# ECOLOGICAL SAMPLING TECHNICAL MEMORANDUM TO SUPPORT THE SUPPLEMENTAL REMEDIAL INVESTIGATION AT SITE 1 AND SITE 8 NAS KEY WEST FL

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TETRA TECH NUS

# Ecological Sampling Technical Memorandum to Support the Supplemental Remedial Investigation at Sites 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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# ECOLOGICAL SAMPLING TECHNICAL MEMORANDUM

## TO SUPPORT THE SUPPLEMENTAL REMEDIAL INVESTIGATION

## AT SITES IR 1 AND 1R 8

## NAVAL AIR STATION KEY WEST, FLORIDA

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

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# 1.0 INTRODUCTION

This technical memorandum provides an overview of proposed sediment toxicity testing for Installation Restoration (IR) site 1 and IR 8 at Naval Air Station (NAS) Key West, Florida. In addition, the results of recent analyses of sediment physical characteristics at the same two sites are presented and discussed. The recent sampling consisted of the collection of sediments from the vicinity of IR 1, IR 8, and three potential reference sites during May 12-14, 1998. This technical memorandum was prepared by Tetra Tech NUS, Inc., on behalf of the U.S. Navy, Naval Facilities Engineering Command, Southern Division, under the Comprehensive Long-Term Environmental Action-Navy (CLEAN) Contact Number N62467-94-0-0888, Contract Task Order 007.

Sediment toxicity tests have been recommended for IR 1 (Truman Annex Refuse Disposal Area) and IR 8 (Fleming Key South Landfill) as a result of an ecological risk assessment recently conducted for eight sites at NAS Key West. The ecological risk assessment was part of a Supplemental Resource Conservation and Recovery Act (RCRA) Facility Investigation and Remedial Investigation (RFI/RI) conducted on behalf of the U.S. Navy, Naval Facilities Engineering Command, Southern Division (NAVY SOUTHDIV). The Eight-Site RFI/RI Report (B&R Environmental, 1998a) has been reviewed and approved by the U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (FDEP). This document is provided in accordance with the RFI/RI Workplan (ABB, 1995).

The ecological risk assessment concluded that potential site-related ecological risks from contaminants at both IR 1 and IR 8 are limited to benthic organisms. The risk assessment determined that the ecological contaminants of concern (COCs) at IR 1 consist of copper, lead, zinc, Aroclor-1260, and organochlorine pesticides. Ecological COCs at IR 8 consist of copper, lead, and zinc. The selection of COCs at these two sites was based primarily on exceedances of sediment benchmarks. However, the bioavailability and actual toxicity of sediment contaminants to benthic organisms at these sites is not known. Thus, there is a need to better characterize the nature and extent of toxicity in site sediments before proceeding with a feasibility study.

Primary issues to be resolved prior to initiation of sediment toxicity tests include test species, number of samples to be collected for testing, reference sites, and test protocols. This document is intended to promote discussion of these items so that resolution of all issues can be achieved prior to initiation of the toxicity tests. Decisions regarding these issues will be made with the concurrence of the NAS Key West Partnering Team. The NAS Key West Partnering Team is the decision-making body for the NAS Key

West environmental restoration sites, including sites IR 1 and IR 8. The team is composed of representatives from the Navy, Tetra Tech NUS, Inc., Bechtel Environmental, Inc., FDEP, and EPA.

Sections 2.0 and 3.0 of this document describe existing ecological conditions at IRs 1 and 8, respectively, and summarize the results of the ecological risk assessment. Section 4.0 describes potential reference sites. Section 5.0 discusses the results of the May, 1998, sampling and analyses of sediment physical characteristics. Section 6 provides a discussion of toxicity tests proposed for IRs 1 and 8.

# 2.0 IR 1 (TRUMAN ANNEX REFUSE DISPOSAL AREA)

The site description, history, and the human health and ecological risk assessments are discussed in detail in Section 5.0 of the Eight-Site RFI/RI Report (B&R Environmental, 1998a) and are summarized below.

