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FINAL REMEDIAL INVEST[illegible]
FEASIBILITY STUDY WORK PLAN
AND
FINAL RI/FS *SAMPLING* AND ANALYSIS PLAN
FOR SITES 40 *AND* 42
BAYOU GRANDE AND PENSACOLA BAY
NAVAL AIR STATION
PENSACOLA, FLORIDA

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NAS PENSACOLA
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Prepared for:

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North Charleston, South Carolina

Prepared by:

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134
(901) 383-9115

September 1995

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	39 and 40	39 and 40
	73 and 74	73 and 74
Sampling and Analysis Plan		
	27 and 28	27 and 28
	87 and 88	87 and 88

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19. Abstract

This work plan describes background information, study endpoints, sampling techniques, and data quality requirements to be used during the investigation at Operable Unit 16, Sites 40 and 42, Bayou Grande and Pensacola Bay, at NAS Pensacola, Florida. The nvestigation will be performed from approximately July 6, 1995 through December 10, 1996 in accordance with the draft NAS Pensacola Site Management Plan.

The purpose of this investigation is to characterize the nature, magnitude, and effects of contaminated sediment and surface water within the bay and bayou adjacent to NAS Pensacola to adequately perform a human health and ecological risk assessment as part of the RI. The investigation will follow a phased approach, starting with a qualitative review of the bay and bayou and possibly leading into more complex studies. If risk can be characterized after any phase of the investigation, further study will be halted. Phasa I involves a search for information related to past practicas within IR sites and associated areas of the bay and bayou, including previous investigations at NAS Pensacola which may relate to the bay or the bayou. Sediment mapping will also be performed during Phase I. This information will be used to choose those areas of the bay and bayou planned for further study in Phase IIA. Phase IIA involves the collection of surface water and rediment samples within areas of potential contamination identified during Phase I.

Phase IIB toxicity tests and diversity studies may be performed if an adverse impact is suspected to occur within a portion of the bay and bayou based on the results of Phasa IIA. These testa will be used to determine the species diversity of benthic macroinvertebrates and toxicity of sediment and surface water to different trophic level organisms. Both tests will be compared to a reference area. These results will link the results of Phasa IIA to help determine the overall impact to the area of concern. If more information is needed to better characterize risks, the study may move into Phase III.

Phase III involves a more refined assessment of impact by using bioaccumulation studies or a more sensitive species for toxicity testing. This information can be modeled within the food chain to predict effects to higher order species.

After all studies are complete, ecological and human health risk at each area of concern within the bay and bayou can be quantified. Recommendationswill be made for remedial alternatives to minimize any known or predicted adverse effects occurring within the bay and bayou ecosystems.

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List of Acronyms and Abbreviatious

ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
BNAs	Base Neutral Acid Extractable Compounds
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
CSAP	Comprehensive Sampling and Analysis Plan
CWA	Clean Water Act
DOD	Department of Defense
DOT	Department of Transportation
E/A&H	EnSafe/Allen & Hoshall
E&E	Ecology & Environment, Inc.
°F	Degrees Fahrenheit
FAC	Florida Administrative Code
FDA	Florida Department of Agriculture
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulation
FFA	Federal Facilities Agreement
FGFWFC	Florida Game and Freshwater Fish Commission
FNAI	Florida Natural Areas Inventory
FS	Feasibility Study
FSP	Field Sampling Plan
G&M	Geraghty & Miller, Inc.
HASP	Health and Safety Plan
IRP	Installation Restoration Program
K_{oc}	Equilibrium coefficient
LD_{50}	Lethal Dose where 50 percent of population dies
MSL	Mean Sea Level
NACIP	Navy Assessment and Control of Installation Pollutant Department
NAS Pensacola	Naval Air Station Pensacola, Florida
NWFWMD	Northwest Florida Water Management District
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAHs	Polynuclear Aromatic Hydrocarbons
PBS	Pensacola Bay System
PCBs	Polychlorinated Biphenyls
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act

RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendment and Reauthorization Act
SDWA	Safe Drinking Water Act
SOP/QAM	standard operating Procedure/Quality Assurance Manual
SOUTHNAVFACENGCOM	Southern Division Naval Facilities Engineering Command
TAL	Target Analyte List
TCL	Target Compound List
TES	Threatened and Endangered Species
TRPHs	Total Recoverable Petroleum Hydrocarbons
USACE	united states Army Corps of Engineers
USDA	United States Department of Agriculture
EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOCS	Volatile Organic Compounds

EXECUTIVE SUMMARY

This Remedial Investigation (RI) work plan is written for Sites 40 and 42, Bayou Grande and Pensacola Bay. The purpose of this investigation is to characterize the nature, magnitude, extent, and effects of contaminated sediment and surface water within the bay and bayou to adequately perform a human health and ecological risk assessment as part of the RI.

The investigation will follow a phased approach, starting with a qualitative review of the bay and bayou and leading into more complex studies as warranted. If ecological and human health risks can be characterized after any phase of the investigation, further study will be halted. Phase I involves a literature search and site reconnaissance related to past practices within IR sites and associated areas of the bay and bayou, including previous investigations at NAS Pensacola. Sediment mapping will also be performed during Phase I. This information will be used to choose those areas of the bay and bayou planned for further study in Phase IIA. Reference areas of the bay and bayou will also be established as a means of comparison to apparently unimpacted

Phase IIA involves the collection of surface water and sediment samples within areas of likely contamination identified during Phase I. For ecological concerns, these results will be compared to State of Florida and EPA acute and chronic surface water criteria and EPA Region IV and Florida sediment screening values. For human health concerns, results will be compared to EPA Region III risk-based residential contaminant screening values. Screening values used in human health risk assessment and ecological risk assessment axe not intended to be cleanup standards or ARARs but are only intended to be an initial comparison.

Phase IIB involves the use of toxicity tests and diversity studies. Phase III evaluates bioaccumulation via whole tissue or organism testing. Both Phase IIB and III will be used to establish a decision end point for remediation by understanding current effects and evaluating remedial technology efficiency.

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1.0 INTRODUCTION

As part of the U.S. Navy's Comprehensive Long-Term Environmental Action Navy Program (CLEAN), this Remedial Investigation/Feasibility Study (RI/FS) work plan has been prepared by EnSafe/Allen and Hoshall (E/A&H) for the Southern Division, U.S. Navy, Naval Facilities Engineering Command [(the Navy),] as *tasked* under Contract Number N62467-89-D-0318/CTO-036. This work plan addresses potential contamination in Bayou Grande and Pensacola Bay at the Naval Air Station Pensacola (NAS Pensacola), Sites 40 and 42.

This RI/FS work plan has been developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), the Superfund Amendment and Reauthorization Act of 1986 (SARA), and the U.S. Navy's Final 1995 Yearly Site Management Plan for NAS Pensacola (U.S. Navy, 1992), pursuant to the Federal Facility Agreement (FFA) *dated* October 23,1990 between the United States Environmental Protection Agency Region IV (EPA Region IV), Florida Department of Environmental Protection [FDEP], and the U.S. Navy.

This work plan outlines the objectives, approach, and methods to be used in conducting the RI of the bay and bayou, discusses applicable site background and setting information, and evaluates potential contaminants, contaminant sources, migration pathways, and receptors associated with the bay and bayou. This work plan addresses only the RI procedures to be perfomed through site characterization. After the site characterization has been completed, an RI report will be written. **[This RI report will include a baseline risk assessment, addressing risk to both human health and the environment.]** If necessary, a FS will be performed based on information obtained during the RI process.

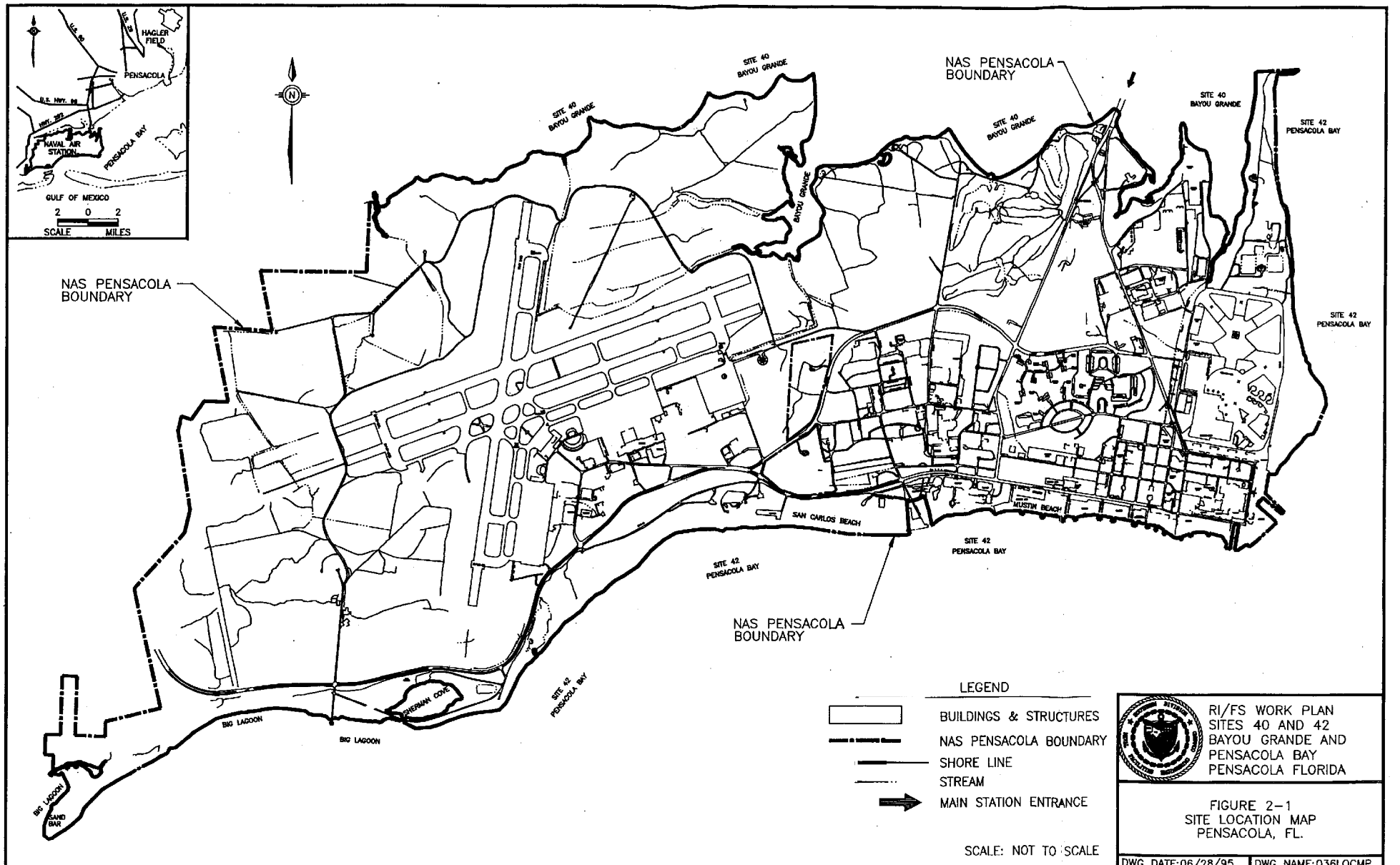
[Bold items in brackets denote changes to the first *draft* of document.]

