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FOCUSED FEASIBILITY STUDY SITE 2 NAS PENSACOLA FL
9/25/1997
ENSAFE/ALLEN AND HOSHALL

FOCUSED FEASIBILITY STUDY
NAS PENSACOLA SITE 2
NAVAL AIR STATION
PENSACOLA, FLORIDA

CONTRACT NUMBER: N62467-89-D-0318

CTO - 0059

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

Prepared by:

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The Contractor, EnSafe/Allen & Hoshall, hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0318 is complete, accurate, and complies with all requirements of the contract.

Date: September 25, 1997

Signature:

Name: Henry Beiro

Title: Task Order Manager

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Appendix A Applicable or Relevant and Appropriate Requirements

List of Abbreviations

ARARs	Applicable or Relevant and Appropriate Requirements
AVS	Acid volatile sulfides
BRA	Baseline Risk Assessment
CDFs	Confined Disposal Facilities
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COPCs	Chemicals of Potential Concern
E/A&H	EnSafe/Allen & Hoshall
E&E	Ecology & Environment
EPA	U.S. Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FFS	Focused Feasibility Study
G&M	Geraghty & Miller
HI	Hazard Index
LS	Lump Sum
LTSM	Long-Term Sediment Monitoring
μg/kg	Micrograms per kilogram
mg/kg	Milligrams per kilogram
NADEP	Naval Aviation Depot
NARF	Naval Air Rework Facility
NAS	Naval Air Station
NCP	National Contingency Plan
NOTW	Navy Owned Treatment Works
NRMRL	National Risk Management Research Laboratory
OSHA	Occupational Safety and Health Administration
O&M	Operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
PAH	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated biphenyls
PRG	Preliminary Remedial Goals

PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
SEM	Simultaneously Extracted Metals
SQAG	Sediment Quality Assessment Guidelines
SSVs	Sediment Screening Values
TBC	To Be Considered
TEL	Threshold effects level
USCOE	United States Corp of Engineers
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

EXECUTIVE SUMMARY

This focused Feasibility Study (FFS) develops, evaluates, and compares four remedial action alternatives that can be used to mitigate hazards and threats to the environment (ecological) at Site 2 at Naval Air Station Pensacola. The FFS addresses sediment contamination only, as recommended in the *Remedial Investigation Report for Site 2, Naval Air Station Pensacola, Florida.*

The FFS evaluates the RI, the baseline risk assessment (BRA), and the ecological risk assessment to develop preliminary remedial goals (PRGs) for Site 2. The BRA did not identify any risk to human health, and no further action is required to protect human health under the current use scenario. However, contaminated sediment poses an unacceptable risk to the benthic organisms at Site 2. PRGs assembled for Site 2 are protective of the environment.

Four primary alternatives were evaluated in this FFS:

- No action
- Capping with sand and gravel in areas exceeding PRGs
- Dredging, treatment, and disposal of sediments exceeding PRGs
- Long-term sediment monitoring

Alternatives were screened based on implementability, effectiveness, and cost. Retained alternatives were then analyzed per the *National Contingency Plan* based on:

- long- and short-term effectiveness
- reduction of toxicity, mobility, and volume
- implementability
- cost
- compliance with applicable or relevant and appropriate requirements (ARARs)
- overall protection of human health and the environment

- state acceptance
- community acceptance

A comparative analysis of the four primary alternatives is discussed below:

Threshold criteria

No human health risks are expected at Site 2 from contaminated sediments, and no further action is required to protect human health. Each of the four alternatives protects the environment in varying degrees. No-action allows the environment to continue to function undisturbed. Capping or dredging afford long-term protection of the environment, but will exterminate benthic organisms in the application area (benthic organisms will gradually re-colonize the area). LTSM seeks to monitor changes in risk to the environment in anticipation of decreasing risk through natural processes.

Balancing Criteria

Capping and dredging both provide more long-term effectiveness than the no cation or LTSM options, but have adverse short-term impacts to benthic organisms in the application area. All alternatives are implementable. Capping and dredging both have a present value in excess of $1,000,000, LTSM has a present value of about $200,000, and no-action has no associated costs.

Modifying Criteria

These criteria will be evaluated in detail following comments on the FFS report and the proposed plan, and will be addressed once a final decision is made and the ROD is prepared.

1.0 INTRODUCTION

1.1 Purpose and Organization

The purpose of this Focused Feasibility Study (FFS) is to develop, evaluate, and compare remedial action alternatives that may be used to mitigate hazards and threats to the environment as a result of sediment contamination at Site 2 on the southeastern shoreline of Naval Air Station (NAS) Pensacola. The FFS is being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendment Reauthorization Act of 1986 (SARA) based upon findings reported in the *Final Remedial Investigation Report, Naval Air Station Pensacola, Site 2* (E/A&H, 1996).

This FFS report is organized in the format suggested in Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-01, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (Interim Final, October 1988). The only medium at Site 2 requiring attention is the near-shore sediment in Pensacola Bay. Because of this, the scope of work and alternatives for Site 2 are limited, and an abbreviated feasibility study format was adopted, as described below:

- **Section 1, Introduction:** This section presents background information regarding the Remedial Investigation (RI), baseline risk assessment (BRA), and preliminary remediation goals (PRGs). Remedial volumes identified using PRGs are presented.

- **Section 2, Identification and Screening of Technologies:** This section presents the remedial elements of each alternative, along with its implementability, effectiveness, and cost.

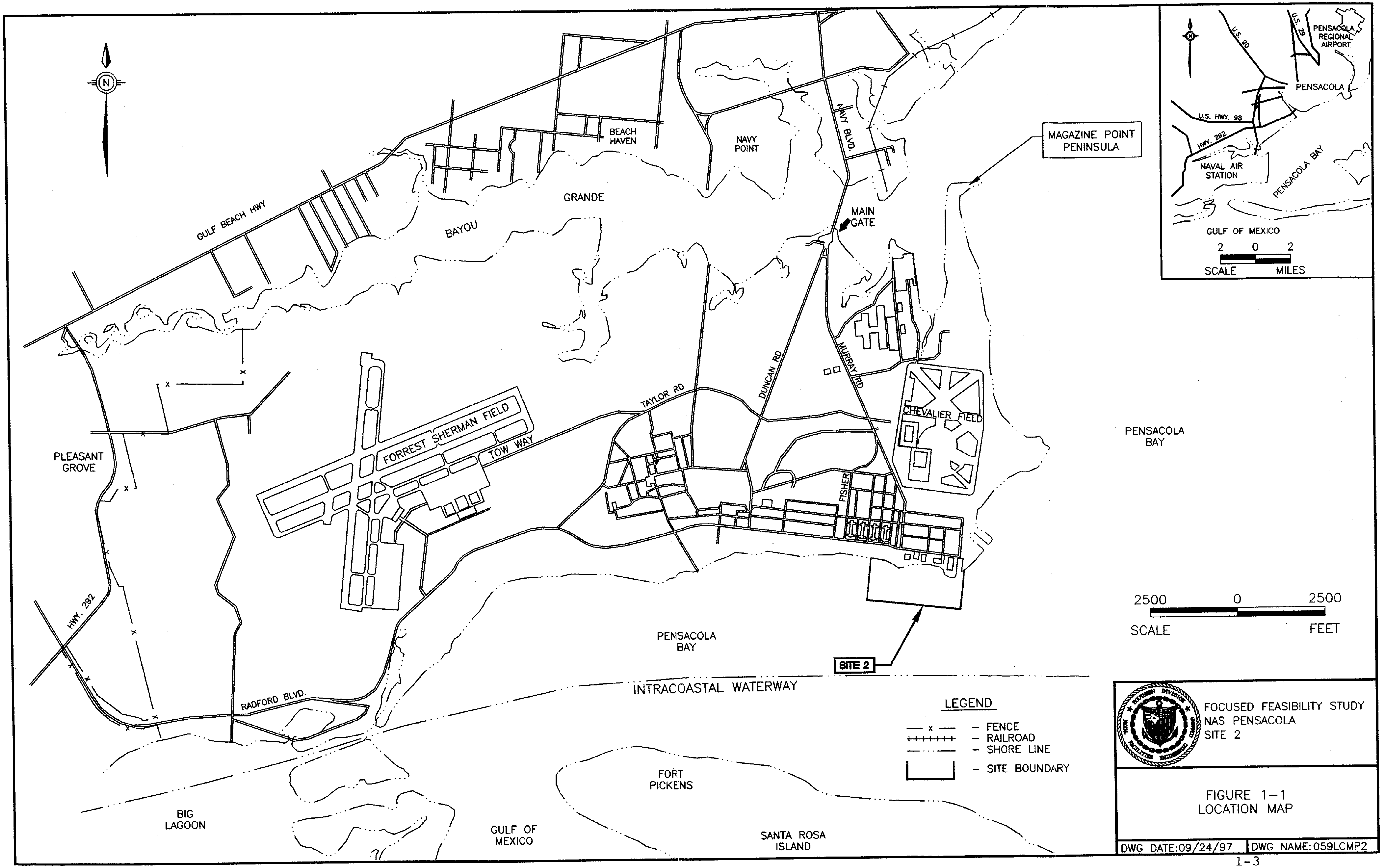
- **Section 3, Detailed Analysis of Alternatives:** This section presents the detailed analysis of alternatives as per the nine criteria outlined in the *National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule* (EPA/540/1-89/002, December 1989).

- **Section 4, Comparative Analysis of Alternatives:** This section compares the alternatives presented in the previous sections, providing decision-makers with a concise summary of differences between the alternatives.

1.2 Background Information

Site 2 is on the southeastern shoreline of NAS Pensacola in Escambia County, Florida. The site consists of an area of near-shore sediments along Pensacola Bay's waterfront. Figure 1-1 is a location map of Site 2 and vicinity. A concrete seawall, approximately 3 to 4 feet high, dominates the shoreline. Fifty-six sewer and industrial wastewater outfalls, ranging from 1 to 42 inches in diameter, were previously identified along the seawall (E&E, 1991). The seawall also accommodates numerous scuppers to drain surface water runoff from the adjacent parking areas.