## 2.1 HABITATS AND ECOLOGICAL RECEPTORS

IR 1 is located adjacent to the open ocean along the southern shore of Truman Annex on Key West (Figures 2-1 and 2-2). The site covers an area of approximately 7 acres, and consists primarily of a Navy antenna field. 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 the 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 (ABB 1995).

Terrestrial habitat at IR 1 consists largely of mowed turf grass enclosed by a chain link fence. Outside the chain link fence is a 5 to 15-foot strip of weeds and a few Australian pines (*Casuarina equisetifolia*). Large concrete rubble and boulders have been placed along the shoreline for protection against erosion. Due to the overall lack of vegetation (other than turf grass) the site is probably utilized by few terrestrial receptors. Birds, however, forage occasionally in grassy areas on the site. There are no freshwater resources at IR 1.

A diverse assemblage of marine life was observed within the near shore vicinity of IR 1 during September 1996 and May 1998 sampling activities. Common aquatic 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 muricatum*), green moray eel (*Gymnothorax funebris*), hermit crab (*Petrochirus diogenes*), tarpon (*Megalops atlanticus*), barracuda (*Sphyraena barracuda*), and several other fish.

## 2.2 ECOLOGICAL RISK SUMMARY

The ecological risk assessment was based on the analyses of groundwater and soil samples collected from IR 1, and the analyses of surface water, sediment, and tissue samples (spiny lobster, Caribbean vase conch, giant hermit crab, and turtle grass) collected from the near-shore vicinity of the site. Runoff and groundwater discharge to the ocean are potential contaminant migration pathways from IR 1.

Ecological COCs in groundwater consist of endosulfan I, dieldrin, and gamma-BHC. Based on exceedances of ecological benchmark values, sediment COCs consist of Aroclor-1260, 4,4'-DDT, dieldrin, endrin, endosulfan, gamma-BHC, some daughter products of these pesticides, as well as copper, lead, and zinc. COCs in soil consist of copper, lead, and zinc. The use of the site by terrestrial receptors is minimal, and thus, these metals do not pose a potential risk to terrestrial receptors; however, they are considered soil COCs due to their potential for migration to aquatic habitats near IR 1. Copper and zinc were elevated (relative to background tissue samples) in some crab and lobster samples from the vicinity of IR 1, but most concentrations were not significantly elevated in comparison to concentrations of these metals reported in the literature for similar organisms from other background areas. Overall, potential ecological risks from metals and organic compounds appear to be limited to benthic organisms. However, the bioavailability and toxicity of sediment contaminants to benthic organisms is not known. Thus, there is a need to better characterize the nature and extent of toxicity in IR 1 sediments before proceeding with a feasibility study.

Figure 2-1. IR 1, IR 8, and Reference Sites.

Figure 2-2. Site Location Map – IR 1

# 3.0 IR 8 (FLEMING KEY SOUTH LANDFILL)

The site description, history, and the human health and ecological risk assessments are discussed in detail in Section 8 of the Eight-Site RFI/RI Report (B&R Environmental, 1998a) and are summarized below.

## 3.1 HABITATS AND RECEPTORS

IR 8 covers approximately 45 acres in the southwestern portion of Fleming Key (Figures 2-1 and 3-1). The southeastern portion of the site is bordered by the City of Key West Sewage Treatment Plant. A munitions storage area is located along the east boundary of the site. The remainder of the site is bordered by ocean water (Man of War Harbor). As much as 8,000 tons of various wastes reportedly were disposed at the landfill annually between 1962 and 1982.

A closed canopy of Australian pines exists throughout most of the site, and ground cover is generally sparse. Brazilian pepper (*Schinus terebinthifolius*) and weedy species such as sandbur (*Cenchrus tribuloides*) and *Cyperus* spp. occur in areas where sufficient sunlight can reach the ground. These areas are limited primarily to narrow dirt access roads within the site. Red mangroves (*Rhizophora mangle*) and sea purslane (*Sesuvium maritimum*) have been planted along the shoreline of IR 8 in order to provide shoreline stabilization as part of recent Interim Remedial Action activities. There are no surface freshwater resources at IR 8.