All investigation activities conducted during this RI/FS will be performed in accordance with *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1991a) and *Environmental* Compliance *Branch — Standard Operating Procedures and Quality Assurance Manual* (SOP/QAM), EPA Region IV, (EPA 1991b) [and the Comprehensive Sampling and Analysis Plan (*CSAP*, E/A&H 1995a).] These documents detail the project organization, project objectives, and specific quality assurance/quality control (QA/QC) measures to be followed during the field investigation and laboratory procedures. [A site! specific Sampling and Analysis Plan (*SAP*, E/A&H, 1995b) has been submitted to complement this work plan.] A site-specific *Health and Safety Plan* (HASP, E/A&H 1993) has been prepared as a supporting document for this RI work plan [and outlines health and *safety* procedures and protocols. The HASP will be submitted to the Navy only. All of the other documents cited above will be submitted to the Navy, EPA, FDEP, and the other resource trustees for review and comment.)

2.0 BACKGROUND INFORMATION

2.1 Facility — NAS Pensacola

NAS Pensacola is located on a peninsula, approximately five miles southwest of the city of Pensacola, in the southeastern portion of Escambia County, Florida. This peninsula is bounded on the north by Bayou Grande and on the east and south by Pensacola Bay (Figure 2-1). NAS Pensacola encompasses approximately 5,800 acres used for housing, administration, training, and *industry*. The older, eastern portion of the base is the most heavily developed. Industrial activities in this area have involved the production, handling, and disposal of various hazardous material or wastes at several locations. Forrest Sherman Airfield and undeveloped woodland are prevalent on the western portion of the activity. The Navy has identified [24] sites under its Installation Restoration (IR) program at NAS Pensacola for investigation regarding past


HAGLER FIELD
PENSACOLA
U.S. HWY. 98
HWY. 292
NAVAL AIR STATION
PENSACOLA BAY
GULF OF MEXICO
2 0 2
SCALE MILES
NAS PENSACOLA BOUNDARY
SITE 40 BAYOU GRANDE
BAYOU GRANDE
SITE 42 PENSACOLA BAY
SAN CARLOS BEACH
MUSTIN BEACH
SHERMAN COVE
BIG LAGOON
SAND BAR
LEGEND
BUILDINGS & STRUCTURES
NAS PENSACOLA BOUNDARY
SHORE LINE
STREAM
MAIN STATION ENTRANCE
SCALE: NOT TO SCALE
RI/FS WORK PLAN
SITES 40 AND 42
BAYOU GRANDE AND
PENSACOLA BAY
PENSACOLA FLORIDA
FIGURE 2-1
SITE LOCATION MAP
PENSACOLA, FL.
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or present operations and potential contamination [in the bay and bayou]. These sites are described in Section 3.

2.2 Bayou Grande and [Pensacola Bay Descriptions]

[As shown on Figure 2-1, Bayou Grande (Site 40) is an estuarine] water body adjacent to the northern border of NAS Pensacola in Escambia County. [Bayou Grande] extends roughly east to west approximately 5 miles inland into the south-Southwestern portion of Escambia County. The northern and central portions of NAS Pensacola, and areas of west Pensacola adjacent to the bayou, drain into Bayou Grande. Bayou Grande flows eastward into Pensacola Bay near NAS Pensacola's Magazine Point. The total surface area covered by Bayou Grande is approximately 1.5 square miles (Olinger *et al.* 1975) and contains approximately 20 miles of total coastline, with approximately 8.5 miles adjacent to NAS Pensacola. The average depth of Bayou Grande is approximately [6.0] feet (Collard 1991).

Bayou Grande is a tributary to Pensacola Bay, part of a larger surf" water system known as the Pensacola Bay System (PBS). Pensacola Bay is at the lowest extent of the PBS, which also includes Blackwater, East, and Escambia Bays (see Figure 2-2). The PBS extends from Escambia into Santa Rosa County and is the fourth largest estuarine ecosystem in the state of Florida (Collard 1991). The PBS has a total surface area covering approximately 144 square miles and has approximately 550 miles of coastline (Olinger et *al.* 1975, Collard 1991). The PBS receives water from four major area rivers: the Escambia, Yellow, Blackwater, and East Bay Rivers. These rivers and their associated drainage basins form an approximately 6,700 square mile drainage area for the PBS. This extensive drainage and tributary system encompasses parts of northwest Florida and extends into southern Alabama (Olinger et *al.* 1975, Collard 1991). Primarily located in Escambia County, Pensacola Bay occupies approximately

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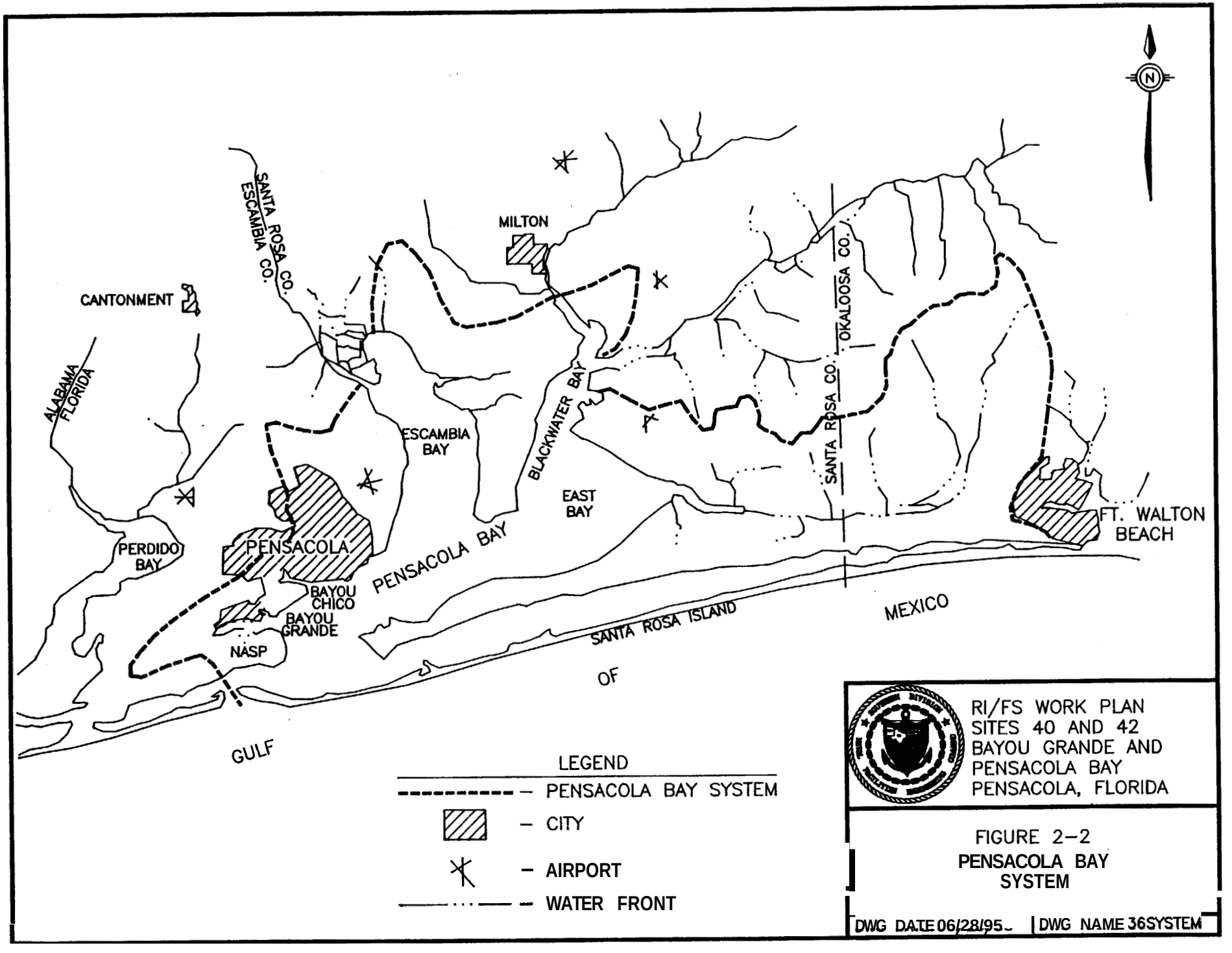
N
MILTON
CANTONMENT
SANTA ROSA CO.
ESCAMBIA CO.
ALABAMA
FLORIDA
ESCAMBIA BAY
BLACKWATER BAY
EAST BAY
OKALOOSA CO.
SANTA ROSA CO.
FT. WALTON BEACH
PERDIDO BAY
PENSACOLA
PENSACOLA BAY
BAYOU CHICO
BAYOU GRANDE
NASP
SANTA ROSA ISLAND
MEXICO
OF
GULF
LEGEND
PENSACOLA BAY SYSTEM
CITY
AIRPORT
WATER FRONT
RI/FS WORK PLAN
SITES 40 AND 42
BAYOU GRANDE AND
PENSACOLA BAY
PENSACOLA, FLORIDA
FIGURE 2-2
PENSACOLA BAY
SYSTEM
DWG DATE 06/28/95
DWG NAME 36SYSTEM

52 square miles of surface area (Olinger *et al.* 1975). Approximately 11 miles of Pensacola Bay coastline borders NAS Pensacola property. Near NAS Pensacola, Pensacola Bay receives waters from Bayou Chico, as well as Bayou Grande. The mean depth of Pensacola Bay is approximately 19.5 feet (Collard 1991).