From 1939 to 1973, untreated industrial wastes from Naval Aviation Depot (NADEP) and Naval Air Rework Facilities (NARF) operations were routinely discharged into Pensacola Bay, near Site 2. Over 34 years, an estimated 83 million gallons of the following materials were disposed of in the bay: waste containing paint, paint solvents, thinners, ketones, trichloroethylene, Alodine, mercury, and concentrated plating wastes (primarily chromium, cadmium, lead, nickel, and cyanide) (G&M, 1984). Other potential impacts may have occurred from vessel operations at the pier and docking facilities in the immediate area. Additionally, because of transport mechanisms characteristic of open bay systems such as Pensacola Bay, offsite sources may also have impacted the site. In 1973, NAS Pensacola's industrial wastestream was diverted to the Industrial Wastewater Treatment Plant (E&E, 1991, 1992a, 1992b) and discharges to Site 2 ceased. Since 1973, numerous environmental studies have been conducted at Site 2 to evaluate the extent of contamination. More detailed information regarding site use and history is presented in the final RI report.



FOCUSED FEASIBILITY STUDY
NAS PENSACOLA
SITE 2

FIGURE 1–1
LOCATION MAP

DWG DATE:09/24/97 | DWG NAME:059LCMP2

1.2.1 Nature and Extent of Contamination

Surface Water: To assess potential environmental impacts, observed water concentrations were compared to federal and state water-quality criteria. Analytical data indicate surface water is not contaminated at or near Site 2. According to the final RI report, few constituents in surface water exceeded established criteria. The only significant occurrence across the site was for silver. However, the reported silver concentrations are suspected to be a result of laboratory matrix interference from the high salinity water.

Sediment: Contaminants of potential concern (COPC) in sediment include metals (cadmium, copper, lead, and zinc) which appear elevated when compared to natural concentrations and organic compounds including polynuclear aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs). However, PAH's and PCB's limited distribution and overall concentrations do not suggest a measurable risk to receptors. Based on contaminant distribution, the final RI report indicates five locations where constituent concentrations exceed an ecological risk assessment hazard index (HI) of 10.

1.2.2 Contaminant Fate and Transport

Site 2 is a complex system with many factors affecting the fate and transport of contaminants introduced to the site. The physical state of the system (saline surface waters, presence of humic substances and clay minerals, and nearby current and past sources for metals) provides a way for contaminants to be introduced into Site 2 media and accumulate there. The bay-gulf channel and intercoastal waterway strongly influence the hydraulic movement of sediment into and away from the site.

Below is a list of potential Site 2 sediment contamination sources identified in the final RI report:

- Past activities associated with Buildings 71 and 72
- Past and current boat maintenance and refueling services in the vicinity

- Past and current surface water runoff
- Past and current routine application of pesticides draining to the Site 2 area
- Past and current offsite bay activities (e.g., boat traffic, non-point source sediment drift)

1.3 Remedial Action Objectives

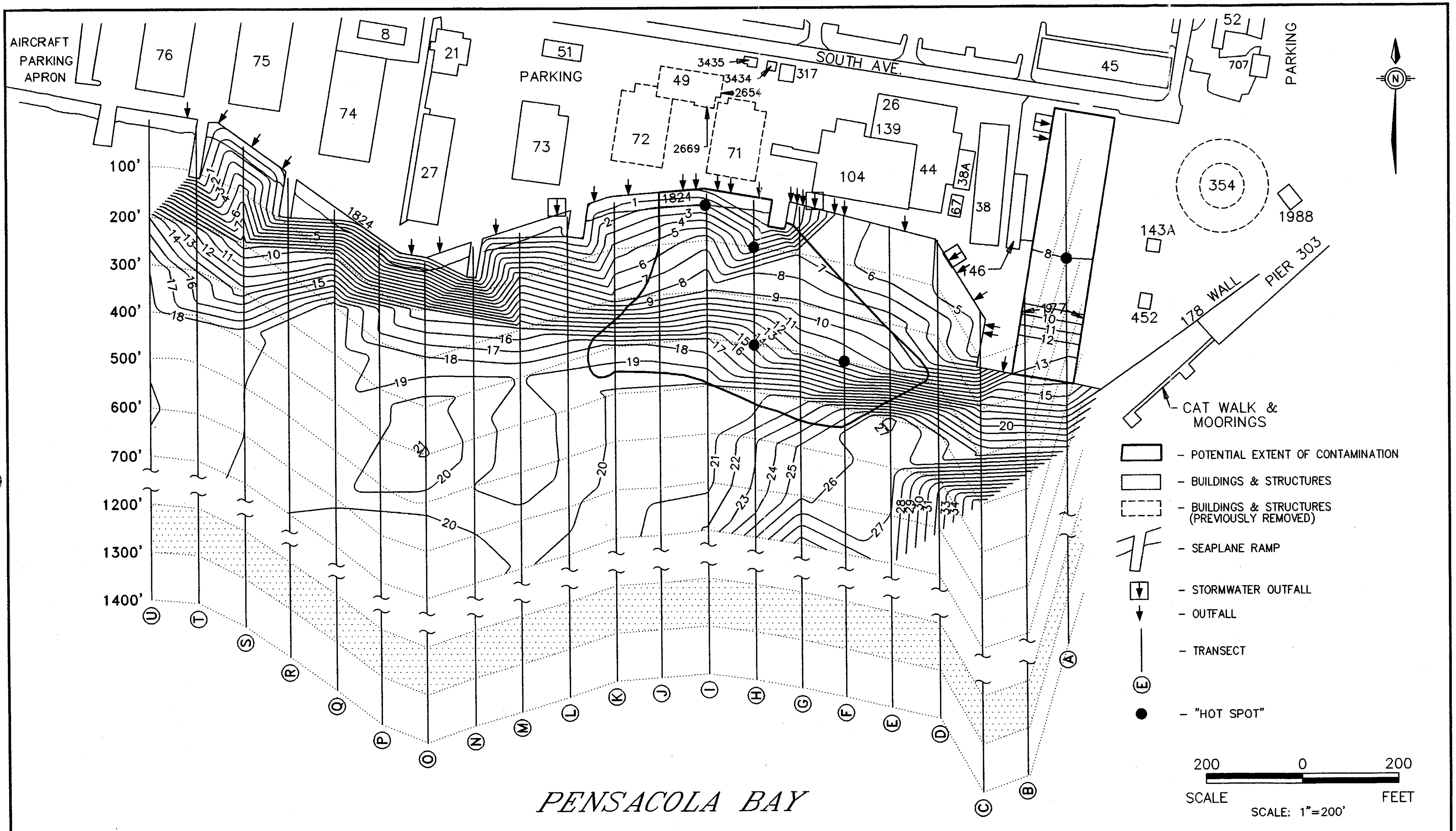
In developing remedial objectives, the following items are reviewed:

- The spatial distribution of sediment contamination, as presented in the RI
- A BRA, including human health and ecological assessments
- Chemical-specific applicable or relevant and appropriate requirements (ARARs)

1.3.1 RI Assessment

As shown in the RI report, sediment contamination was concentrated in the northeast portion of Site 2. This distribution moderately correlated with fine-grain sediments and shallow waters in that portion of the site. The RI characterized five sampling points (Stations I0, H1, H3, F3, and A2) as "hot spots," areas where positive toxicity effects were correlated with an ecological risk assessment HI exceeding 10. Their locations are shown in Figure 1-2. A conservative areal extent of contamination was estimated based on sediments surrounding the "hot spots" having a minimum of 60% fines, given the COPC's affinity for fine grained sediment.

Possible groundwater transport from Site 38 to Site 2 sediments was also assessed as a potential pathway. The investigation at Site 38 concluded that groundwater and soil had been impacted. According to data in the Site 38 RI, the greatest potential impact to Site 2 is from a volatile organic compound (VOC) plume underneath former Building 71. Sampling was directed near the shoreline of Site 38 and within the estimated outfall width for offshore groundwater discharge. Sediment and surface water samples collected at Site 2 did not detect the VOCs identified in the groundwater at Site 38. The absence of these VOCs suggests several attenuation possibilities. Primarily, complex transport and mixing processes occurring at the fresh-saline groundwater



FOCUSED FEASIBILITY STUDY
SITE 2
NAS–PENSACOLA

FIGURE 1–2
EXTENT OF CONTAMINATION

DWG DATE: 09/24/97 | DWG NAME: 059EXOC2

interface would tend to exacerbate dispersion. Tidal flushing and biodegradation may also account for reduced VOC concentrations near Site 2. Based on this assessment, groundwater discharge from Site 38 is not likely to be a continuous source of contaminants above risk-based action levels.

The RI report recommends conducting a feasibility study to determine the most appropriate method for dealing with the contaminated sediment.

1.3.2 Baseline Risk Assessment

The BRA was reviewed to identify site COPCs in contaminated media posing a risk or hazard in current or future-use scenarios. Both human health risk and ecological risk were assessed. Potential receptors were identified and adverse effects associated with the site COPCs were qualitatively and quantitatively evaluated. Two media were assessed in this BRA, surface water and sediment.

Ecological Risk Assessment: Marine biota have been or are currently being impacted by sediment contamination in some areas of Site 2. Bioassays completed during Phase IIB indicate a toxic effect on test organisms at five locations. This feasibility study focuses on the area surrounding the five locations.

Human Health Risk Assessment: The human health risk and hazard associated with exposure to Site 2 environmental media were assessed for hypothetical current and future (combined) child, and hypothetical current and future (combined) adult recreationists crabbing exclusively at Site 2. The tissue ingestion exposure pathway was selected as an indicator of potential human health risk. According to the RI report, using maximum detected concentrations in crab tissue, no COPCs were identified for the tissue ingestion pathway. Based on the Site 2 exposure scenarios, no human health levels exceeding acceptable risks were calculated.