Since most of the site is a monoculture of Australian pines, the site provides poor habitat for terrestrial species. Nevertheless, a few species of mammals, reptiles, arboreal birds, and avian raptors utilize the site. Turtle grass is abundant and is the dominant aquatic vegetation in near shore waters of IR 8. Aquatic marine life observed during sampling activities conducted in 1996 and 1998 included queen conch, milk conch (*Strombus costatus*), stone crab (*Menippe mercenaria*), spiny spider crab (*Mithrax spinosissimus*), true tulip snails (*Fasciolaria tulipa*), spiny lobsters, and several fish species.

## 3.2 ECOLOGICAL RISK SUMMARY

The ecological risk assessment was based on the analyses of groundwater and soil samples collected from IR 8, and the analyses of surface water, sediment, and tissue samples (spiny lobster, stone crab, spiny spider crab, true tulip, milk conch, and turtle grass) collected from the near shore vicinity of the site. Based on exceedances of ecological benchmark values, ecological COCs at IR 8 consist of copper, lead, and zinc in sediment. Groundwater discharge of these metals to the ocean appears to be the dominant

migration pathway. These metals were also elevated (relative to background tissue samples) in some crab, lobster, and conch samples from the vicinity of IR 8, but most concentrations were not significantly elevated in comparison to concentrations of these metals reported in the literature for similar organisms from other background areas. Interim Remedial Actions have been recently completed at IR 8. These actions consisted of removal of debris from along the shoreline, the installation of shoreline protection structures, and revegetation (using native species) along the shoreline. The impact of these actions on sediments is not known. However, sediment concentrations of site-related contaminants are expected to gradually decrease as a result of the Interim Remedial Action activities.

Overall, potential ecological risks at IR 8 are confined to risks to benthic organisms from copper, lead, and zinc in sediments. However, the bioavailability and toxicity of these metals to benthic organisms is not known. Thus, there is a need to better characterize the nature and extent of toxicity in IR 8 sediments before proceeding with a feasibility study.

Figure 3-1. Site Location Map – IR 8

# 4.0 REFERENCE SAMPLING LOCATIONS

The assessment of in situ sediment toxicity at IRs 1 and 8 will be aided by the collection and testing of reference samples. Reference sediments are used to assess sediment conditions exclusive of the materials of interest, and provide a site-specific basis for evaluating toxicity. A reference sediment should possess similar geomorphological and physico-chemical characteristics as the test sediment.

Sediment samples were collected from three reference locations that were utilized in the Eight-Site RFI/RI Report. The designations used in the Eight-Site RFI/RI Report (i.e., Background 4, Background 5, and Background 8) will be retained when referring to these sites, which are briefly described below.

The results of chemical analyses of sediment samples for the Eight-Site RFI/RI Report collected from these sites indicate that sediments at all three sites are relatively uncontaminated. Background 4 and Background 8 appear to be the most similar to IRs 1 and 8 in terms of shoreline types and near shore marine habitats.

## 4.1 BACKGROUND 4 (DREDGERS KEY)

Dredgers Key is ½ mile north of Key West and 1 mile east of Fleming Key (Figure 2-1). Various U.S. Navy facilities exist on the western and central portions of Dredgers Key. The northeastern portion of the island is relatively undeveloped. The northeastern shoreline is covered by Australian pines and red mangroves (*Rhizophora mangle*). Sea grass communities exist in near shore waters. During May 13, 1998, one sediment sample was collected from an area near the northeastern shoreline of Dredgers Key, and one sample was collected from the area immediately south of the eastern tip of the island.

## 4.2 BACKGROUND 5 (BLUEFISH CHANNEL)

This site is located approximately 5 miles north of Key West, and consists of the open-water area between Bluefish Channel and Bay Keys (Figure 2-1). Aquatic habitat in the vicinity of BG 5 consists of large areas dominated by turtle grass. Manatee grass (*Syringodium filiforme*), shoal grass (*Halodule wrightii*), and other submerged aquatic plants are also found in the shallow water (3 to 6 ft) in this area. Two sediment samples were collected from this area during May 14, 1998.

