA | 2.9E-01 | NA |
| Inhalation of Fugitive Dust | NA | NA | NA | NA | ** | NA |
| Subtotal | NA | NA | NA | NA | 3.4E-01 | NA |
| **Sediment** | | | | | | |
| Incidental Ingestion | 6.3E-01 | 1.6E-02 | 3.6E-02 | NA | NA | NA |
| Dermal Contact | 2.9E-01 | 4.4E-02 | 7.0E-02 | NA | NA | NA |
| Subtotal | 9.2E-01 | 6.1E-02 | 1.1E-01 | NA | NA | NA |
| **Surface Water** | | | | | | |
| Incidental Ingestion | 1.4E-03 | 7.2E-05 | 1.6E-04 | NA | NA | NA |
| Dermal Contact | 8.2E-04 | 3.6E-05 | 5.7E-05 | NA | NA | NA |
| Subtotal | 2.2E-03 | 1.1E-04 | 2.1E-04 | NA | NA | NA |
| **Shellfish*** ** | | | | | | |
| Ingestion | 1.7E-02 | NA | NA | NA | NA | NA |
| Subtotal | 1.7E-02 | NA | NA | NA | NA | NA |
| **TOTAL** | 3.5E+00 | 9.2E-02 | 1.6E-01 | 1.7E-02 | 3.4E-01 | 1.5E-01 |

** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
*** = Adult Resident Only.
NA = Not Applicable; pathway is not applicable for the respective media.

## TABLE 2-7

## CUMULATIVE RISKS - REASONABLE MAXIMUM EXPOSURE RISKS AT IR 8
## NAS KEY WEST, FLORIDA

| Exposure Route | Resident | Trespasser Adult | Trespasser Adolescent | Maintenance Worker | Excavation Worker | Occupational Worker |
|---|---|---|---|---|---|---|
| **INCREMENTAL CANCER RISK** | | | | | | |
| **Surface Soil** | | | | | | |
| Incidental Ingestion | ** | ** | ** | ** | NA | ** |
| Dermal Contact | ** | ** | ** | ** | NA | ** |
| Inhalation of Fugitive Dust | ** | ** | ** | ** | NA | ** |
| Subtotal | ** | ** | ** | ** | NA | ** |
| **Subsurface Soil** | | | | | | |
| Incidental Ingestion | NA | NA | NA | NA | 4.7E-08 | NA |
| Dermal Contact | NA | NA | NA | NA | 9.0E-08 | NA |
| Inhalation of Fugitive Dust | NA | NA | NA | NA | 1.4E-15 | NA |
| Subtotal | NA | NA | NA | NA | 1.4E-07 | NA |
| **Sediment** | | | | | | |
| Incidental Ingestion | 9.5E-06 | 5.4E-07 | 6.8E-07 | NA | NA | NA |
| Dermal Contact | 3.4E-05 | 4.7E-06 | 4.3E-06 | NA | NA | NA |
| Subtotal | 4.4E-05 | 5.2E-06 | 4.9E-06 | NA | NA | NA |
| **Surface Water** | | | | | | |
| Incidental Ingestion | 3.4E-05 | 3.0E-06 | 3.8E-06 | NA | NA | NA |
| Dermal Contact | 1.2E-05 | 1.7E-06 | 1.5E-06 | NA | NA | NA |
| Subtotal | 4.6E-05 | 4.6E-06 | 5.3E-06 | NA | NA | NA |
| **Shellfish*** ** | | | | | | |
| **Ingestion** | 1.1E-05 | NA | NA | NA | NA | NA |
| Subtotal | 1.1E-05 | NA | NA | NA | NA | NA |
| **TOTAL** | 1.0E-04 | 9.8E-06 | 1.0E-05 | ** | 1.4E-07 | ** |
| **HAZARD INDEX** | | | | | | |
| **Surface Soil** | | | | | | |
| Incidental Ingestion | ** | ** | ** | ** | NA | ** |
| Dermal Contact | ** | ** | ** | ** | NA | ** |
| Inhalation of Fugitive Dust | ** | ** | ** | ** | NA | ** |
| Subtotal | ** | ** | ** | ** | NA | ** |
| **Subsurface Soil** | | | | | | |
| Incidental Ingestion | NA | NA | NA | NA | 7.3E-03 | NA |
| Dermal Contact | NA | NA | NA | NA | 1.4E-02 | NA |
| Inhalation of Fugitive Dust | NA | NA | NA | NA | ** | NA |
| Subtotal | NA | NA | NA | NA | 2.1E-02 | NA |
| **Sediment** | | | | | | |
| Incidental Ingestion | 8.4E+00 | 2.2E-01 | 4.7E-01 | NA | NA | NA |
| Dermal Contact | 6.5E-01 | 1.0E-01 | 1.6E-01 | NA | NA | NA |
| Subtotal | 9.0E+00 | 3.2E-01 | 6.3E-01 | NA | NA | NA |
| **Surface Water** | | | | | | |
| Incidental Ingestion | 4.3E+00 | 2.2E-01 | 4.8E-01 | NA | NA | NA |
| Dermal Contact | 2.9E+00 | 1.3E-01 | 2.0E-01 | NA | NA | NA |
| Subtotal | 7.2E+00 | 3.5E-01 | 6.8E-01 | NA | NA | NA |
| **Shellfish*** ** | | | | | | |
| **Ingestion** | 1.2E-01 | NA | NA | NA | NA | NA |
| Subtotal | 1.2E-01 | NA | NA | NA | NA | NA |
| **TOTAL** | 1.6E+01 | 6.6E-01 | 1.3E+00 | ** | 2.1E-02 | ** |