Collard states "the PBS is a mosaic of different types of estuaries whose characteristics change with river flow, seasons, tides, and the chronic and episodic activities and influences of man" (Collard 1991). Using a system classifying estuaries based on predominant tidal ranges, the PBS best fits the definition of a microtidal estuary system (Collard 1991). In this system, tides range from 0 to 2 meters and tidal currents assume importance only at the mouth of the system and at inlets (bayous). Coarse sediments are found in the mouths of rivers and deltas in this type of system while finer silts and clays are transported to the deeper central portions of the system. Sediment transport occurs mainly by wind-driven, storm-driven, and/or induced currents or waves (Collard 1991). Since its sediments' are derived from rivers, PBS can be classified as a "positive-filled" estuary (Collard 1991). Salinity within the PBS ranges from 0.5 parts per thousand (ppt) near the tributary rivers to approximately 40 ppt at the mouth of the system (Collard 1991). Pensacola Bay, located adjacent to the mouth of the system,. is characterized by the higher salinity of this range. During a previous study, mean temperature extremes in Pensacola Bay ranged from approximately 16" to 28" Celsius (C°) during February and August (Olinger *et al.* 1975).

The PBS has supported commercial and recreational fishing activities since the 1800s. Presently and throughout most of this century, this water system has been heavily utilized for commercial shipping and recreational boating. In recent decades, these and other industrial and agricultural, have increased sediment loads into the system (Collard 1991). A sedimentation problem, at least partially attributable to these activities, has developed in the PBS where fme-grained sediments

have been retained in the system and cover some 70 percent of the system bottom. These sediments tend to trap certain types of pollutants including synthetic organic compounds and trace metals (Collard 1991).

Pensacola Bay is dredged periodically to provide a navigable channel for naval and commercial shipping. Dredging projects in Pensacola Bay have been performed by the United States Army Corps of Engineers (USACE), Mobile District, since the turn of the century as authorized by the River and Harbor Acts of 1902, 1935, 1937, and 1962 (Northwest Florida Water Management District [NWFWMD] 1990). Dredging activities associated with these acts were completed in May 1965 and provided an entrance channel from the Gulf of Mexico into the lower Pensacola Bay, a bay channel, an inner-harbor channel, two parallel approach channels to opposite ends of the inner-harbor channel, an approach channel to the south of Muscogee wharf [(located immediately southeast of Pensacola)], an entrance channel into Bayou Chico, and a turning basin within Bayou Chico (NWFWMD 1990). Since approximately 1973, few dredging activities have occurred in the bay to significantly change existing channels or create new ones. During the past 20 years, dredging has been conducted in Pensacola Bay every three to four years to maintain established channel dimensions (USACE 1992). The most recent significant dredging project was a modification to the NAS Pensacola aircraft carrier turning basin to accommodate the USS Forrestal. This project began in 1988 and lasted about 3 years, when maintenance dredging was also performed. [All dredge spoils in the NASP area were traditionally placed on Site 11, Site 14, or Magazine Point.]

2 3 Physical Setting

23.1 Climate

The Pensacola area typically experiences a mild subtropical climate as a result of the approximately 30" north latitude and influences of the adjacent Gulf of Mexico. Temperatures

for this area range from 55° Fahrenheit (°F) in the winter to 81°F in the summer. These temperatures are generally stable; however, temperature extremes of less than 7°F and up to 106°F have been recorded. During summer, thunderstorms frequently occur and *can* cause a 10 *to* 20°F drop in air temperature in minutes.

Annual rainfall is fairly high in the Pensacola area, averaging approximately 61 inches per year. Generally, rainfall amounts are highest during the warmer months of July and August, averaging more than 7 inches per month, and lowest during the months of May, October, and November, averaging under 4 inches per month. During summer, high rainfall commonly accompanies thunderstorms and *can* produce up to 3 to 4 inches of rain within one hour. Due to the higher temperatures, evaporation rates *are* generally higher during the warmer months, reducing the full groundwater recharge potential of the heavy rains. During the cooler months of fall and spring, rainfall is usually less intense but lasts longer, allowing for higher rates of groundwater recharge through percolation and infiltration of rainfall.

In the Pensacola area, winds prevail from the north and northwest during the fall and winter, and from the south and southwest during the spring and summer. Wind velocities are usually moderate, but *can* reach gusting *speeds* during thunderstorms. During *the* warmer months, land-sea temperature differentials and the effects of prevailing Atlantic Bermuda High pressures produce a daily clockwise rotation of area winds commonly referred to as the sea-breeze effect. Severe weather is infrequent to the Pensacola area; however, hurricanes and tornadoes have caused significant damage in the past. Since 1980, six hurricanes have passed within 50 miles of Pensacola without touching land in the area (E&E 1992b).

23.2 Surface Waters

Pensacoh Bay and Bayou Grande, parts of the Pensacola Bay System (PBS), are the major surface water bodies in the immediate area of NAS Pensacoh (Figure 2-1). Surface soil is composed primarily of highly permeable sands limiting *stream* formation. Several naturally occurring intermittent streams and numerous man-made drainage ditches flow south into Pensacola Bay. Some intermittent streams flow north into Bayou Grande from the northern, central and eastern portions of the base. The NAS Pensacola peninsula also contains wetland areas, with many of [them] containing standing water.

23.3 Physiography

NAS Pensacola is in the Gulf Coastal Lowlands Subdivision of the coastal Plain Province physiographic division. Laud surface elevation ranges from 0 to approximately 40 feet above mean sea level (msl). The most prominent topographic feature at NAS Pensacola is a bluff paralleling the southern and eastern shorelines. Between the bluff and the shoreline, a nearly level marine terrace occurs at approximately 5 feet above msl. Gently rolling uplands reach elevations of up to 40 feet above msl landward of the bluff (E&E 1992b).

The PBS primarily drains the western highlands physiographic region of the northwest Florida and contiguous areas extending into southeast Alabama. Overall, the PBS is described as a low relief, open, coastal plain *estuary*, partly blocked by a barrier island backed by a sound or lagoon (Collard 1991).

23.4 Hydrogeology

Underlying NAS Pensacola are three principal hydrogeologic units (in descending order): the Sand-and-Gravel Aquifer, the Intermediate System, and the Floridan Aquifer System

(E&E 1992b). Figure 2-3 illustrates the distribution of these hydrogeologic units across northwest Florida.

Sand-and-Gravel Aquifer — *At* NAS Pensacola, this aquifer extends from the land surface to a depth of approximately 300 feet bls (Wagner et al. 1984). This hydrogeologic unit primarily consists of sequences of unconsolidated to poorly indurated sand and gravel deposits, with interspersed lenses of clay. In this area of northwest Florida [west of the Choctawhatchee River], the surficial aquifer functions as aa important source of water. [In southern Escambia County, the federal classification for] groundwater from wells screened in this aquifer is [Class I: potential or actual discharge into a sensitive ecological environment (EPA, 1986)]. Because this aquifer is contiguous with land surface and recharged locally through infiltration and percolation, it is susceptible to contamination from surface sources. The sediments comprising this unit area are Pliocene to Holocene Series, and at NAS Pensacola, primarily consist of the [Pliocene/Pleistocene-age] Citronelle Formation overlain by [Holocene] marine terrace deposits. Due to differences in permeabilities, the Sand-and-Gravel aquifer is divided into three zones: the surficial, the low permeability, and the main producing zones (Wilkins *et al.* 1985). [The] *surficial zone* comprises the uppermost portion of the Sand-and-Gravel Aquifer within the vicinity of NAS Pensacola (Wilkins et *al.* 1985).

Numerous borings conducted during previous studies indicate *that* this zone ranges from 40 to 70 feet thick. The lithology of this zone is described as light tan to brown, fine- to medium-*grained* quartz sand. Groundwater within the surficial *zone* exists under water table or perched conditions. The depth to water within this zone ranges from less than 1 foot to approximately 20 feet bls, depending upon land surface elevation and proximity to surface water bodies. The surficial zone is characterized by relatively high permeabilities and horizontal groundwater flow velocities. Hydraulic conductivity values ranging from 10^{+1} to 10^{+2} feet per day have been

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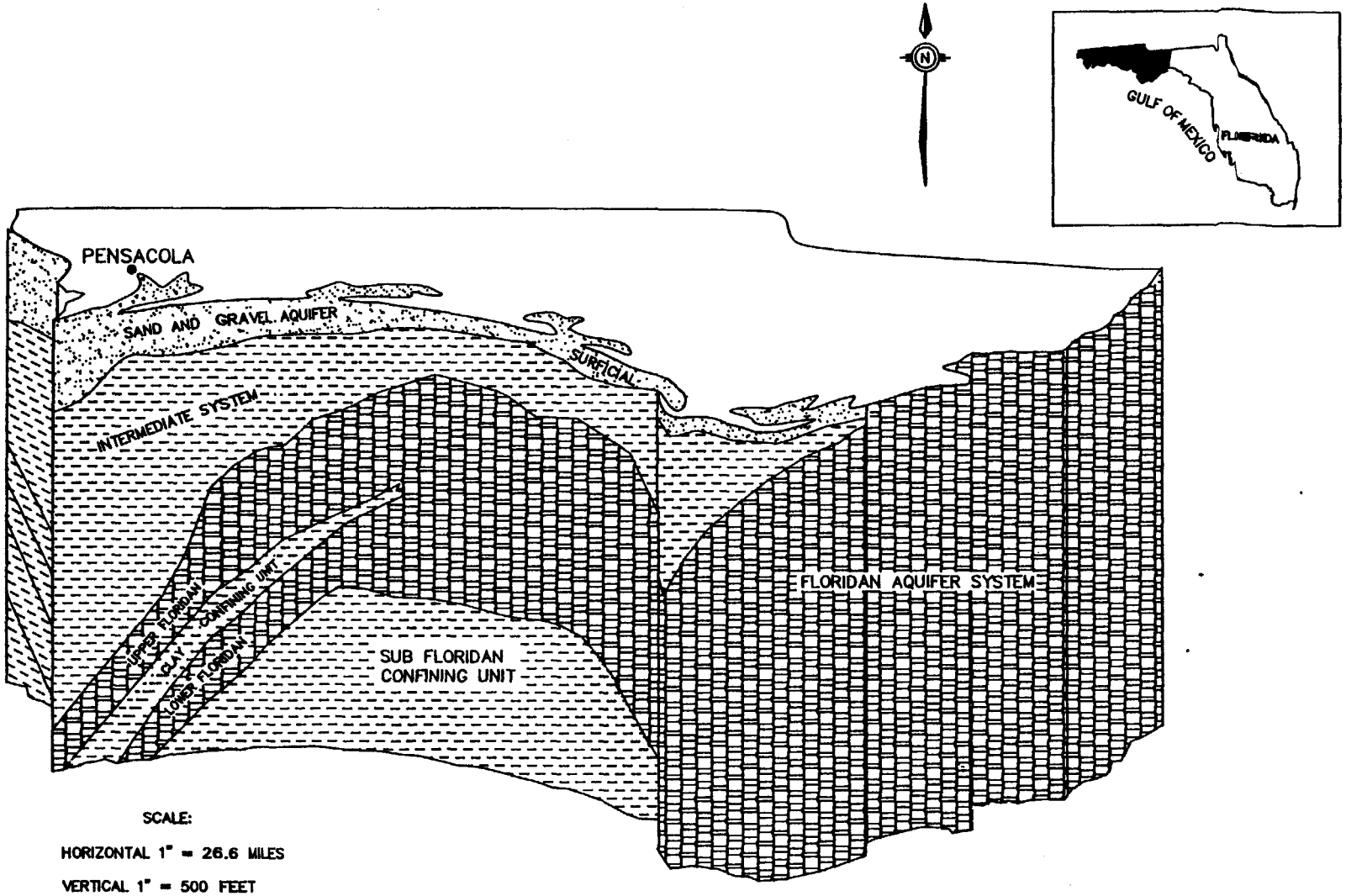