1.3.3 ARARs and TBCs

There are no sediment-specific ARARs. However, there are several action-specific ARARs (Appendix A) associated with potential remedial actions. The lead agency, in consultation with the support agencies, decides which requirements are applicable or relevant and appropriate. Waivers must be obtained for alternatives which are selected but do not comply with established ARARs, in accordance with CERCLA 121(d)(4).

In the absence of sediment-specific ARARs, the applicability of state and federal screening values to data collected at Site 2 was analyzed in depth. The BRA compared Site 2 sediment concentrations to Sediment Screening Values (SSVs) established by U.S. Environmental Protection Agency (USEPA) Region IV. USEPA Region IV SSVs (1994) were proposed after review of three studies (Long & Morgan 1990; MacDonald 1993; and Long et al., 1995) which evaluated effects-based concentrations. SSVs were selected based on the lowest effects value from one of these studies, or placed at the contract laboratory program (CLP) practical quantitation limit (PQL). Although these proposed SSVs are not ARARs, and will not be considered as such, they are used for comparison and screening. These SSVs are used as benchmark values or To Be Considered (TBC) criteria, as appropriate, for the medium of concern.

1.3.4 Remedial Goals

Table 1-1 lists preliminary contaminant-specific remedial goals for site sediment. As explained in the final RI, sediment samples were collected on two separate occasions, once during Phase IIA and once during Phase IIB of the remedial investigation. The parameters and exceedances in Table 1-1 include both sampling events.

Table 1-1
Preliminary Contaminant Specific Remediation Goals for Site 2 Sediments

Parameters	PRG	Number of Exceedances	Range	Basis
Inorganics (mg/kg)				
Antimony	11.0	4	11.8 - 23.2	TEL
Arsenic	7.24	17	0.52 - 21.9	FDEP SQAG
Cadmium	0.676	7	2.2 - 24.1	FDEP SQAG
Chromium	52.3	6	2.6 - 220.0	FDEP SQAG
Copper	18.7	17	2.7 - 316.0	FDEP SQAG
Lead	30.2	18	0.15 - 406.0	FDEP SQAG
Mercury	0.13	10	0.1 - 3.4	FDEP SQAG
Nickel	15.9	2	6.3 - 17.5	FDEP SQAG
Silver	0.733	5	1.3 - 4.1	FDEP SQAG
Zinc	124.0	6	1.5 - 1790.0	FDEP SQAG
Semivolatiles (μg/kg)				
2-Methylnaphthalene	20.2	3	27 - 32	FDEP SQAG
Acenaphthene	6.71	3	28 - 98	FDEP SQAG
Acenaphthylene	5.87	1	43	FDEP SQAG
Anthracene	46.9	5	25 - 360	FDEP SQAG
Benzo(a)anthracene	74.8	17	80 -1400	FDEP SQAG
Benzo(a)pyrene	88.8	13	72 - 300	FDEP SQAG
Chrysene	108.0	15	68 - 850	FDEP SQAG
Dibenz(a,h)anthracene	6.22	3	87 - 300	FDEP SQAG
Fluoranthene	113.0	22	35 - 2600	FDEP SQAG
Fluorene	21.2	2	26 - 150	FDEP SQAG
Naphthalene	34.6	2	26 - 62	FDEP SQAG
Phenanthrene	86.7	8	50 - 2400	FDEP SQAG

Table 1-1
Preliminary Contaminant Specific Remediation Goals for Site 2 Sediments

Parameters	PRG	Number of Exceedances	Range	Basis
Semivolatiles (μg/kg)				
Pyrene	153.0	17	28 - 2200	FDEP SQAG
bis(2-Ethylhexyl)phthalate	182.0	7	84 - 5500	FDEP SQAG
Pesticides (μg/kg)				
4,4'-DDD	1.22	4	0.24 - 3.5	FDEP SQAG
4,4'-DDT	1.19	4	0.72	FDEP SQAG
Aroclor-1242	21.6	1	21.6	USEPA SSV
Aroclor-1260	21.6	1	21.6	USEPA SSV
gamma-BHC (Lindane)	0.32	2	0.32	FDEP SQAG

Notes:
mg/kg = Milligram per kilogram
μg/kg = Microgram per kilogram
FDEP SQAG = Florida Department of Environmental Protection Sediment Quality Assessment Guidelines
USEPA SSV = Environmental Protection Agency Sediment Screening Value
TEL = Threshold Effects Level

1.3.5 Remedial Objectives

The remedial objective is to protect the ecological environment where sediment concentrations yield an HI greater than 10. This area is concentrated in the northeast portion of Site 2 and includes about 10,000 yd^3 of sediment (assuming a 1 foot depth of contamination).

1.4 Preliminary Technology Screening

The following remedial process options were considered for Site 2, given site sediment conditions and Pensacola Bay characteristics.

- No Action
- Capping
- Long-term Sediment Monitoring
- Dredging and Offsite Disposal
- Solidification/Stabilization
- Dredging and Confined Disposal Facilities (CDFs)

Implementability: The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required. Technical implementability was used to initially eliminate technology types and process options that are clearly ineffective or unworkable. The readily available information from the RI site characterization is used to eliminate technologies and process options. Administrative implementability emphasizes the institutional aspects of implementability, such as the ability to obtain necessary permits for offsite actions; the availability of treatment, storage, and disposal services (including capacity); and the availability of necessary equipment and skilled workers to implement the technology.

Effectiveness: The effectiveness screening evaluation is based on how effective each technology would be in protecting human health and the environment. Each technology is evaluated according to its effectiveness in providing protection and reducing toxicity, mobility, or volume of contamination. Both short- and long-term components of effectiveness should be evaluated; short-term refers to the construction and implementation period, and long-term refers to the period after the remedial action is complete.

Cost: Costs play a limited role in the screening process. Relative capital and operation and maintenance (O&M) costs are used rather than detailed estimates. At this stage in the process, the cost analysis is based on engineering judgment, and each process is evaluated as to whether costs are high, low, or medium relative to other process options.

Table 1-2 presents the six treatment technologies and their objectives, along with implementability, effectiveness, and cost issues. The table is consistent with technology screening techniques presented in the NCP and USEPA guidance because it includes containment, removal, disposal, and treatment technologies, along with implementability, effectiveness, and cost criteria as per USEPA guidance.

Using the implementability, effectiveness, and cost criteria discussed in this table to screen remedial technologies, neither the CDF nor the solidification/stabilization alternatives are very practical and/or efficient when compared to the other four proposed technologies. It would not be practical to construct a CDF onshore and continually have to maintain it, or to construct it in shallow water where the current and tidal fluctuations could cause erosion. The solidification/stabilization technology is difficult to implement and involves many inaccuracies when operating on a large scale. These two technologies are not required or desired for either technical or regulatory reasons, and therefore, will not be retained in the assembly of alternatives.

1.5 Focused Feasibility Study Alternatives

As described in the NCP, the FFS primary objective is to ensure that appropriate remedial alternatives are developed and evaluated so that relevant information concerning these options can be presented to decision-makers, and the appropriate remedy selected. To accomplish this objective, the feasibility study is tasked with addressing only remedial measures appropriate to the scope and complexity of the project.

Table 1-2
Technology Screening for Site 2

Technology	Objectives	Implementability	Effectiveness	Cost
No Action	The no-action alternative leaves the contaminated sediment in place allowing natural sedimentation to cover and contain pollutants, and/or natural biodegradation to occur.	This option may be appropriate at Site 2 because the pollutant discharge source has been halted; the burial process is naturally occurring; and the environmental effects of cleanup may be more damaging than allowing the sediment to remain in place.	Contaminant concentrations are suspected to currently be at their highest levels and to naturally degrade over time, therefore reducing the chronic effects on marine organisms. No acute effects were observed or measured.	There are no costs associated with No Action
Capping	Subaqueous capping consists of covering contaminated sediment with cleaner, less contaminated sediments in an attempt to isolate them.	This technology is implementable at Site 2; however, some navigational and tidal conflicts may arise. Suitable capping material is readily available.	This technology is effective in reducing chronic effects on the ecology. It also eliminates further resuspension of the contaminated sediment. Annual maintenance would be necessary to replace cap material that is eroded by wave action, tidal influences, currents, and/or storms.	High capital cost, high O&M cost.
Dredging and CDFs	CDFs are engineered structures designed to retain dredged material. They can be constructed away from the water, partially in water near shore, or surrounded by water. The primary goal of the CDF design is containment and solids retention.	This technology is implementable at Site 2 onshore only. It would not be practical to construct a CDF in the shallow water near Site 2 or in the bay where navigational conflicts could arise.	CDFs offer an attractive, cost-effective method of dredged material disposal. When properly located and constructed, they can isolate contaminated sediment from the environment fairly well.	Low capital cost, low O&M cost.

Table 1-2
Technology Screening for Site 2

Technology	Objectives	Implementability	Effectiveness	Cost
Dredging and Offsite Disposal	This alternative consists of dredging the contaminated sediments, dewatering, soil washing, separating waste streams, and transporting the remaining residual to an offsite approved landfill. Hydraulic equipment would be used for dredging and trucks would be used for transport.	This technology is implementable at Site 2. The hot spot locations are accessible, and the volumes will be relatively easy to manage. However, this technology adds an additional handling step of transporting the sediment offsite. It is advantageous to avoid multiple handling steps.	This technology is effective at containing contaminated media in an approved landfill. Long-term risk to the ecological system and environment onsite is eliminated.	Low to moderate capital cost, no O&M cost.
Solidification and Stabilization	In-situ solidification/stabilization treatments immobilize sediment and contaminants by treating them with reagents to solidify them. These fixatives neutralize or bind the pollutants to reduce contaminant mobility. Another method covers sediment with barriers or sorbents to reduce transfer of the pollutants to water and biota. This technology satisfies the statutory preference for treatment.	This treatment technology is readily implementable onsite, considering the contaminants which are present. However, little is known about the large-scale treatments, their effectiveness, or their possible toxic by-products.	Although this technology is effective at rendering sediments and contaminants immobile, several problems are associated with solidification and stabilization. There are inaccuracies in reagent placement, erosion, long-term monitoring requirements, and the inability of the procedure to remove and detoxify contaminants. It is also difficult to adjust solidification mixtures and agents for subaqueous settings.	Moderate to high capital cost, low O&M cost.