** = Either no COPCs were selected or the COPCs selected for this pathway did not have applicable toxicity values.
*** = Adult Resident Only.
NA = Not Applicable; pathway is not applicable for the respective media.

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# APPENDIX A

# RESPONSIVENESS SUMMARY

## APPENDIX A. RESPONSIVENESS SUMMARY

## RESPONSES TO COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD FOR SITES IR 1 AND IR 8

Mr. Ray Blazevic, private citizen, Key West, Florida, submitted the following comments during the public meeting held on 27 March 2000:

**Comment 1:** There should be more announcements given for public meetings such as this. For example, radio advertisements and newspaper announcements could have been repeated on the day of the public meeting to remind people about the meeting.

**Response 1:** A full public information package was sent to everyone listed on the NAS Key West IR Program Public Mailing list, which has about 100 addresses on it. In addition, a public announcement was published in the local newspaper (*The Citizen*) for the public comment period and the public meeting.

**Comment 2:** How did the Navy avoid all of the rubble and debris that is buried at Site IR 1?

**Response 2:** Soil was only removed to a depth of about one foot. The only objects encountered were two cannonballs, which were determined inert by trained ordnance experts and retained by the Naval Air Station as historic artifacts.

**Comment 3:** An injection well was recently installed near the City's sewage treatment plant, which is just south of site IR 8 on the southern tip of Fleming Key. The Navy should get a copy of the final installation report for this well. It could provide some valuable information regarding the local subsurface geology.

**Response 3:** The Navy plans to obtain a copy of the installation report.

**Comment 4:** The NAS newspaper (the *Southernmost Flyer*) should write an article about the good environmental work that the Navy is performing at NAS Key West. The local paper might pick up and publish such an article as well. It would help get the word out to the local community.

**Response 4:** The NAS Key West newspaper has carried numerous environmentally-related articles that the local Key West paper did not publish. The local Key West paper did, however, publish an article about the current public comment period on the day after the public meeting. In addition, NAS Key West environmental personnel have worked diligently over the past five years to establish the Restoration Advisory Board (RAB). Local RAB meetings have become the most effective method for getting NAS Key West environmental information to the citizens of Key West.

## APPENDIX B

## FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION CONCURRENCE LETTER

## APPENDIX B. FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION CONCURRENCE LETTER

Note: The final Decision Document will include the FDEP concurrence letter.