SCALE:

HORIZONTAL 1" = 26.6 MILES

VERTICAL 1" = 500 FEET

VERTICAL EXAGGERATION = 281

SOURCE: E&E 1992c.

RI/FS WORK PLAN
SITES 40 AND 42
BAYOU GRANDE AND
PENSACOLA BAY
PENSACOLA, FLORIDA

FIGURE 2-3
GENERALIZED GEOLOGIC CROSS-SECTION OF
HYDROGEOLOGIC UNITS IN
NORTHWEST FLORIDA

DWG DATE: 06/28/95 | DWG NAME: 048GEO1

calculated for this zone (E&E 1990). Groundwater flow within the surficial zone is generally controlled by local topography and discharge to surface water bodies. **[The FDEP classification of the surficial zone is EI and the EPA classification is IIA. The main producing zone of the surficial aquifer, which is used as a potable water source, is overlain by a confining unit.]**

[The] ***low permeability zone*** underlies **the surficial zone at NAS Pensacola (Wilkins *et al.*** 1985). This zone is comprised primarily of clay- to silt-sized sediments **acting as a confining** or **semi-confining** unit, inhibiting vertical groundwater flow between the surficial **and the main** producing zone. Laboratory permeability tests **indicate** vertical hydraulic conductivities for this zone [ranging] from **4.2 x 10^{-5} to** 9.9 **x 10^{-2}** feet **per** day (G&M 1984). **The** lithology of **the** low permeability zone **at NAS** Pensacola has **been** described **as** gray **to** blue, **silty,** sandy, slightly fossiliferous clay **ranging from** 8 to 40 feet in thickness **[(E&E 1992a)].** This zone has **been** encountered in numerous **borings** completed **across** the **base** and is generally **[considered to be laterally persistent] at** *the* facility. **No** wells **are** known **to be** *open* **to** the low permeability zone ***at* NAS Pensacola;** therefore, the [occurrence and) **direction** of groundwater flow within *this* zone is not known **(E&E** 1992b).

[The] ***main . producing zone*** **is** the lowermost portion of the Sand-and-Gravel Aquifer (Wilkins *et al.* 1985). The **zone** is **comprised** primarily of ***sand*** **and** gravel deposits interspersed with minor **amounts *of*** clay **and** silt. The **main** producing **zone** characteristically has the highest permeabilities within the surficial aquifer due **to the** presence **of thick beds of coarse-grained materials.**

Most major producing wells within **the Pensacola area are open to** this zone. Three production wells **at NAS** Pensacola **are screened** in **this zone;** however, due **to** the **high** iron **content in this**

[Bold items in brackets denote changes to the first draft of document.]

water, these wells are used infrequently. Production wells at Corry Field, 3 miles north of NAS Pensacola, are screened within the main producing zones and are principal sources of water for NAS Pensacola.

Regionally the depth [to] the main producing zone varies significantly from approximately 60 to 120 feet bls. The thickness of this zone [also varies], but is estimated [to be as thick] as 300 feet at NAS Pensacola (Wilkins *et al.* 1985). [In southern Escambia County] groundwater flow within the main producing zone is generally [toward the larger water bodies (i.e., Pensacola Bay to the east, and the Gulf of Mexico to the south)]. Groundwater in this zone is generally [subject to] confined or semi-confined conditions due to the overlying low permeability zone. Depending on the location and surf..elevation of the area, positive or negative vertical gradients have been [measured between] wells screened in the main producing zone [and wells screened in the surficial zone. Water levek measured in] wells in low-topography areas near surface water bodies indicate a potential for upward groundwater flow to the surficial zone. Conversely, [water levels measured in] wells in high-topographic areas indicate a potential for downward groundwater flow from the surficial zone into the main producing zone (E&E 1992b).

Intermediate System — The Intermediate System is an extensive hydrogeologic unit of lower permeability immediately underlying the Sand-and-Gravel Aquifer in the vicinity of NAS Pensacola (Wilkins *et al.* 1985). In this area, the occurrence of the Intermediate System is approximately 300 feet bls and approximately 1,100 feet thick. The top of this unit correlates with the Miocene Coarse Clastics, while the remainder comprises the lower portion of the Miocene Coarse Clastics, the Upper Member of the Pensacola Clay, the Escambia Sand Member of the Pensacola Clay, and the Lower Member of the Pensacola Clay, all of Miocene Age. This unit is primarily composed of fine-grained [material] acting as an effective confining unit

between the overlying Sand-and-Gravel Aquifer and the underlying Floridan Aquifer System. The water-bearing properties of this unit are poor; however, there are thin *stringers* or beds of sandy sediments within the sequence possibly producing small amounts of [ground]water (E&E 1992b).

***Floridan** Aquifer System* — The Floridan Aquifer System immediately underlies the Intermediate System in the vicinity of NAS Pensacola at a depth of approximately 1500 feet bls (E&E 1992b). In this area, the unit comprises the Chickasawhay Limestone and undifferentiated Tampa Limestone. Groundwater from this aquifer is highly mineralized in [southern Escambia County] and is not potable (Wagner *et al.* 1984).

2.3.5 Regional Geologic Structure

The hydrogeology in the NAS Pensacola vicinity is primarily influenced by the Gulf of Mexico Sedimentary Basin (E&E 1992a), a regionally extensive negative feature which is the cause of the southwest dip in northwest Florida's strata. To the east of the Gulf of Mexico Sedimentary Basin are two other dominant structural features: the Apalachicola Embayment and the Chattahoochee Anticline. Because of their location (further east and north of NAS Pensacola), these structures have had little impact on NAS Pensacoh-specific hydrogeology. Figure 2-4 illustrates the approximate location of these structures in northwest Florida.

2.4 Previous Investigations — Bayou Grande and Pensacola Bay

[Review of previous investigations in relation to the bay and bayou is important to focusing sample locations and parameters of analysis. This information can be viewed in relation to the history and characteristics at NAS Pensacola to give a better idea of source and receptor interactions.] *Since* the early 1950s, numerous investigations have been conducted in and around the PBS to monitor the ecological health of the bay [and bayou] and to determine

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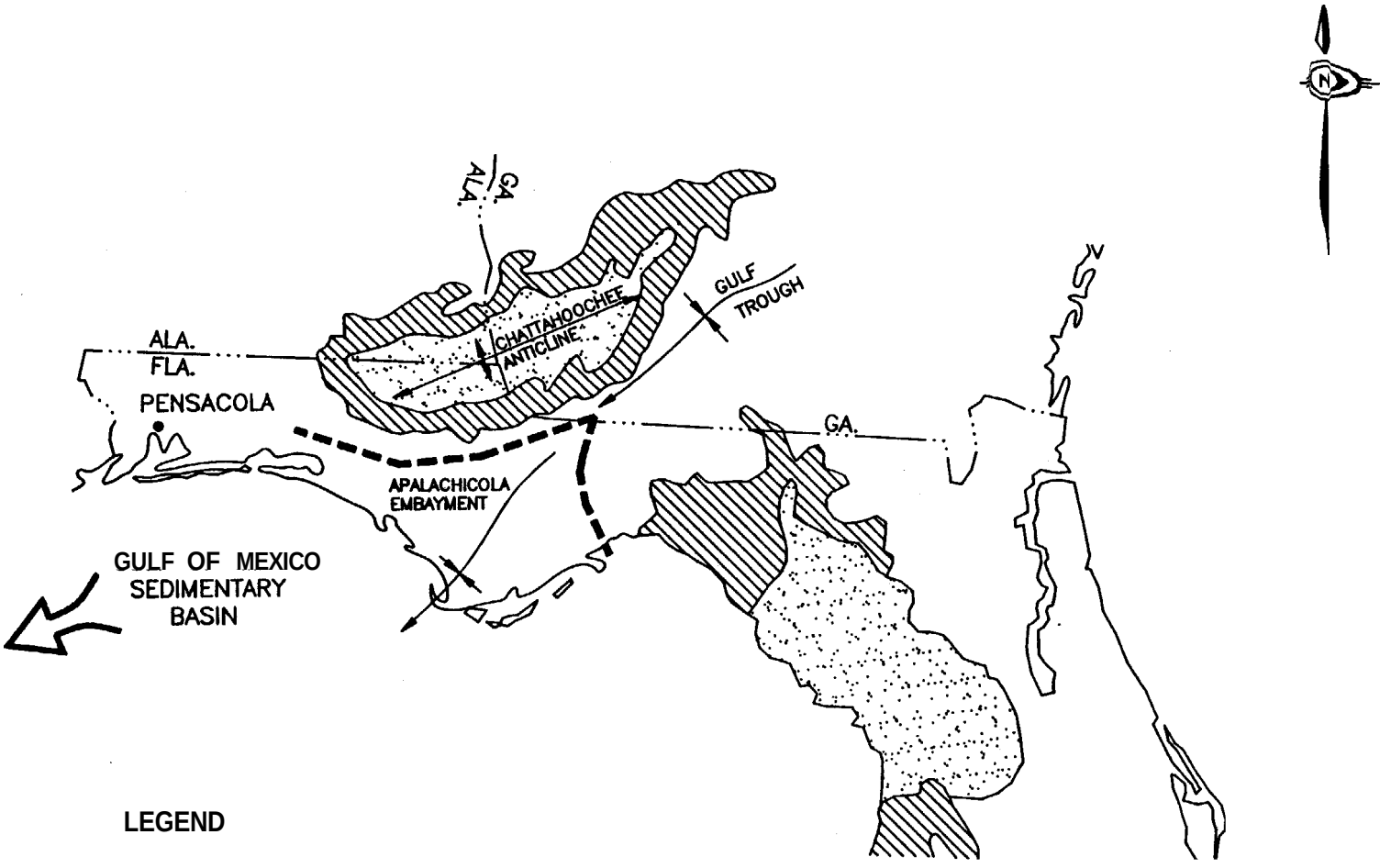

LEGEND

EOCENE OUTCROPS

OLIGOCENE OUTCROPS

SCALE: NONE

SOURCE: E&E 1992b.