Table 1-2
Technology Screening for Site 2

Technology	Objectives	Implementability	Effectiveness	Cost
Long-term Sediment Monitoring (LTSM)	Assess the bioavailability of COCs and changes in concentrations over time	LTSM is implementable at Site 2 and may be appropriate due of the low level of risk calculated in the BRA. Source discharges have stopped, and there are no human health risks associated with the site. Other alternatives may cause negative short-term impacts to the environment.	Natural burial or decrease in CPOC concentrations may occur gradually over time. Use restrictions already in place at Site 2 reduce the potential for human exposure. A long-term monitoring plan would include criteria for deciding whether to proceed with closure, continued monitoring, or another alternative.	Low capital cost, low O&M cost.

Fewer remedial options are available for sediment contamination when compared to other media (i.e., soil, groundwater, air). Consequently, the available technologies for remediating contaminated sediment are very similar. Because the remediation objectives for this site are clearly defined and sediment volumes are relatively small, the FFS format will be used to address the medium of concern. Four remedial alternatives will be evaluated:

- **Alternative 1 — No Action:** Consideration of this alternative is required under the NCP. Under the no-action alternative, contaminated sediment would be left in place. This alternative poses no risk to current workers and site trespassers, and no additional risk to the ecosystem. Current sediment conditions are suspected to be represent worst-case scenarios over the next 30 years.

- **Alternative 2 — Capping:** Subtidal capping involves placement of a clean sand layer to isolate contaminants and limit their vertical migration and release into the water column. In addition to limiting migration, a cap would also limit the potential for marine organisms to reach the contaminated sediment. Capping would cause an immediate acute adverse impact to the benthic organisms in that area, but would ultimately limit the chronic impacts.

- **Alternative 3 — Dredging and Offsite Disposal:** The areas identified in Figure 1-2, which include the five hot spots associated with the site, can be dredged to remove the contaminated sediment from the site, eliminating future adverse effects to the ecological system. Dredged sediment would be disposed of offsite in an approved Subtitle D facility. Although this alternative would result in an immediate acute adverse impact to the benthic organisms, it would ultimately limit the long-term effects to the ecological system in that area.

- **Alternative 4 — Long-term Sediment Monitoring:** Under this alternative, contaminated sediments would remain in place, controls would be implemented to limit access to the site, and the site would be monitored once every five years for changes which may effect risk. This alternative poses no risk to human health and relies on the continued prohibition of waste disposal at this site and natural processes within the bay to mitigate risk to benthic organisms.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section describes the initial steps toward remedy selection: identification of remedial objectives, general response actions, applicable technologies, and regulatory constraints under which remediation is conducted.

2.1 Alternative 1: No Action

The NCP requires that a no-action alternative be considered as a "baseline" against which all other alternatives are evaluated. In the no-action alternative, no remedial actions are taken to contain, remove, or treat sediment contamination that exceeds risk- or leachability-based cleanup goals. Sediment will remain in place to attenuate according to natural biotic or abiotic processes.

2.1.1 Alternative 1 Remedial Elements

No remedial elements are associated with the no-action alternative.

2.1.2 Alternative 1 Implementability

This alternative is technically feasible. No construction, operation, or maintenance is required. No technology-specific regulations apply. This alternative is administratively feasible.

2.1.3 Alternative 1 Effectiveness

The no-action alternative does not provide any additional effectiveness over the current use scenario. This alternative does not reduce the toxicity, mobility, or volume of the contaminants. However, current site access controls prohibit swimming, reducing the potential for direct human contact with contaminated sediments. Under the no-action alternative, the only risks are to the resident marine organisms.

2.1.4 Alternative 1 Cost

No cost is associated with the no-action alternative.

2.2 Alternative 2: Capping

A subaqueous cap (Figure 2-1) would consist of a 24 inch thick (USCOE, 1988) coarse sand and gravel layer to prevent benthic organisms from contacting contaminated material and to hold contaminated sediment in place. To protect the cap from erosion, adequate controls would need to be constructed (i.e. riprap facing, breakwaters, groins, etc.).

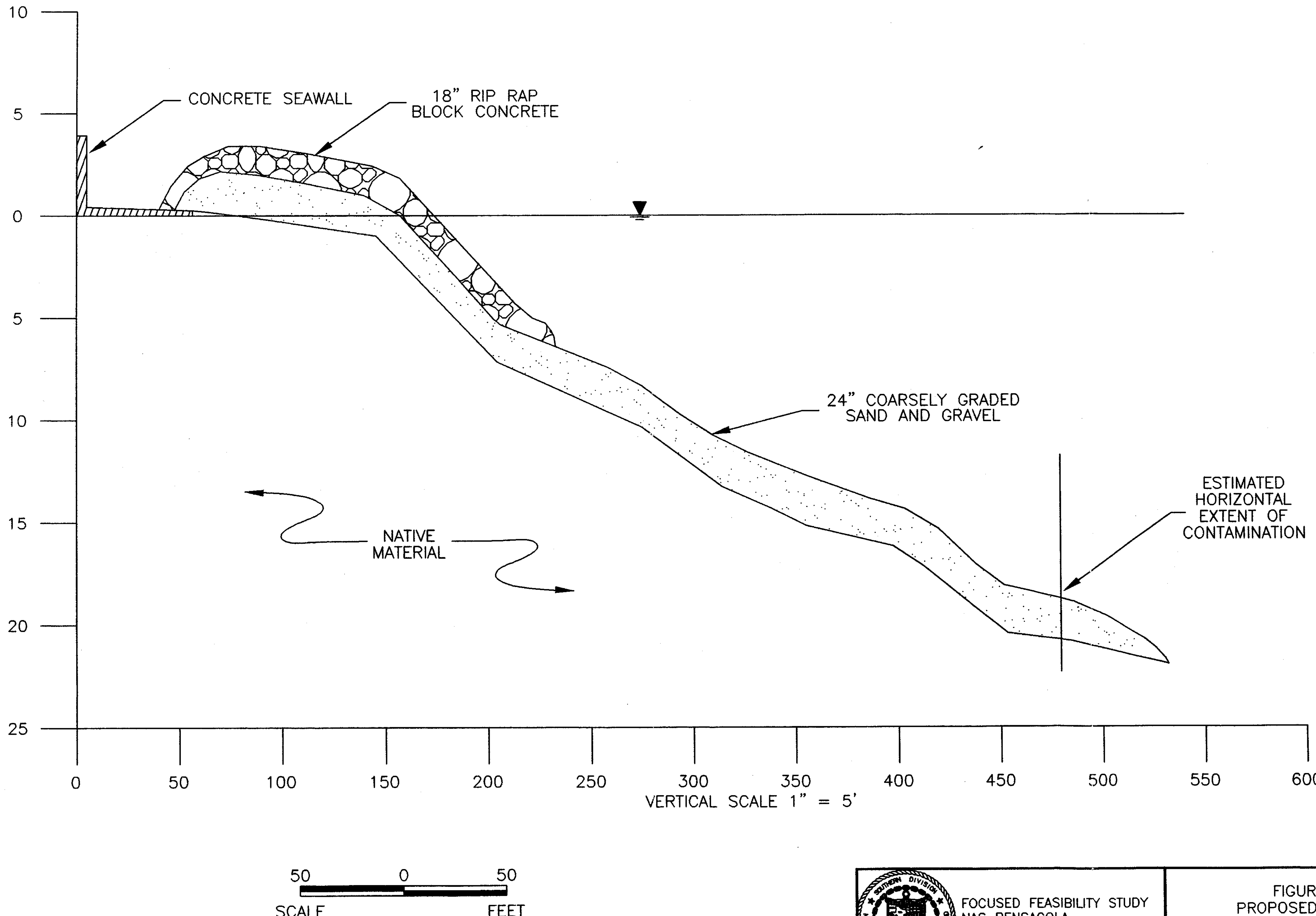
2.2.1 Alternative 2 Remedial Elements

A remedial design investigation would be needed to further delineate the area of concern, determine actual current velocities and directions, and study wave action at the site to evaluate potential erosion controls.

Remedial action would consist of placing 24 inches of material over the contaminated sediments and placing appropriate erosion controls on the shoreline. The cap would require annual monitoring to ensure its integrity. If the cap showed excessive erosion, lost material would need to be replaced with new backfill. Controls would be needed to prevent the USCOE from dredging near the cap, and markers would be needed for boating safety due to loss of navigational depths.

2.2.2 Alternative 2 Implementability

This alternative is administratively and technically feasible. Potential implementation concerns include temporary loss of shoreline use to the Navy and dredging activity restrictions associated with the nearby navigational channel operations. A remedial design investigation and associated engineering plans and specifications would need to be developed.



FOCUSED FEASIBILITY STUDY
NAS PENSACOLA
SITE 2

FIGURE 2-1
PROPOSED IN-PLACE
CAPPING DESIGN

DWG DATE:09/24/97 | DWG NAME:059PIPCD

2.2.3 Alternative 2 Effectiveness

Based on USCOE studies on capping of contaminated dredged material, this alternative would adequately protect Site 2 ecology. Changing the bottom type from fine grained sediment to coarse sand would change the benthic community structure. Capping would also eliminate any resident benthic organisms. However, benthic organisms would be expected to recolonize the area over time.

Several studies would be needed during remedial design to ensure cap effectiveness. Current and velocity mapping would be needed to evaluate sediment transport and potential erosion rates. Burrowing depths for bay biota should also be assessed to design an adequate cap thickness.

The main concern regarding the cap's effectiveness would be storm-induced erosion. Hurricanes and other strong storms occur annually in and around Pensacola. Forces induced by these storms are difficult to predict and could destroy even a well-designed system. However, the presence of unconsolidated, fine-grained sediments indicate a general lack of high water velocities and favor the durability of a well-designed coarse grained cap.