## 4.3 BACKGROUND 8 (WISTERIA ISLAND)

Wisteria Island is located approximately ½ mile northwest of Key West (Figure 2-1). No development exists on the island, which is covered with a dense canopy of Australian pines. The shoreline consists of calcareous rock and shell fragments. Submerged aquatic vegetation surrounding the island is dominated by turtle grass. Three sediment samples were collected from the vicinity of Wisteria Island on May 12, 1998; one each from the northern, western, and southern shorelines.

# 5.0 SEDIMENT PHYSICAL CHARACTERISTICS

This section presents a brief overview of the recent sampling and analyses of sediment physical and chemical characteristics.

## 5.1 COLLECTION AND PROCESSING

Sediment samples were collected from the vicinity of IR 1, IR 8, and three potential reference sites during May 12-14, 1998. Sediment was collected using a "clamshell" grab sampler. This sampler is similar to a petite ponar, but slightly smaller. Samples were collected primarily from the upper two centimeters of sediment, since this is often the most "biologically active" portion of sediments. Extreme care was taken to obtain the samples with as little disruption as possible and to retain the fine-grained portion of each sediment grab. Samples generally consisted of a composite of several grabs collected from the within the same general area and sediment type. Four samples were collected from each IR site, three samples were collected from reference site BG 8, and two each from reference sites BG 4 and BG 5. Samples were stored on ice at 4°C and shipped via overnight delivery to the testing laboratory. Samples were processed and shipped in accordance with FDEP standard operating procedures (FDEP 1992), Section 4.4 of the RFI/RI Sampling and Analysis Plan (ABB, 1995), and the Ecological Sampling Technical Memorandum (B&R Environmental, 1998b).

## 5.2 RESULTS OF ANALYSES

The results of the sediment analyses are provided in Table 5-1. Parameters measured in whole sediment samples included water content, grain size, total organic carbon, pH, and redox potential. Pore water was extracted from whole sediment by placing homogenized samples into a centrifuge for approximately 15 minutes, after which the liquid fraction was decanted into a separate container for the desired analyses. Dissolved oxygen, pH, ammonia, and salinity were measured in sediment pore water. The redox potential was measured in the field using a hand-held ORP meter. Particle size distribution was determined by Thompson Engineering, Mobile, Alabama. All other parameters were analyzed by Savannah Laboratories and Environmental Services, Inc., Savannah, Georgia.

The pore water salinity values in three of four IR 1 samples (48-65 ppt) and in one of three BG 8 samples (48 ppt) were somewhat higher than expected. The salinity of overlying water at the same locations measured using portable field instrumentation ranged from 34 to 36 ppt. Seawater salinity is usually approximately 35 ppt. An explanation for the elevated pore water values is lacking; the values could possibly be an artifact of the analytical process, such as partial evaporation of the samples prior to the

salinity being measured. Sediment pore water was not analyzed for sample IR 1-2 (Table 5-1) due to insufficient sample volume.

# 6.0 PROPOSED INVESTIGATIONS

This section describes the proposed sediment toxicity test organism and test methodology, and briefly discusses how the sediment samples will be collected, processed, and analyzed.

## 6.1 TEST ORGANISM

A variety of organisms have been used in sediment toxicity tests, and the choice of a test organism has a major influence on the relevance and interpretation of a toxicity test. Amphipods are among the most sensitive of marine benthic species (Lamberson et al, 1992), and are intimately associated with sediment, due to their tube-dwelling or free-burrowing habits, and sediment ingesting nature (EPA, 1994). Based on the data summarized in Table 5-1, and upon the sediment grain-size, temperature, and salinity requirements of potential amphipod species discussed in EPA (1994), *Leptocheirus plumulosus* is the most appropriate species for toxicity testing of sediments at IRs 1 and 8.