RI/FS WORK PLAN
SITES 40 AND 42
BAYOU GRANDE AND
PENSACOLA BAY
PENSACOLA, FLORIDA

FIGURE 2-4
GEOLOGIC STRUCTURES
OF THE NORTHWEST
FLORIDA REGION

DWG DATE: 04/11/95 | DWG NAME: 036GEO2

the impact of commercial, industrial, and municipal activities on the [PBS]. Previous investigations have documented site activities at NAS Pensacola discharging to the bay and bayou. Other studies have been associated with industrial activities of the entire PBS area.

A recent report by Collard (1991) summarizes the environmental-biological history of the PBS, documenting published as well as previously unpublished data from numerous studies conducted from the 1950s to the present. These studies were conducted to identify biological trends and help understand the current status of the [PBS]. A large number of studies have been performed with varying sampling methods, locations and analytical procedures. Because of the voluminous amount of raw data, specifics of these investigations will not be presented here. Instead, the overall conclusions and findings of the more notable studies will be synthesized to provide a basis for understanding the current status of the PBS. In doing so, it is important to note the overall conclusion of Collard's biological trends analysis. His review of previous studies concluded: (1) the data did not support distinct, discemable trends and (2) future investigations should not attempt to evaluate existing data for these trends because of significant deficiencies in the database. Collard's opinions on the investigations and discussions of investigations completed before 1970 are contained in Collard (1991).

Facility-specific studies related to NAS Pensacola summarized [below are taken] from E&E (1991a, 1991b and 1992b).

NAS Pensacola Facility-Specific Studies

1982 NACIP — Environmental studies were conducted under the Navy Assessment and Control of Installation Pollutant Department (NACIP). Elevated [concentrations] of lead and chromium were detected in nearshore sediment samples, although approved FDER methods were not used.

1984 **Thompson** Engineering **& Testing** — Sediment samples were collected **from the area** of the **turning basin and analyzed for** metals and PCBs. The **turning basin** is located **'off** the southeast corner **of** the **NAS Pensacola** facility. The sampling **was** required **by** the dredge **and fill** permit. The analytical method was **an EP-TOX** method **and** did **not** reveal **any metals** or PCBs leachable in sediment.

1984 G&M — **Sediment** samples were **taken** from **storm** sewer **outfalls** approximately **300 feet** offshore of the facility's southeastern waterfront. Samples were analyzed using extraction **procedure (EP)** toxicity methods. **Trace** amounts of **arsenic** were **detected** in some samples, **but** there **was** evidence **that** the samples were improperly **handled and analyzed.**

1982-1985 FDER — **Sediment** samples were taken from **Pensacola** Bay's **turning** basin **south** of the waterfront, **and** from the Big Lagoon **[and]** the mouth of Bayou Grande. Results showed elevated levels of mercury **and** lead for some sites. **Ratios** of [Total Kjeldahl Nitrogen]:Total Organic Carbon **(TKN:TOC)** indicated nitrogen-enriched sediments at the **turning basin,** south of the **facility, and** at the mouth of **Bayou** Grande.

1986 **United States Navy** — Water **and** sediment samples were collected **from the turning basin and** analyzed for heavy **metals during** a **supporting study** for **an** environmental **impact** statement. Results were suspect **because incorrect analytical methods** were **used and detection limits and** laboratory **QA/QC** data were **not** provided. **According to the** report, elevated [concentrations] of chromium **and zinc** were **detected** in *sediments.*

1991 Ecology and Environment — A Phase I Contamination Assessment/Remedial Activities Investigation was conducted at Site 2, the waterfront sediments, to identify potential source areas and contaminants of concern and provide recommendations for subsequent phases of the investigation. Results indicated sediment contamination as outlined below.

Primary Sediment Contaminants at Site 2:

- metals
- volatile *organic* compounds (VOCs)
- total recoverable petroleum hydrocarbons (TRPHs)
- polynuclear aromatic hydrocarbons (PAHs)

[At Site 2,] detected contamination does not point to a distinct source. Potential sources possibly contributing to the sediment contamination include operations at the aircraft carrier berth and naval boatyard, commercial shipping, and past naval industrial facilities discharging effluent to the bay. [E/A&H recently submitted an RI report for Site 2. Results of this investigation am summarized in Section 4 of the *SAP* for Sites 40 and 42.

25 Ecological Resources — Bayou Grande

Bayou Grande averages 6 feet in depth and is connected to Pensacola Bay by a narrow pass north of Magazine Point. The bayou drains freshwater from *Garcon* Swamp to the west, urban watersheds of west Pensacola to the north, and NAS Pensacola to the south. Because of the concentration of freshwater [outfalls] and the bay's constricted Opening, Bayou Grande is [not as saline as] the lower reaches of Pensacola Bay. The biological communities comprising the Bayou Grande ecosystem are similar to those in Pensacola Bay. However, the species composition of aquatic communities [are adapted to less *saline* environments than species in

the] lower Pensacola Bay. Also, communities adapted to low-energy environments (e.g., intertidal mud flats) are more prevalent in Bayou Gmde than in Pensacola Bay.

The intertidal margin of Bayou Grande dong NAS Pensacola generally consists of two different habitats. Relatively narrow, sandy strands with emergent vegetation, predominantly marshhay cordgrass (*Spartina patens*) and needlerush (*Juncus roemerianus*), occur along exposed portions of the shoreline. These exposed habitats support a relatively low diversity of species; fiddler crabs (*Uca* spp.) and marsh periwinkles (*Littorina irrotata*) are two of the more common species. In contrast, intertidal mud flats in protected embayments of the bayou contain a relatively diverse group of species, including **[small crustaceans, amphipods and bivalve mollusks such as** clams]. During flooding tides, these intertidal mud flats are common feeding grounds for rays and bottom-feeding fish. During low tides, shore and wading birds such as ducks, teals, herons and egrets forage on the exposed flats.

Although the shallow depth of Bayou Grande is conducive to benthic photosynthesis, submerged aquatic vegetation does not exist in the bayou (Collard 1991). Likewise, oyster beds are not **[as prevalent in the bayou].** However, many of the commercially and recreationally harvested fish species in Pensacola Bay are likely residents or migrants in Bayou Grande.

26 Ecological Resources — Pensacola Bay

Pensacola Bay in the vicinity of NAS Pensacola is a lower estuarine environment characterized by irregular tidal flushing and **[varying] salinities** (Collard 1991). A master species list compiled by Collard (1991) for the PBS from literature collected over a 35-year period included over 400 species, consisting primarily of sessile macroinfauna taxa. Some of the species on the list may have *since emigrated* or become locally extinct due to changing conditions in the bay. The species diversity of Pensacola Bay has been comparatively low to the cumulative record,

with most individual sampling programs yielding only 4 to 28 species (E&E 1992b). Pensacola Bay system does support significant ecological communities. The bay provides habitat, including critical nesting and nursery areas, for many commercially and recreationally important fish, crustacean, and shellfish species. In addition, the bay contains ecologically important habitats, namely seagrass beds and oyster reefs.

In the soft bottom benthic communities of lower Pensacola Bay, dominant species are tubicolous, surface deposit-feeding polychaetes (*Aricidea* spp., *Capitella* spp.) various spionids, (*Haploscoloplos* spp.), amphipods and small suspension-feeding bivalve mollusks (*Anodontia* alba and *Tellina* spp.). *Gastropods,* hermit crabs, ctenophores, algae, sponges, bryozoans, and barnacles are also present in Pensacola Bay. Few individual species are abundant, although more species representing different trophic levels are present in higher salinity water in the lower bay than in other parts of the estuary. Overall species abundance is greater in the winter than in any other season (Collard 1991).

Information on [fish species] is generally limited *to* species of recreational or commercial importance. Based on landing *statistics,* 21 species or species groups comprise the majority of game or commercially caught fish in Pensacoch Bay (Collard 1991). Fish species diversity is *greatest* in the higher salinity water near NAS Pensacoch during spring and summer. Menhaden and striped mullet are the two most important target species of Pensacola Bay fisheries (Collard 1991). Other abundant species in Pensacola Bay not of major commercial or recreational importance include pinfish (*Lagodon rhombiodes*), bay anchovy (*Anchoa mitchelli*), longspine porgy (*Stenotomus caprinus*), silver perch (*Bairdiella chrysura*), southern hake (*Urophycis floridanus*), inshore lizardfish (*Synodus foetens*), and spotted hake (*Urophycis regius*) (Collard 1991).

Other commercially harvested species include blue crabs (*Callinectes sapidus*), stone crabs (*Menippe mercenaria, M. adina* and hybrids), shrimp (*Penaeus aztecus, P. setiferus*, and *P. duorarum*), oysters (*Crassostrea virginica*), scallops (*Argopecten irradians*) and squid (*Loligunculus* spp.). The distribution and abundance of these species is mainly determined by their salinity preference. The area of Pensacola Bay in the vicinity of NAS Pensacola is permanently closed to oyster harvesting due to the effluent outfall of the City of Pensacola main sewage treatment plant being only three miles northeast from NAS Pensacola. Scallops are found principally in seagrass beds in Santa Rosa Sound and Big Lagoon (Collard 1991).