For cost estimating purposes, a potential cap design was evaluated for erosion potential using RI estimates of channel velocities ranging from 5.0 to 13.4 $ft \cdot s^{-1}$. Channel velocity distribution is based on shoreline features, irregularity of the channel bottom, and depth of flow. Velocities at the bottom of a channel are theoretically zero; however, it is reasonable to assume half the average velocity is acting on bed sediments. Taking half of the assumed average velocity range results in bed velocities of 1.5 to 4.0 knots (2.5 to 6.7 $ft \cdot s^{-1}$). For channel design, several tables describe permissible water velocities for specific channel-lining materials. Permissible water velocities are the maximum at which the channel lining material will remain in place. Coarse gravel has a permissible velocity of 6.0 ft/sec (North Carolina Sedimentation Control Commission, 1988), which is inadequate for the upper end of the assumed velocities. However, fine grained sediments present at Site 2 indicate that either RI velocity estimates are too high, less than half the average estimated velocity is acting on the sediment bed, or cohesive forces are preventing erosion of bottom sediments.

2.2.4 Alternative 2 Cost

Table 2-1 presents the cost estimate for the capping alternative:

Table 2-1
Estimated Costs Associated with Capping

Action	Quantity	Cost per Unit	Total Cost
Remedial Design Investigation	LS	\$43,500	\$43,500
Remedial Design Report	LS	\$30,100	\$30,100
Remedial Design Drawings and Specifications	LS	\$32,900	\$32,900
Remedial Action	LS	\$577,000	\$577,000
Development of Operation and Maintenance Plan	LS	\$11,300	\$11,300
Contingency	LS	30% of Direct Cost	\$208,000
Total Cost			**\$903,000**
Estimated Annual Operation and Maintenance Costs			
Annual Renourishment of Cap and Hydrographic Survey	2,250 tons of cap material[a]	LS	\$98,500[b]
Total Present Value[c]			\$2,259,000

Notes:

a = Includes material and placement. Assumes 10% of material lost to erosion.
b = Does not include inflation.
c = Based on 10% annual material loss over 30 years and a 6% discount rate
LS = Lump Sum

2.3 Alternative 3: Dredging and Offsite Disposal

This alternative involves dredging the contaminated sediment from the two areas delineated in Figure 1-2. Dredged spoils would be dewatered, separated and tested for contamination. Material determined to be contaminated would be transported by truck to an approved offsite Subtitle D facility. All other remaining materials could be used as backfill, replaced, or used for other purposes as necessary. By dredging the material and removing the contaminated sediment offsite, future risk would be eliminated.

2.3.1 Alternative 3 Remedial Elements

Before dredging could occur, the depth of contaminated sediments must be known, and a permit must be obtained from the USCOE. Waste treatability studies would also be conducted prior to project mobilization in order to:

- Simulate on a bench scale and in a controlled environment, actual operating conditions and operating parameters using representative in-situ waste stream samples

- Assess the approximate percent of contaminated material

- Determine exact filtration/separation processing requirements for waste treatment purposes.

- Determine actual processing parameters.

Hydraulic equipment (e.g., Mudcats) would be used to remove sediment from the potentially contaminated areas determined in the RI. Silt curtains and possibly inflatable bladders would be used to recapture and isolate resuspended sediments. A protective netting could also be placed along the shoreline to prevent contaminated sediment from washing ashore.

Dredge spoils would be dewatered onshore through a filter press and classified for either disposal at a Subtitle D facility or onsite re-use as backfill, capping material, or other purposes. Excess dredged water would be treated and tested prior to discharge to the source, POTW, or other disposal option.

2.3.2 Alternative 3 Implementability

This alternative is both technically and administratively feasible at Site 2. Pensacola Bay and the boat slip near Pier 303 are now dredged on an as-needed basis. Dredging is a reliable option for removing contaminated sediment. Dredged areas include about 265,000 ft^2. Assuming a depth of 1 foot, sediment volumes would be about 10,000 cubic yards (c.y.). Hydraulic dredges proposed for this site have average production rates between 50 and 500 c.y. per hour, so dredging would require between 20 and 200 hours per foot of depth of contaminated sediment to complete.

Disadvantages of dredging include potential resuspension of contaminated sediments and mobilization of otherwise bound contaminants. This resuspension and release could have an immediate negative impact in the water column. The dredging operation would include specialized containment devices specifically designed to eliminate the possibility of re-entrained sediments from being carried into areas outside the remediation zone.

Dredging is administratively feasible. Permits would be required before any dredging operations could take place. However, because the bay and boat slip are currently being dredged, it is expected permits to dredge Site 2 could be obtained without abnormal difficulty.

2.3.3 Alternative 3 Effectiveness

Dredging is effective at limiting chronic impacts to the ecology, but immediate protection would not be provided. Initially, benthic organisms living in the contaminated sediments would be destroyed by dredging operations. However, benthic organisms would gradually re-establish themselves in the dredged areas.

2.3.4 Alternative 3 Cost

Table 2-2 shows capital costs associated with the dredging alternative based on an excavation depth of one foot. For each additional vertical foot of excavation, dredging costs can be expected to increase linearly by a factor of about 1.75 per foot and transportation costs by a factor of 2 per foot.

Table 2-2
Estimated Costs Associated with Dredging and Offsite Disposal [a]

Action	Action	Quantity	Cost per Unit	Total Cost
Delineate vertical extent of contaminated sediments	Coring sample collection (Labor, Travel, Equipment Rental)	5	LS	$13,600
	Laboratory analysis (SW-846 metals, SVOCs, and Pest/PCBs)	15	$480	$7.200
Dredging Activities	Pretreatment Waste Treatability Studies	1	LS	$7,200
	Personnel and Equipment Mobilization	1	LS	$9,200
	Sediment Dredging	1	LS	$171,000
	Material Processing	1	LS	$201,000
	Equipment Decontamination/ Demobilization	1	LS	$10,100
Transport and Disposal	Transportation	50 trucks (assuming 20 yd^3 trucks) hauling 120 miles	$3.50/loaded mile	$105,000
	Disposal	5,000 yd^3	$50/$yd^3$	$250,000
Contingency	Contingency	LS	30% of Direct Cost	$232,300
Total Cost	**(One foot excavation)**			**$1,006,600**

Notes:
LS = Lump Sum
a = Cost estimate provided by Industrial Cleanup, Inc.
* = No O&M costs are associated with this alternative.

2.4 Alternative 4: Long-term Sediment Monitoring

Under this alternative, contaminated sediments would be left in place, controls would be implemented to limit site access, and the site would be monitored annually. This alternative poses no risk to human health and relies on the continued prohibition of waste disposal at this site and natural processes within the bay to prevent increased risk to benthic organisms.

Developing and implementing a detailed monitoring plan would be necessary. In addition to detailing sampling and analysis procedures, the long-term sediment plan would outline remedial goals in terms of ecological risk and conditions warranting implementing another remedial alternative, further monitoring, or closure.

2.4.1 Alternative 4 Remedial Elements

Under LTSM, a regular schedule of site monitoring would be implemented to evaluate the effectiveness of natural processes in reducing the level of risk to the environment. Each monitoring event would include:

- Sediment sampling and analysis for metals, semivolatile organic compounds (SVOCs), Pesticides, and PCBs to evaluate changes in concentrations.

- A hydrographic survey to assess changes in benthic topography and evaluate the potential for further migration of contaminated sediments.

- Measurement of sediment accumulation above feldspar marker horizons placed during the initial monitoring event to assess the rate of natural sedimentation.

The initial monitoring event would also include:

- Cesium dating and COPCs analysis of sediment cores to assess the historic rates of sedimentation, depositional ages of the highest concentrations of selected metals, and thickness of contaminated sediments.

- Field (Redox potential and pH) and laboratory testing (grain size, clay content, total organic carbon, acid volatile sulfides, simultaneously extracted metals, and metals partitioning) to assess the in-situ bioavailability of COPCs.

Access controls are currently in place at Site 2. Access from shore to the contaminated sediments at Site 2 is controlled by the U.S. Navy. The shoreline is dominated by a 3- to 4-foot high concrete seawall. The intracoastal waterway between Site 2 and the opposing shore restricts site access to boats only. Crabbing occurs in the Site 2 area, but no risk is expected to human health through consumption of Site 2 crab tissue according to the RI.

2.4.2 Alternative 4 Implementability

This alternative is technically and administratively feasible. No construction, operation, or maintenance is required. The original Site 38 outfalls have not been used for at least 18 years, and no other outside point-source of contamination was identified during the RI.

2.4.3 Alternative 4 Effectiveness

This alternative has no short-term effectiveness, and only long term monitoring results will indicate long-term effectiveness. However, many factors support this option's potential for long-term effectiveness:

- Natural sedimentation could be occurring in the area of concern and could eventually bury the contaminated material

- Organisms at Site 2 could transform or degrade organic COPCs to less toxic forms via bioprocesses. "Intrinsic bioremediation, even of these persistent (organic) compounds, occurs naturally but slowly in sediments, and uses indigenous microorganisms and enzymatic pathways of both aerobic and anaerobic processes." As natural sedimentation and/or transformation of the chemicals occur, other less opportunistic species in the bay may begin to move into the area naturally (Bishop, 1996).

- Additional testing may refine risk assessment capabilities and show a reduced level of risk not requiring further remedial action.

Other advantages of LTSM include no disturbance of the sediments and continued protection of the water column from groundwater infiltration. Not disturbing the sediments eliminates the risk of releasing sediment bound contaminants into the water column. The existing sediments could also be preventing contaminants in infiltrating groundwater from entering into the surface water column. Heavily reduced sediments are typically capable of removing inorganic and organic compounds through binding and reductive processes.

2.4.4 Alternative 4 Cost

Table 2-3 presents the costs associated with natural attenuation.