*Ampelisca abdita* is an amphipod that is found in Florida and is often used in sediment toxicity tests. However, *Ampelisca* does not tolerate sediments where the silt-clay fraction is less than 10 percent. Five of the eight IR1 and IR 8 sediment samples had less than 10 percent silt-clay. *Ampelisca* is also more sensitive to ammonia (which can be toxic) than is *Leptocheirus* and has a lower temperature requirement. *Leptocheirus plumulosus* also occurs in Florida (although not as far south as the Keys) and tolerates a wide variety of sediment grain sizes.

## 6.2 TEST METHODS

Twenty-eight day whole sediment toxicity tests will be performed using *Leptocheirus plumulosus.* This organism is commonly used in laboratory toxicity tests, even though 28-day chronic sediment toxicity tests have not been standardized. Standard protocols, however, are being developed and are available in draft format. Methods provided in “The *Leptocheirus plumulosus* Chronic Sediment Toxicity Test Method for the Round-Robin Study”, available from USEPA, will serve as the basis for the test methodology. This will be supplemented by EPA 600/R-94/025, *Methods for Assessing the Toxicity of Sediment-associated Contaminants with Estuarine and Marine Amphipods* (EPA, 1994). Mortality, growth (length), and reproduction/sexual maturation (number of young/surviving female) will be measured. If initial observed mortality is high, test duration will be shortened to the 10 days of an acute toxicity test.

Ten sediment samples will be collected from the near shore areas of IR 1 and IR 8. Toxicity tests will be conducted on each sample, along with analyses for metals, pesticides/PCBs, total organic carbon, particle size distribution, and water content. Although pesticides and PCBs were not final ecological COCs at IR 8, concentrations were elevated in some sediment and tissue samples. Volatile and semivolatile organic compounds were not shown to be a concern in previous studies of IR 1 or IR 8. Proposed sampling stations consist of ten locations placed at even intervals along the shorelines of IR 1 and IR 8 (Figures 2-2 and 3-1). Each sample will consist of a composite of at least four grabs.

Biologists conducting the recent sediment sampling noted that a large proportion of the sediments at both IR 1 and IR 8 is composed of calcareous rock and shell remnants, with a low proportion of silt, clay, and organic material. Thus, even though attempts were made to collect sediments from depositional areas with a higher ratio of silt and clay, the sediments tended to have a high sand-gravel content, and low silt-clay content. As mentioned in Section 6.1, five of the eight IR1 and IR 8 sediment samples collected during May 12-14, 1998, were composed of less than 10 percent silt-clay. The silt-clay content in the other three samples ranged from 20 to 50 percent.

Two composite reference samples will be collected for toxicity testing and chemical analysis: one from BG 4 and one from BG 8. These two samples will be subjected to the same analyses as the IR 1 and IR 8 samples. The results of the toxicity tests using IR1 and IR 8 samples will be compared to toxicity test results using one of the two reference samples. The pairing of the individual reference samples with IR samples will be based primarily on sediment particle size. The toxicity tests, chemical analyses, and results of the previous ecological risk assessment will be used to characterize the risks to benthic organisms in IR 1 sediments.

## 6.3 SAMPLING PROCEDURES

Sediments will be collected using a ponar grab sampler or scoop. The upper two centimeters of sediment will be targeted for collection. Extreme care will be taken to obtain the sediment samples with as little disruption as possible and to retain the fine-grained portion of each sediment grab.

Samples will be stored on ice at 4°C and shipped via overnight delivery to the testing laboratory. Samples will be processed and shipped in accordance with FDEP standard operating procedures (FDEP 1992) and Section 4.4 of the RFI/RI Sampling and Analysis Plan (ABB, 1995). Any deviation from these procedures will be discussed and resolved with the NAS Key West Partnering Team.

General field observations of habitat conditions (water depth, bottom type, cover type and extent, channel/basin morphology) and field measurements of physical and chemical water quality parameters (pH, conductivity, salinity, dissolved oxygen, and water temperature) will be made using portable field instrumentation at each site. A formal field notebook will be maintained to document field activities and observations, including any problems and deviations from plans and procedures, for all field sample collection and processing activities.

# 7.0 REFERENCES

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