Seagrass beds, once an abundant habitat throughout Pensacola Bay, no longer occur in the lower reaches of the bay (Collard 1991). The nearest seagrass beds to NAS Pensacoh are located in Big Lagoon along the southwest portion of the base.

Terrestrial or semiterrestrial animals feeding on aquatic biota from Pensacola Bay include ghost crabs (*Ocyopode* spp.), common along sandy shorelines of Magazine Point, and various shore birds. Birds are among the highest level consumers in the Pensacola Bay ecosystem. Some of these species prey exclusively on fish and aquatic organisms, whereas others may also consume terrestrial fauna.

[2.7 Threatened or Endangered Species

Threatened and *endangered* species (TES) locations relative to NAS Pensacoh are shown on Figure 2-5 (Florida Natural Areas Inventory, FNAI 1992) followed by a legend describing the species and its legal status. Figure 2-5 cannot be construed as the most accurate interpretation of the occurrence of TES at NAS Pensacoh and would not preclude a visual inspection during any of the investigation. Visual assessments will be performed

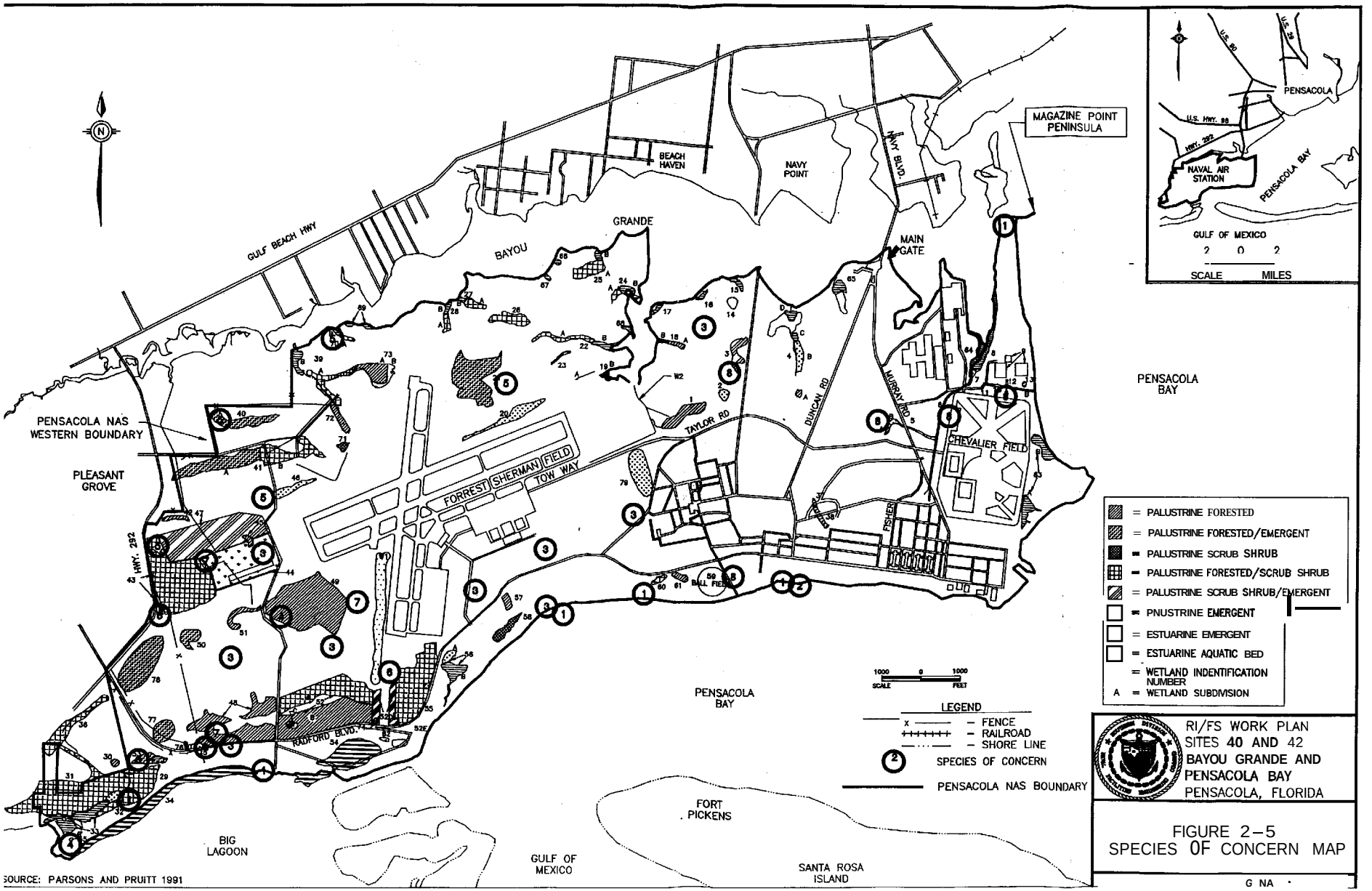

FIGURE 2-5
SPECIES OF CONCERN MAP

G NA

Figure 2-5 (continued)

LEGEND

Number	Common Name	Scientific Name	Federal/State Legal Status
1	Godfrey's Golden Aster	*Chryopsis godfreyi*	C2/N
2	Gulf Rockrose	*Helainthemum arenicola*	N/N
3	Large-Leaved Jointweed	*Polygonella macrophylla*	C1/LT
4	Osprey	*Pandion haliaetus*	N/LS
5	White-Top Pitcher Plant	*Sarracenia leucophylla*	C2/LE
6	Spoon-Flower	*Peltandra sagittifolia*	N/N
7	Spoon-Leaved Sundew	*Drosera intermedia*	N/LT
8	Carolina Lilaeopsis	*Lilaeopsis carolinensis*	3CM

[RANK EXPLANATIONS

FEDERAL

C1 **Candidate Species** for addition to the List of Endangered and **Threatened** Wildlife and Plants, Category 1. The USFWS currently has substantial **information** on hand to support the biological appropriateness of proposing to **list** the **species as endangered** or **threatened. However,** the **species is** *not* yet **officially listed** and **currently has** no **legally** protected status.

C2 Candidate **Species,** Category 2. **Information** on **taxa now** in **possession** of the USFWS indicates that proposing to list the **species as endangered** *or* threatened is possibly appropriate, but conclusive data on **biological** vulnerability and threat(s) are *not* **currently** available to support proposed rules at this time.

3C Category 3C. **Taxa** have proven to be more abundant or **widespread** than was **previously** believed and/or those **not** subject to **any** identifiable threat.

N **Not currently** listed or being considered for addition to the List *of* Endangered and **Threatened** Wildlife and **Plants.**

STATE

LE **Listed as Endangered Plants in the Preservation of Native Flora of Florida Act. Defined as a species of plants native to the state in imminent danger of extinction within the state. Survival is unlikely if the causes of a decline in the number of plants continue, and includes all species determined to be endangered or threatened pursuant to the Federal Endangered Species Act of 1973 as amended.**

LT **Listed as Threatened Plants in the Preservation of Native Flora of Florida Act. Defined as a species native to the state in rapid decline in the number of plants within the state, but has not so decreased in such number to cause them to be endangered.**

LS **Listed as a species of Special Concern by the FGFWFC (Florida Game and Freshwater Fish Commission). Defined as a species, subspecies, or isolated population warranting special protection, recognition, or consideration because it has an inherent significant vulnerability to habitat modification, environmental alteration, human disturbance, or substantial human exploitation, and in the foreseeable future may result in its becoming a threatened species.**

N **Not currently listed, nor being considered for listing.]**

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a

during different times of the year to account for the possibility of other species in the area during different seasonal periods. Other TES not confirmed but possibly living within or near the bay and bayou are described in Table 2-1 and will be considered during any field event of the ecological assessment.]

3.0 INITIAL EVALUATION

3.1 Applicable or Relevant and Appropriate Requirements (ARARs) and Screening Values

The proposed scope of work for the RI/FS at Sites 40 and 42 will be discussed in Section 4 of this work plan and detailed in the SAP. In developing this scope of work, it was anticipated that data would be evaluated with regard to CERCLA, SARA, and other ARARs. The ARARs potentially applicable to this investigation are listed below. The applicability of these ARARs will be reviewed and updated during this investigation along with the development and analysis of remedial alternatives.

Preliminary Federal ARARs

- Clean Water Act (CWA) 40 CFR Parts 230, 231, 403.5, and 122-125
- Safe Drinking Water Act (SDWA) 40 Code of Federal Regulations (CFR) Part 141
- Clean Air Act (CAA) 40 CFR Parts 52 and 61
- Occupational Safety and Health Act (OSHA) 29 CFR 1910.1000
- Resource Conservation and Recovery Act (RCRA) 40 CFR Parts 264,265,268, 270, and 271

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Table 2-1
Threatened and Endangered Flora and Fauna
Observed or Likely to Occur within Habitats of NAS Pensacola

Scientific Name	Common Name	Base Status[a]	Status[b] FGFWFC (or FDA)	Status[b] USFWS	Habitat
FISHES					
Ammocrypta asprella	Crystal darter	U	T	UR 2	Frerh water
Etheostoma histrio	Harlequin darter	U	SSC		Frerh water
Fundulus jenkinsi	Salt marsh topminnow	P	SSC		Salt, fresh, brackish waters
Lepisosteus spatula	Alligator gar	U	SSC		Brackish, fresh salt water
Moxostoma carinatum	River redhorse	U	SSC		Frerh water
AMPHIBIANS AND REPTILES					
Alligator mississippiensis	American alligator	R	SSC	T	Swamps, marshes, ponds
Drymarchon corias couperi	Eastern indigo snake	P	T	T	Open areas near water
Graptemys pulchra	Alabama map turtle	U	SSC		Swamps, streams, mnrrher, ponds
Macroclemys temmincki	Alligator snapping turtle	SR	SSC	UR2	Swamps, marshes, pond
BIRDS					
Charadrius melodus	Piping plover	P	T	T	Open, dry, randy bencher
Charadrius alexandrinus	Snowy plover	P	T	UR2	Open, dry, randy beacher
Dendroica dominica stoddardi	Stoddard's yetlow-throetad warbler	P-u		UR2	Wooded habitats
Dendroica kirtlandii	Kirtland's warbler	U	E	E	Wooded habitats
Haematopus palliatus	American oystercatcher	U	SSC		Coastd hnbitats
Egretta rufescens	Reddish egret	P-u	SSC	UR2	Freshwater/coastal wetlands

[Bold items in brackets denote changes to the first draft of document.]