Table 2-3
LTSM Cost Estimate

Initial Monitoring Event

Cost Category	Task	Description	Unit Cost	Units	Total
Monitoring Plan		Development of long term monitoring plan	LS	1	$25,000
Lab Analysis	Sediment Grab Samples	SW-846 Metals, SVOCs, and Pest/PCBs	$480	5	$2,400
		Metals partitioning (Soluble, exchangeable, and organic/sulfide bound)	$130	5	$650
		Acid Volatile Sulfides	$30	5	$150
		Simultaneously Extracted Metals	$130	5	$650
		Grain size, clay content, and total organic carbon	$80	5	$400
	3-foot Sediment Cores	SW-846 Metals, SVOCs, and Pest/PCBs	$480	15	$7,200
		Cesium-137 dating (25 segments per core)	$800	5	$4,000
		Metals (Cd, Pb, Cu, Zn) analysis for each core	$520	5	$2,600
	Shipping and handling	7% of laboratory analytical costs	-	-	$1,260
Fieldwork	Labor	Engineer/ Scientist	$560	5	$2,800
		Engineer/ Scientist	$560	5	$2,800
		Sr. Engineer/ Sr. Scientist	$800	2	$1,600
	Equipment Rental	Boat	LS	-	$4,500
	Travel		LS	-	$3,500

Table 2-3
LTSM Cost Estimate

Cost Category	Task	Description	Unit Cost	Units	Total
Initial Monitoring Event					
Hydrographic survey			LS	-	$10,000
Reporting			LS	-	$10,000
Contingency		30% of direct costs	-	-	$23,850
Subtotal		**(Initial event)**			**$103,360**
Subsequent LTSM Events					
Lab analysis	Sediment Grab Samples	SW-846 Metals, SVOCs, and Pest/PCBs	$480	10	$4,800
	Shipping and handling	7% of lab costs	-	-	$336
Fieldwork	Labor	Engineer/ Scientist	$560	3	$1,680
		Engineer/ Scientist	$560	3	$1,680
	Equipment rental	Boat	LS	-	$3,000
	Travel		LS	-	$2,500
Hydrographic survey			LS	-	$10,000
Reporting			LS	-	$8,000
Contingency		30% of direct costs	-	-	$9,600
Subtotal		**(One subsequent event)**			**$41,600**
Total Present Value		**(Based on 5-year monitoring intervals for 30 years and 6% siscount rate)**			**$203,000**

3.0 DETAILED ANALYSIS OF ALTERNATIVES

In this section, the remedial alternatives discussed in Section 2 will be examined with respect to requirements stipulated in CERCLA as amended, the NCP, OSWER Directive No. 9355.9-19 (*Interim Guidance on Superfund Selection of Remedy,* December 24, 1986), and factors described in *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*.

3.1 Evaluation Process

The detailed analysis of alternatives consists of analyzing and presenting the relevant information needed to allow decision-makers to select a site remedy, but it does not replace the decision-making process. During the detailed analysis, each alternative will be assessed against the evaluation criteria and all other alternatives. The results of the assessment are arrayed to compare the alternatives and identify the key tradeoffs among them. This approach to analyzing alternatives is designed to provide decision-makers sufficient information to adequately compare the alternatives, select an appropriate remedy for the site, and demonstrate satisfaction of CERCLA remedy-selection requirements.

Nine evaluation criteria have been developed to address the CERCLA requirements and considerations, and to address the additional technical and policy considerations that have proven important for selecting among remedial alternatives. These evaluation criteria serve as the basis for conducting the detailed analyses during the FFS and for subsequently selecting an appropriate remedial action. The evaluation criteria with the associated statutory considerations are:

- Short-term effectiveness
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Implementability

- Cost
- Compliance with ARARs
- Overall protection of human health and the environment
- State acceptance
- Community acceptance

Each remedial alternative is evaluated with respect to the above criteria, as described in the following sections. In Section 4, the statutory factors and nine criteria listed above are compared for each alternative to assist in the remedy selection process.

3.1.1 Short-Term Effectiveness

The short-term effectiveness of a remedial alternative is evaluated relative to its effect on human health and the environment during implementation. Short-term effectiveness is based on four key factors:

- Risks to the community during implementation of the remedial action
- Risks to workers during implementation of the remedial action
- Potential for adverse environmental impact as a result of implementation
- Time until remedial response objectives are achieved

3.1.2 Long-Term Effectiveness and Permanence

Evaluation of alternatives under this criterion addresses the results of a remedial action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The following components should be addressed for each alternative:

- **Magnitude of Residual Risk:** This factor assesses the residual risk from untreated waste or treatment residuals at the conclusion of remedial activities. This risk may be measured by numerical standards such as cancer risk levels or the volume or concentration of constituents in waste, media, or treatment residuals remaining onsite.

- **Adequacy and Reliability of Controls:** This factor assesses the adequacy and suitability of any controls used to manage treatment residuals or untreated wastes remaining onsite. It may include an assessment of containment systems and institutional controls to determine whether they are sufficient to ensure that exposure to human and environmental receptors is within protective levels.

3.1.3 Reduction of Toxicity, Mobility, or Volume

This evaluation criterion addresses the statutory preference for remedial actions employing treatment technologies that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances.

The evaluation should consider the following specifics:

- The treatment processes, the remedies they will employ, and the materials they will treat.

- The quantity of hazardous materials that will be destroyed or treated, including how principal threat(s) will be addressed.

- The degree of expected reduction in toxicity, mobility, or volume, measured as a percentage of reduction (or order of magnitude) whenever possible.

- The degree to which the treatment will be irreversible.

- The type and quantity of treatment residuals that will remain.

- Whether the alternative would satisfy the statutory preference for treatment as a principal element.

3.1.4 Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required for implementation. The following factors will be evaluated:

Technical Feasibility

- Construction and operation relating to the technical difficulties and unknowns.

- Reliability of technology, focusing on the likelihood of technical problems causing schedule delays.

- Ease of undertaking remedial action, discussing future remedial actions that may be required and the difficulty of implementing them.

- Monitoring considerations such as the ability to monitor the remedy's effectiveness, including an evaluation of exposure risks should monitoring be insufficient to detect a system failure.

Administrative Feasibility

- Activities needed to coordinate with other offices and agencies.

Availability of Services and Materials

- Availability of adequate offsite treatment, storage capacity, and disposal services.
- Availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources.
- Availability of services and materials, including the potential to obtain competitive bids, which may be particularly important for innovative technologies.
- Availability of prospective technologies.

3.1.5 Cost

Detailed cost estimates for each remedial alternative are based on engineering analyses, suppliers' estimates of necessary technology, and costs for similar actions (such as excavation) at other CERCLA and Resource Conservation and Recovery Act (RCRA) sites. Costs are expressed in 1996/1997 dollars. The cost estimate for a remedial alternative consists of four principal elements: capital cost, operation and maintenance cost, costs for five-year evaluation reports, and present-worth analysis.

Capital Costs

- ***Direct costs*** for equipment, labor, and materials used to develop, construct, and implement a remedial action.
- ***Indirect costs*** for engineering, financial, and other services that are not actually a part of construction, but are required to implement a remedial alternative. The percentage applied to the direct cost varies with the degree of difficulty associated with construction and/or implementation of the alternative. In this FFS, the indirect costs include health and safety items, permitting and legal fees, bid and scope contingencies, and engineering design and services.

Annual O&M Costs

O&M costs refer to postconstruction costs necessary to ensure the continued effectiveness of a remedial action. They typically refer to long-term power and material costs (such as the operational cost of a water treatment facility), equipment replacement costs, and long-term monitoring costs.

Costs for Five-Year Evaluation Reports

These costs are for reports prepared every five years evaluating the results of monitoring activities.

Present-Worth Analysis

This analysis allows to comparison of remedial alternatives based on a single cost that, if invested in the base year and disbursed as needed, would be sufficient to cover remedial action costs during its planned life. A 30-year performance period is assumed for present-worth analyses. Discount rates of 6% are assumed for base calculations. An increase in the discount rate decreases the present worth of the alternative.

The cost elements of each alternative are summarized in the cost analysis section. Cost estimates are intended to reflect actual costs with an accuracy of minus 30% to plus 50%, in accordance with USEPA guidelines.

3.1.6 Compliance with ARARs

This criterion is used to evaluate whether each alternative will meet all federal and state ARARs identified in previous stages of the remedial process. The detailed analysis identifies which requirements are applicable or relevant and appropriate to an alternative, and should include:

- Compliance with chemical-specific ARARs
- Compliance with location-specific ARARs
- Compliance with action-specific ARARs

The actual determination of which requirements are applicable or relevant and appropriate is made by the lead agency (the Navy) in consultation with the support agencies (USEPA and FDEP).

3.1.7 Overall Protection of Human Health and the Environment

This criterion provides a final check to assess whether each alternative adequately protects human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Evaluation of an alternative's overall protectiveness focuses on whether it eliminates, reduces, or controls risks from each pathway through treatment, engineering, or institutional controls. This evaluation also addresses whether an alternative poses any unacceptable short-term or cross-media impacts.

3.1.8 State Acceptance

This step evaluates the technical and administrative issues and concerns the state may have regarding each alternative. This criterion is largely satisfied through state involvement in the entire remedial process, including review of the FFS.

3.1.9 Community Acceptance

This step evaluates the issues and concerns the public may have regarding each alternative. This criterion would be addressed in the Record of Decision (ROD) when comments on the FFS have been received.

3.2 Evaluation of Selected Alternatives

The following sections present a detailed analysis of each alternative in Section 2.

3.2.1 No Action

The no-action alternative for Site 2 would involve no active remedial effort. No actions would be taken to contain, remove, or treat sediment contaminated above risk-based cleanup goals. Sediment would remain in place and would attenuate according to natural biotic or physical processes.

Short-Term Effectiveness

Short-term effectiveness assesses the effects of an alternative on human health and the environment while implementing the remedial alternative. There are no implementation concerns associated with the no-action alternative. This alternative may be implemented immediately.

Long-Term Effectiveness and Permanence

The long-term effectiveness criterion evaluates the results of a remedial action relative to the remaining onsite risk, particularly any residual risk and the adequacy and reliability of controls. Current contaminant levels at Site 2 would attenuate slowly, decreasing the volume and concentrations of contaminated sediment. Over time, adverse effects to benthic organisms would diminish.

Controls currently in place at the site, including military security and limited access to the site, would remain. These controls are considered reliable for protecting human health, given current projected site use.

Reduction of Toxicity, Mobility, and Volume

The no-action alternative does not reduce the mobility or volume of contaminants. Contaminants would remain onsite. However, natural processes (either biological, physical, and/or chemical degradation and/or burial) would continue which could decrease the risk to benthic organisms.

Implementability

The no-action alternative is technically feasible and easily implemented. No construction, operation, or reliability issues are associated with this alternative. Current site controls have proven reliable in the past. No administrative coordination is required to implement the no-action alternative. The no-action alternative would not require offsite services, materials, specialists, or innovative technologies.

Cost

No costs are associated with the no-action alternative.

Compliance with ARARs

The no-action alternative complies with all ARARs and does not trigger any location- or action-specific ARARs. However, no-action does not comply with the TBC criteria set forth in the BRA. It does not reduce the sediment contaminant concentrations to the proposed PRGs for the protection of the ecological system.

Overall Protection of Human Health and the Environment

The no-action alternative does not afford any long-term effectiveness and permanence beyond natural processes. No short-term impacts are associated with this alternative. The alternative does not comply with TBC criteria.

However, as stated in the BRA, no human health risks are associated with contaminated sediment in the bay. The physical controls presently in place at Site 2 adequately restrict human contact with contaminated sediment.

State Acceptance

FDEP has been involved with the USEPA in the entire remedial process. FDEP would have the opportunity to review and comment on this FFS.

Community Acceptance

Community acceptance would be determined following the public-comment period.

3.2.2 Capping

Capping would involve constructing a physical barrier between contaminated sediments and the biota in Pensacola Bay. Soil would remain in place and be covered with a layer of coarse-grained sand and gravel. In areas where waves may cause excessive erosion, riprap or other suitable material would be placed to stabilize it.

Short-Term Effectiveness

In the short-term, implementing this alternative would eliminate all marine life within the immediate area of Site 2. Upon completion of construction, no risk to species re-colonizing the area would be expected.

Long-Term Effectiveness

The effectiveness of this design would be determined by its ability to prevent biota from migrating through the cap and contacting contaminated sediment, and whether contaminated sediments are held in place. If these two properties are maintained, risk to human health and the environment would not be expected.

The cap may be eroded by wave action, high-velocity currents, prop wash, and other physical wear. Sufficient controls could be designed to prevent catastrophic erosion; however, the presence of fine-grained sediments at Site 2 indicates this area is in a relatively low energy zone.

Reduction of Toxicity, Mobility, and Volume

Capping is a containment action which would restrict movement of underlying contaminated sediments. The cap would be thick enough to prevent contaminated sediment contact with burrowing benthic organisms.

Capping would not remove, treat, remediate or reduce the amount of contaminated sediments. However, capping would further reduce the oxidation state of contaminated sediments, thereby further immobilizing sedimentary metals .

Implementability

This alternative is technically and administratively feasible. Capping would require a remedial design phase, remedial action, O&M, and site monitoring. Remedial design would consist of further site investigation, report preparation, design drawings, specifications, an O&M plan, and a 30-year monitoring plan. Remedial action would consist of all activities necessary to construct the cap. O&M and monitoring plans would need to be implemented. Site access controls would be necessary to restrict navigational dredging, and a warning system (e.g., buoys) would be needed to identify the new shallow water depth.

Cost

Capping costs are detailed in Section 2.2.4. Direct capital costs associated with cap construction are $903,000, including an additional 30% for contingencies. Annual maintenance costs are expected to be $98,500 based on a 10% annual material loss. 30-year present worth for capping is about $2,259,000 assuming a 6% discount rate. Present worth increases about $1,218,000 for each additional 10% cap material lost annually.

Compliance with ARARs

According to the Clean Water Act, a permit must be obtained before dredged or fill material is discharged into navigable waters. In addition, State of Florida (FR 62-312) and federal (33 CFR 320 and 322) regulations outline dredging and filling requirements applicable to this action.

This alternative does address the TBC criteria (proposed USEPA Region IV SSVs), as identified in the BRA and proposed as PRGs for protection of the benthic species.

Overall Protection of Human Health and the Environment

According to the BRA, no human health risks are posed by the contaminated sediment. Capping would likely exterminate benthic organisms in the application area, but would effectively protect the environment, including bottom-dwelling life, after construction is completed. Over time, benthic organisms would re-colonize the area.

State Acceptance

FDEP has been involved with the USEPA in the entire remedial process at Site 2 and would have the opportunity to comment on this FFS.

Community Acceptance

Community acceptance would be determined following the public comment period.

3.2.3 Dredging with Offsite Disposal

This action includes dredging, dewatering, treatment, classification, and disposal of sediment contaminated above PRGs. Pending classification results, dredged sediments could be separated for use as backfill or disposal offsite at a permitted facility.

Short-Term Effectiveness

Dredging Site 2 with the small hydraulic dredges recommended in this study would have no impact on the community. The dredging operation would be sufficiently removed from the public to minimize health and safety concerns associated with sediment removal. Dredge operators would have to take appropriate protective measures to prevent direct contact with the contaminated sediment, particularly during maintenance of dredging equipment. The filter press and soil washing would be located onshore and would require restrictions to prevent access by the public.

In the short-term, dredging would exterminate benthic organisms in the area of application. Upon completion of construction, no risk would be expected to species re-colonizing the area.

Long-Term Effectiveness

Dredging eliminates long-term risk posed by the contaminated sediments to benthic organisms, the overall ecology, and human health and the environment. However, future liability would be incurred by the Navy through disposal at a landfill.

Reduction of Toxicity, Mobility, or Volume

Dredging satisfies the statutory preference for reducing toxicity, mobility, or volume through treatment. Soil washing, which is proposed to be combined with the dredging alternative, is a treatment technique. Treated dredged materials which continue to exceed PRGs would be disposed of at a permitted landfill where contaminant mobility would be restricted.

Implementability

Dredging with offsite disposal is implementable. The Site 2 boat slip and nearby ICW navigational channel are dredged periodically.

Dredging is a common remediation technique for contaminated sediments. The only potential technical problems that could slow removal activities are materials handling and disposal (standby time between confirmatory sampling and disposal), management of removed sediment and drained water, and tidal fluctuations. Administrative coordination would involve acquiring a permit from the USCOE before dredging could begin. Coordination with the Navy owned waste water treatment works may be necessary if the wastewater from the soil washing process requires treatment before being discharged. Independent contractors capable of performing dredging operations for this alternative are located in the area.

Cost

Dredging costs are detailed in Section 2.3.4. Based on a one foot depth of and assuming a 30% contingency, total direct and indirect costs are about $1,007,000. Each additional foot of excavation would cost about $850,000.

No long-term O&M costs are associated with this alternative.

Compliance with ARARs

According to the Clean Water Act, a permit must be obtained before dredged or fill material is discharged into navigable waters. In addition, State of Florida (FR 62-312) and federal (33 CFR 320 and 322) regulations outline dredging and filling requirements applicable to this action. Dredging activities and soil-washing operations could also require compliance with federal, state, and local air emissions and storm water control regulations. Offsite transportation would trigger Department of Transportation regulations. Land disposal restrictions would not be triggered because the contaminated sediment is nonhazardous. Occupational Safety and Health Administration (OSHA) regulations apply to any remedial activities on a CERCLA site.

This alternative addresses the TBC criteria (proposed USEPA Region IV SSVs) identified in the BRA and proposed as PRGs for protection of the benthic species.

Overall Protection of Human Health and the Environment

Dredging with offsite disposal addresses the long-term effectiveness and permanence criterion by removing contaminated sediment from the site. Short-term risks posed during implementation include elimination of benthic organisms in the application area and human health risks from inhalation and dermal contact exposures. However, benthic organisms would re-colonize the area, and human health risks can be controlled with common engineering techniques and personal protective equipment.

State Acceptance

FDEP has been involved with the USEPA in the entire remedial process at Site 2 and would have the opportunity to comment on this FFS.

Community Acceptance

Community acceptance would be determined following the public comment period.

3.2.4 Long-Term Sediment Monitoring (LTSM)

LTSM is not the same as no-action. Under this alternative, contaminated sediments would be left in place, site access controls would continue, and the site would be monitored every five years for changes which may affect risk.

Short-Term Effectiveness

Access controls are currently in place at Site 2. Access from shore to the contaminated sediments at Site 2 is controlled by the U.S. Navy. The shoreline is dominated by a 3- to 4-foot high concrete seawall. The intracoastal waterway between Site 2 and the opposing shore restricts site access to boats only. Crabbing occurs in the Site 2 area. According to the RI report, no risk is expected to human health through consumption of Site 2 crab tissue.

In the short-term, this plan would not change current risks to the ecology. Industrial discharges from Site 38 have been eliminated. Sewer outfalls have been out of service for at least 18 years. Unlike capping or dredging, LTSM would not exterminate benthic organisms in the application area.

Long-Term Effectiveness and Permanence

Many factors support the potential long-term effectiveness of this option:

- Natural sedimentation may be occurring in the area of concern and may eventually bury the contaminated material. If needed, a groin or breakwater could be constructed to enhance natural deposition over the area. This possibility would be contingent on minimizing the obstruction of navigational channels.

- Organisms at Site 2 could transform or degrade organic COPCs to less toxic forms via bioprocesses. "Intrinsic bioremediation, even of these persistent (organic) compounds, occurs naturally but slowly in sediments, and uses indigenous microorganisms and enzymatic pathways of both aerobic and anaerobic processes." As natural sedimentation and/or transformation of the chemicals occur, other less opportunistic species in the bay may begin to move into the area naturally (Bishop, 1996).