Table 2-1
Threatened and Endangered Flora and Fauna
Observed or Likely to Occur within Habitats of NAS Pensacola

Scientific Name	Common Name	Base Status[a]	Status[b] FGFWFC (or FDA)	Status[b] USFWS	Habitat
BIRDS (continued)					
Egretta caerulea	Little blue heron	P-u	SSC		Freshwater/coastal wetlands
Egretta thula	snowy egret	P-u	SSC		Freshwater/coastal wetlands
Grus canadensis pratensis	Florida sandhill crane	U	T		Freshwater wetlands
Falco perigrinus tundrius	Arctic peregrin falcon	M	E	T	Winters on the coast
Falco sparverius paulus	Southeastern kestrel	R	T	URZ	Open pine forests, clearings
Haliaeetus leucocephalus	Bald eagle	P-u	T	E	Pine forests/coastal
Pandion haliaetus	Osprey	R	SSC		Near water
Pelecanus occidentalis	Brown pelican	R	SSC	AC	Mangrove trees, coasts
Picoides borealis	Red-cockaded woodpecker	P-u	T	E	Cavity nests/old pine stands
Vermivora bachmanii	Bachmann's warbler	U	E	E	Wooded habitats
Campephilus principalis	Ivory-billed woodpecker	U	E	E	Wooded habitats
Sterna antillarum	Least tern	U	T		Coastal habitats
Mycteria americana	Wood stork	U	E	E	Freshwater/coastal wetland8
Rostrhamus sociabilis	Snail kite	U	E	E	Freshwater/coastal wetlands
PLANTS					
Drosera intermedia	Spoon-leaved sundew	R	T		Aquatic habitats
Kalmia latifolia	Mountain laurel	U	T		Rich, moist, shady woods

[Bold items in brackets denote changes to the first d[illegible] of document.]

Table 2-1
Threatened and Endangered Flora and Fauna
Observed or Likely to Occur within Habitats of NAS Pensacola

Scientific Name	Common Name	Base Status*	Status[b] FGFWFC (or FDA)	Status[b] USFWS	Habitat
PLANTS (continued)					
Lilaeopsis carolinensis	Carolina lilaeopsis	R		URZ	Aquatic habitats
Lilium iridollae	Panhandle lily	U	E	**UR2**	Black, mucky soil
Pinguicula planifolia	Chapman's butterwort	U	RE	URZ	
Rhododendron austrinum	Orange azalea	U	. E	UR5	Moist, woody habitats
Sarracenia leucophylla	White-top pitcher plant	R	E		Open acid bogs
Sarracenia rubra	Sweet pitcher plant	U	E	URZ	Acid bogs/slash **pine** woods

Source: Ecology *end* Environment, Inc., 1992a after florida Natural Inventory 1988.

Key:

*	=	Status of species on the **NAS Pensacola** facility:
R	=	Resident
M	=	Migrant
SR	=	Suspected resident
P	=	**Possible** resident due to available habitat; survey required.
U	=	Unknown; survey required.
b	=	State **and Federal Status:**
E	=	Endangered
T	=	Threatened
AC	=	Agency concern; not currently listed or e candidate for listing
UR2	=	Under **review, insufficient biological** data available
UR 5	=	**Candidate species** but taxa ha8 proven to be more widespread than previously believed and/or those species ere not subject to any identifiable threat.
FDA	=	florida Department of Agriculture
FGFWFC	=	florida **Game** and Freahwatar Fish Commission
USFWS	=	U. **S. Fish and** Wildlife Service
SSC	=	Species of Special Concern

[Bold items in brackets denote changes to the first draft of document.]

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- Department of Transportation (DOT) 49 CFR Parts 170-173

- Endangered Species Act (16 USC 1531 et. seq.); 50 CFR Part 200 and 402

- Fish and Wildlife Coordination Act (16 USC 661 et. seq.); 40 CFR Part 6.302

- Executive Order 11988, Floodplains Management, 40 CFR Part 6, Appendix A

Preliminary State ARARs

- Florida Administrative Code (FAC), Chapter 62-3 (Water Quality Standards)
- FAC, Chapter 62-301 (Surface Waters of the State)
- FAC, Chapter 62-302 (Surface Water Quality Standards)
- FAC, Chapter 62-28.700 (Stormwater Discharges to Groundwater)
- FAC, Chapter 62-550 (Drinking Water Standards, Monitoring, and Reporting)

Screening Values (not listed as ARARs)

- EPA Region IV Waste Management Division Sediment Screening Values for Hazardous Waste Sites (2/16/94 Version).

- State of Florida Sediment Quality Assessment Guidelines ([11/94] version)

3.2 Potential Contaminants and Sources — Bayou Grande

Numerous activities and industrial operations performed at NAS Pensacola have led to the production, handling, or disposal of hazardous materials and/or wastes. Of the 42 sites identified at NAS Pensacola for investigation regarding possible contamination, 16 have been identified during a preliminary scoping study performed by E&E as potentially contributing or

having contributed pollutants to Bayou Grande (E&E 1992b). Known or suspected contaminants associated with these 16 sites include metals, TRPHs, VOCs, base/neutral acid extractable organic compounds (BNAs), PAHs, phenols, and polychlorinated biphenyls (PCBs) (E&E 1992b). Figure 3-1 illustrates the location of these 16 sites at NAS Pensacola.

EPA has collected sediment and surface water samples within 10 wetlands at NAS Pensacola as part of its July 1992 field investigation. E/A&H has collected sediment and surface water samples within seven wetlands as part of RI related activities. Both of these investigations have shown elevated concentrations of metals, pesticides, and SVOCs likely associated with several IR sites which may impact Bayou Grande. To date, general areas of contaminant discharge have correlated with areas identified by E&E.

Due to equipment malfunctions, some EPA sampling locations were not precisely identified. On the basis of the above, E/A&H has used the EPA data, where available, to screen future sample locations shown in the Sites 40 and 42 *SAP*. Specific sample locations and results of the EPA and E/A&H investigations are presented in the Sites 40 and 42 *SAP*.

Two general areas of contaminant discharge, along with the number of sites potentially contributing contaminants to each area, were identified and are listed below:

- The yacht basin west of Magazine Point (13 sites discharging groundwater or surface water to this area).

- The southcentral portion of Bayou Grande (three sites discharging groundwater or surface water to this area).