- Additional testing may allow refinement of the risk assessment and show a reduced level of risk not requiring further remedial action.

Other advantages of LTSM include no disturbance of the sediments and continued minimization of the water column from groundwater infiltration. Not disturbing the sediments would eliminate the risk of releasing sediment bound contaminants into the water column. Contaminants in infiltrating groundwater may also be prevented from entering into the surface water column as heavily reduced sediments are typically capable of removing inorganic and organic compounds through binding and reductive processes.

Reduction of Toxicity, Mobility, or Volume

LTSM does not reduce toxicity, mobility or volume through treatment, and does not satisfy the statutory preference for treatment as a principal element. COPCs would remain in place, and no treatment would be effected during remedial actions. However, natural degradation of COPCs or burial of contaminated sediments could occur, and toxicity could decrease with time.

Implementability

LTSM is technically feasible and easily implemented. A monitoring program would need to be developed. Institutional controls, including military security and the ICW navigational channel, adequately restrict human access.

Cost

LTSM costs are detailed in Section 2, Table 2-3. Initial monitoring event costs are about $103,000. Subsequent monitoring events at five year intervals yield a total present value of about $203,000 (assuming a 6% discount rate over 30 years).

Compliance with ARARs

LTSM complies with all ARARs and the TBC criteria developed in the BRA. Sediment would be expected to reach remedial goals with time through natural processes. The long-term monitoring plan would set forth specific progress goals. If goals are not met, a decision would have to be made as to whether or not to abandon LTSM in favor of another alternative(s).

Overall Protection of Human Health and the Environment

This alternative poses no risk to human health. LTSM would continue to monitor for changes in site conditions which could affect risk conditions described in the BRA.

State Acceptance

FDEP has been involved with the USEPA in the entire remedial process. FDEP would have the opportunity to review and comment on this FFS.

Community Acceptance

Community acceptance for Alternative 4 would be established after the public comment period for the FFS.

4.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section provides a comparative analysis of alternatives, examining potential advantages and disadvantages of each according to the nine criteria.

4.1 Threshold Criteria

All alternatives considered for selection must comply with the threshold criteria: overall protection of human health and the environment, and ARARs.

4.1.1 Overall Protection of Human Health and the Environment

This criterion evaluates the overall degree of protectiveness afforded to human health and the environment. It assesses the overall adequacy of each alternative.

Protection of Human Health

The BRA indicates no human health risks are expected at Site 2 from sediment contamination. Access controls are currently enforced at the site, and there is no direct contact between workers and/or residents and the contaminated sediment.

Protection of the Environment

The ecological risk assessment employed the use of the hazard index approach (USEPA, 1989) to evaluate risk to potential receptors in the marine environment. An HI of 10 was selected as a screening level; USEPA suggests that levels above 10 may indicate a moderately high potential risk. At an HI of 10, minimal changes to the benthic assemblage at Site 2 were observed. Five of ten stations had an HI above 10 (the five hot spots depicted in Figure 1-2).

Each of the four alternatives protects the environment in varying degrees. No-action allows the environment to continue to function undisturbed. Capping or dredging afford long-term protection of the environment, but will exterminate benthic organisms in the application area (benthic organisms would gradually re-colonize the area). LTSM would monitor for changes in the sedimentary environment in anticipation of decreasing risk via natural processes.

4.1.2 Compliance with ARARs

As discussed in Section 1, no threats to human health are present at Site 2. If physical controls continue to be implemented at the site, no further action will be required at Site 2 to protect human health.

Alternatives 1 and 4 comply with ARARs. Compliance with action- and location-specific ARARs for alternatives 2 and 3 is attainable. USEPA Region IV SSVs are considered applicable to the site, therefore only Alternatives 2 and 3 comply with chemical-specific TBCs.

As outlined in the NCP, onsite remedial actions selected in the ROD must attain those ARARs identified at the time of the ROD signature or provide grounds for invoking a waiver under 300.430(f)(1)(ii)(C) (or CERCLA 121[d][4]).

4.2 Primary Balancing Criteria

Five primary balancing criteria typically highlight the major differences between alternatives. These criteria include: long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost.

4.2.1 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence criterion assesses the results of a remedial action in risk remaining at the site, particularly the magnitude of residual risk and the adequacy and reliability of controls.

Magnitude of Residual Risk

As stated in the BRA, no risk is posed to human health at Site 2. Alternative 1 has no long-term effectiveness. Alternative 2 reduces risk by preventing contact between benthic organisms and the contaminated sediment. Risk to the environment is eliminated in Alternative 3 by removing contaminated sediments that exceed SSVs. Alternative 4's long-term effectiveness is based on natural processes and can only be estimated as more effective than Alternative 1 but less effective than Alternatives 2 and 3.

Adequacy and Reliability of Controls

Controls inherent to Site 2 include a concrete seawall, limited access, and restrictions on recreational use. No further actions are required to protect human health at Site 2 under the current-use scenario.

Alternative 2 provides slightly more reliable controls than the no-action and LTSM alternatives. The completed cap will reduce the threat to future biota in that area of the bay. However, the cap could require annual maintenance to ensure contact with the contaminated sediment is restricted. Alternative 3 provides the most reliability, because sediment is removed from the site. However, long-term liability will be incurred by the Navy through disposal at a landfill.

4.2.2 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives 1 and 4 do not reduce toxicity, mobility, or volume of contaminants through treatment. Alternative 2 could reduce mobility by preventing sediment migration and immobilizing metals by providing conditions that favor reduced oxidation state. Alternative 3 is the only option that includes treatment and volume reduction of contaminated sediment.

4.2.3 Short-Term Effectiveness

No short-term effectiveness issues are associated with Alternatives 1 or 4. Alternatives 2 and 3 would exterminate benthic organisms in the application area. In these alternatives, exposure to workers and the area around Site 2 can be controlled with engineering controls and use of proper personal protective equipment. Duration of field activities for both Alternatives 2 and 3 would likely be less than 3 months.

4.2.4 Implementability

All four alternatives are implementable and technically and administratively. Capping would require a remedial design investigation before implementation. Velocities and directions of currents and the potential for possible erosion of the cap need to be evaluated. Dredging would require dewatering, soil washing, and transportation of sediment to an offsite facility. However, these alternatives do not require extraordinary services or materials. Permits would need to be obtained for both the dredging and capping alternatives before implementation can take place. The LTSM alternative would require monitoring and a management plan for making decisions about how monitoring results would affect future actions at the site.

4.2.5 Cost

Capital (direct and indirect), O&M, and net present-worth costs for all four alternatives are presented in Table 4-1. Note that costs for Alternative 2 (Capping) are significantly linked to erosional/depositional patterns, and Alternative 3 (Dredging) costs are linked to the depth of sediments requiring investigation and the percentage of sediments requiring offsite disposal. Therefore, further field investigation will be required to collect data effectively evaluate costs associated with either of these alternatives. However, this data would be collected during the initial monitoring event in Alternative 4.

Table 4-1
Cost Comparison for Alternatives

Alternative	Variables	Direct and Indirect Costs	Annual O&M Costs	Total Net Present Worth[a]
Alternative 1	None	$0	$0	$0
Alternative 2	No net erosion	$903,000	$10,000	$913,000
	10% material loss	$903,000	$98,500	$2,259,000
	20% material loss	$903,000	$187,000	$3,477,000
	Each additional 10% loss	—	+ $88,500	+ $1,218,000
Alternative 3	1-foot excavation depth	$1,007,000	—	$1,007,000
	2-foot excavation depth	$1,857,000	—	$1,857,000
	Each additional foot of excavation	$850,000	—	$850,000
Alternative 4	Initial event + monitoring at 5-year intervals for 30 years	$103,000	$41,600	$203,000

Note:
a = Present worth is based on 30-years operation and maintenance using a 6% discount rate.

4.3 Modifying Criteria

These criteria will be evaluated in detail following comments on the FFS report and the proposed plan, and will be addressed once a final decision is made and the ROD is prepared.

5.0 REFERENCES

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6.0 FLORIDA PROFESSIONAL GEOLOGIST SEAL

I have read and approve of this Focused Feasibility Study, NAS Pensacola Site 2, and seal it in accordance with Chapter 492 of the Florida Statutes. In sealing this document, I certify the geological information contained in it is true to the best of my knowledge and the geological methods and procedures included herein are consistent with currently accepted geological practices.

Name:	Henry H. Beiro
License Number:	#1847
State:	Florida
Expiration Date:	July 31, 1998

Henry H. Beiro

Henry H. Beiro

9-25-97

Date

7.0 FLORIDA PROFESSIONAL ENGINEER'S SEAL

I am registered to practice engineering by the Florida State Board of Professional Examiners (License No. 50413). I certify, under penalty of law, that the Final Focused Feasibility Study for Naval Air Station Pensacola Site 2 was performed in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. To the best of my knowledge and belief, the information submitted is true, accurate, and complete; and the contents of this document are consistent with currently accepted engineering practices. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Elizabeth Claire Barnett

Elizabeth Claire Barnett

9-25-97

Date

License Expires February 28, 1999

Appendix A

Applicable or Relevant and Appropriate Requirements

Table A-1
Summary of Potential Action-Specific ARARs
NAS Pensacola Site 2

ARAR	Status	Description	Application
State Requirements			
FR 62-312 Dredge and Fill Activities	Applicable	Describes permitting and review process for dredge activities	Applicable if Alternatives 2 or 3 are selected.
FR 62-45 25-year Permits for Maintenance of Dredging in Deepwater Ports	Relevant	Applies to dredging activities in deepwater ports	Relevant if this area is deemed and continues to be part of a deepwater port.
Federal Requirements			
33 CFR 320	Applicable	Gives Corps of Engineers (USCOE) authority to regulate actions in navigable waterways, including dredging.	Applicable if Alternatives 2 or 3 are selected.
33 CFR 322	Applicable	Contains USCOE permitting structure for work in or affecting navigable waters of the United States	Applicable if Alternatives 2 or 3 are selected.