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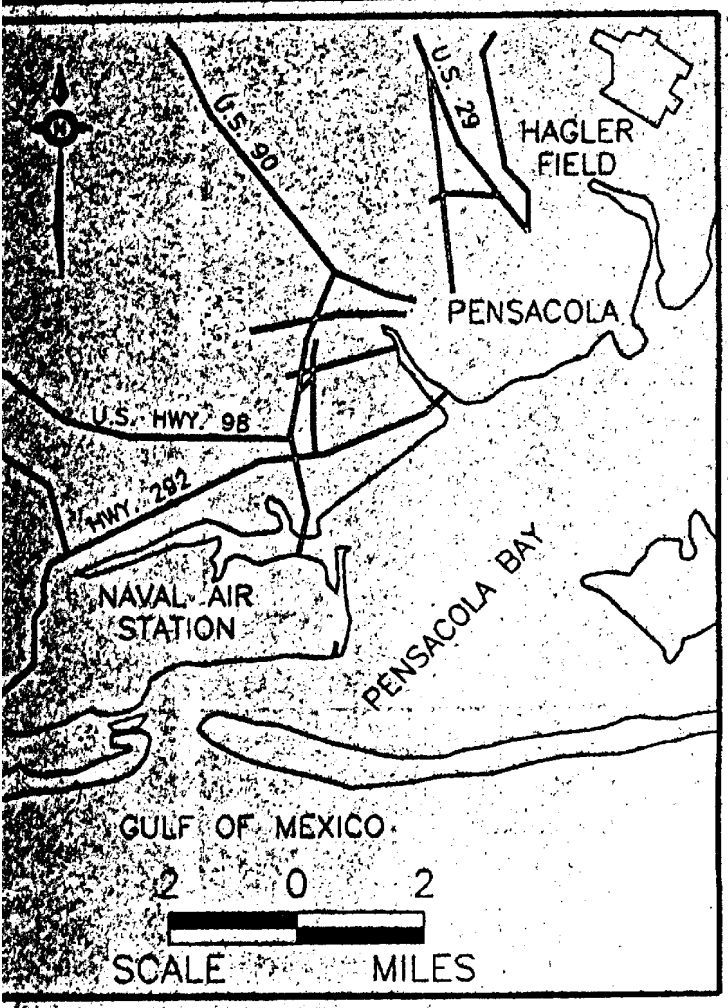
Attachment A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U.S. 29
HAGLER FIELD
PENSACOLA
U.S. HWY. 98
HWY. 292
NAVAL AIR STATION
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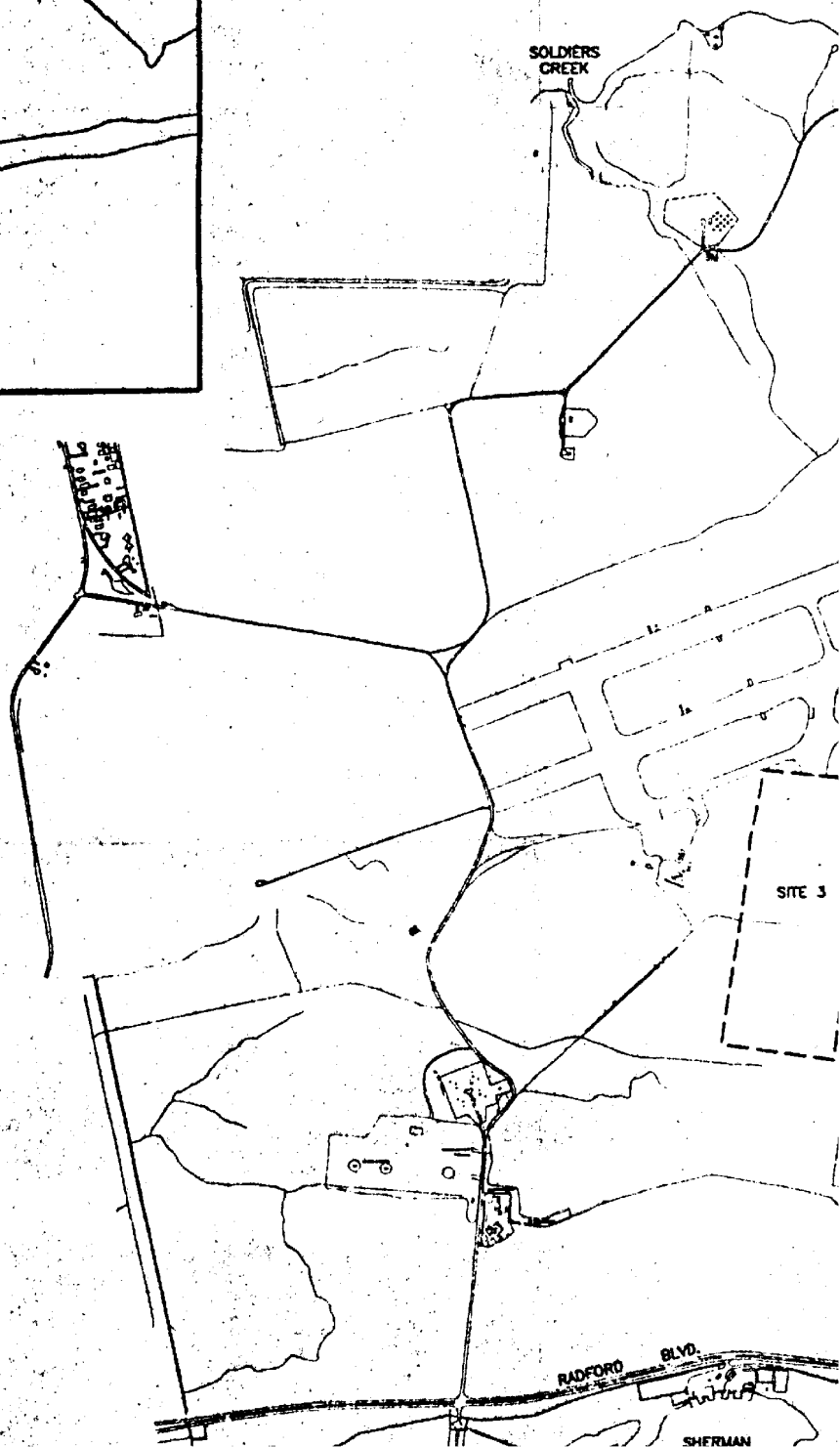
SCALE MILES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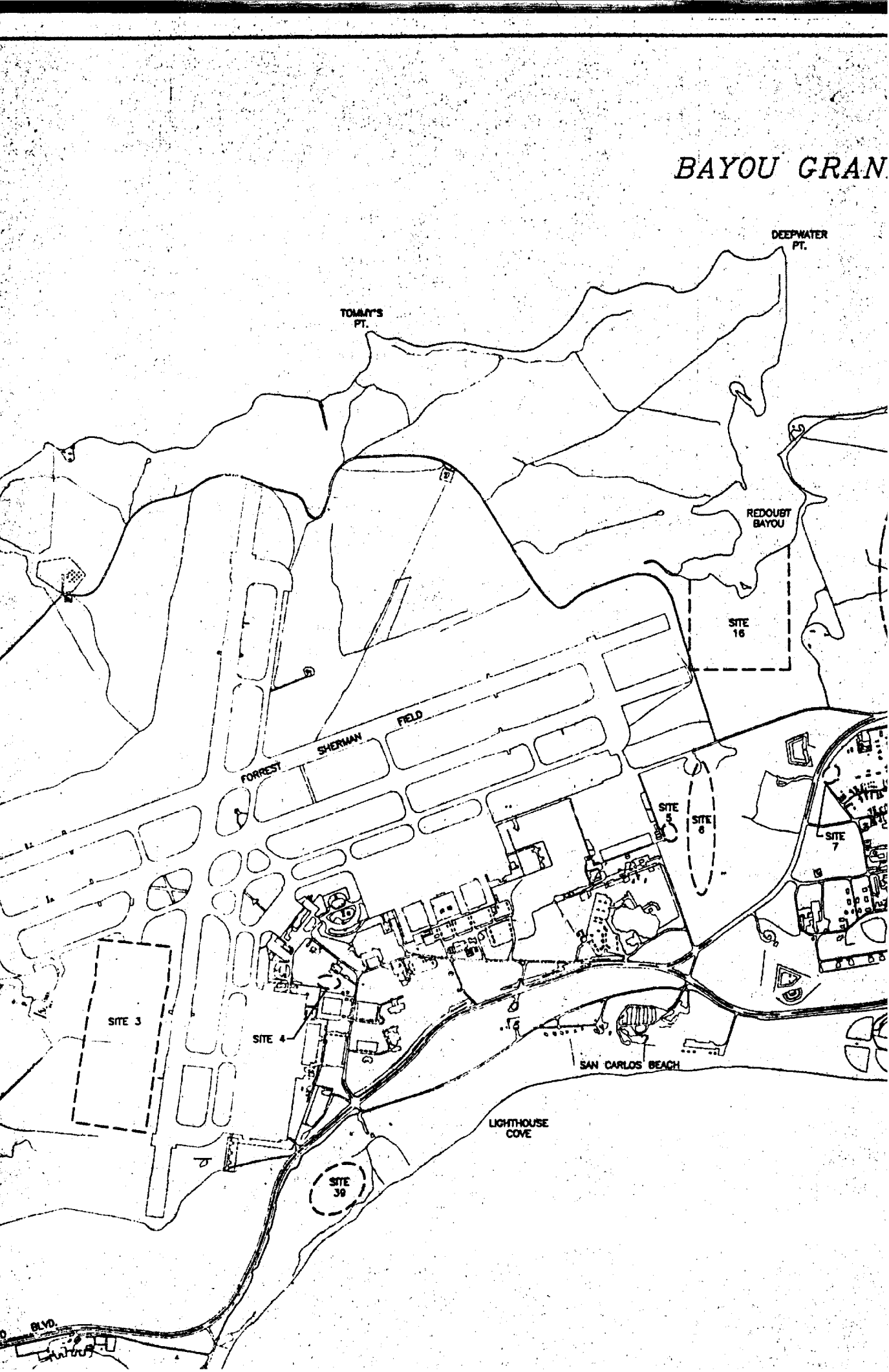
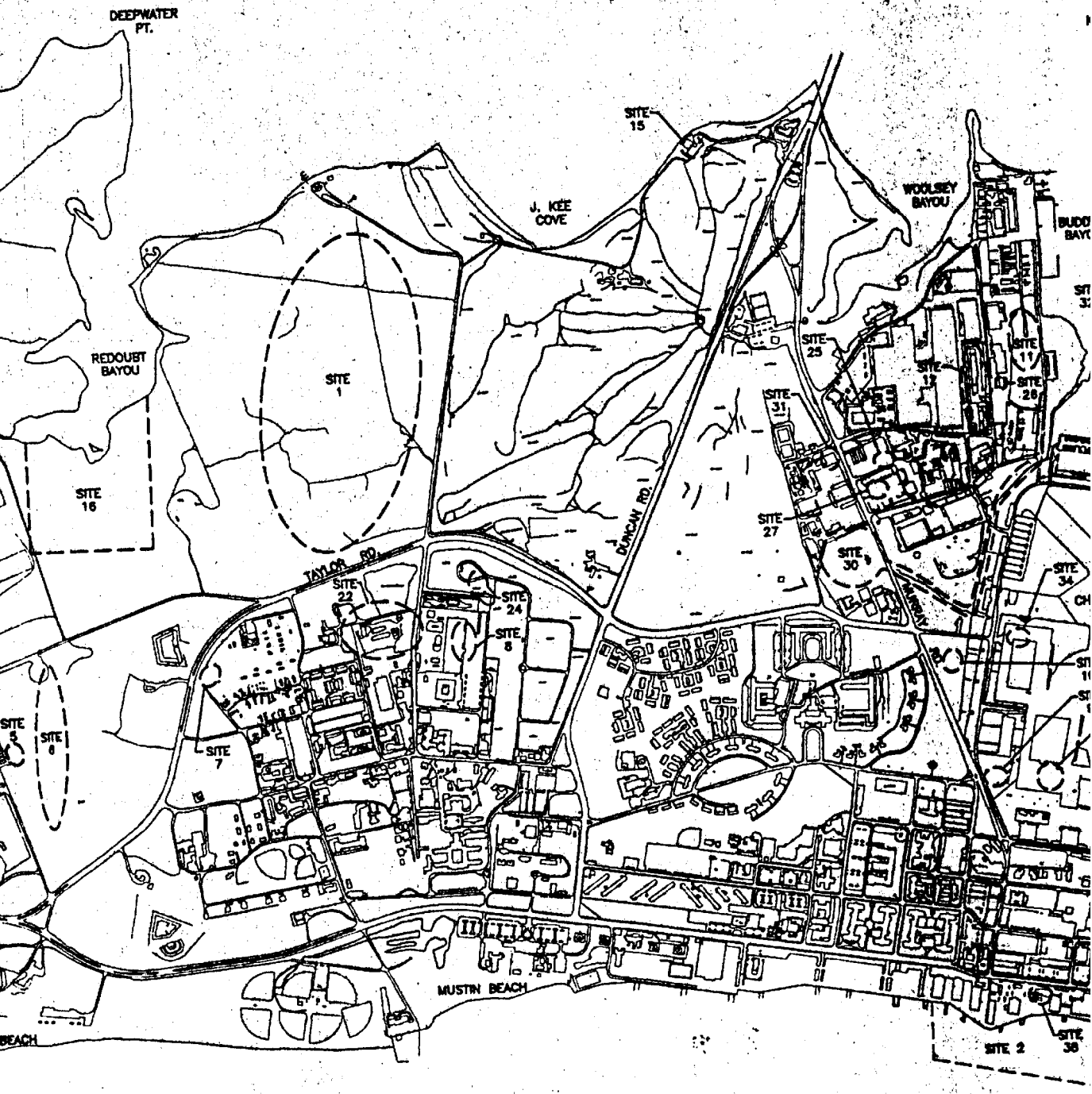
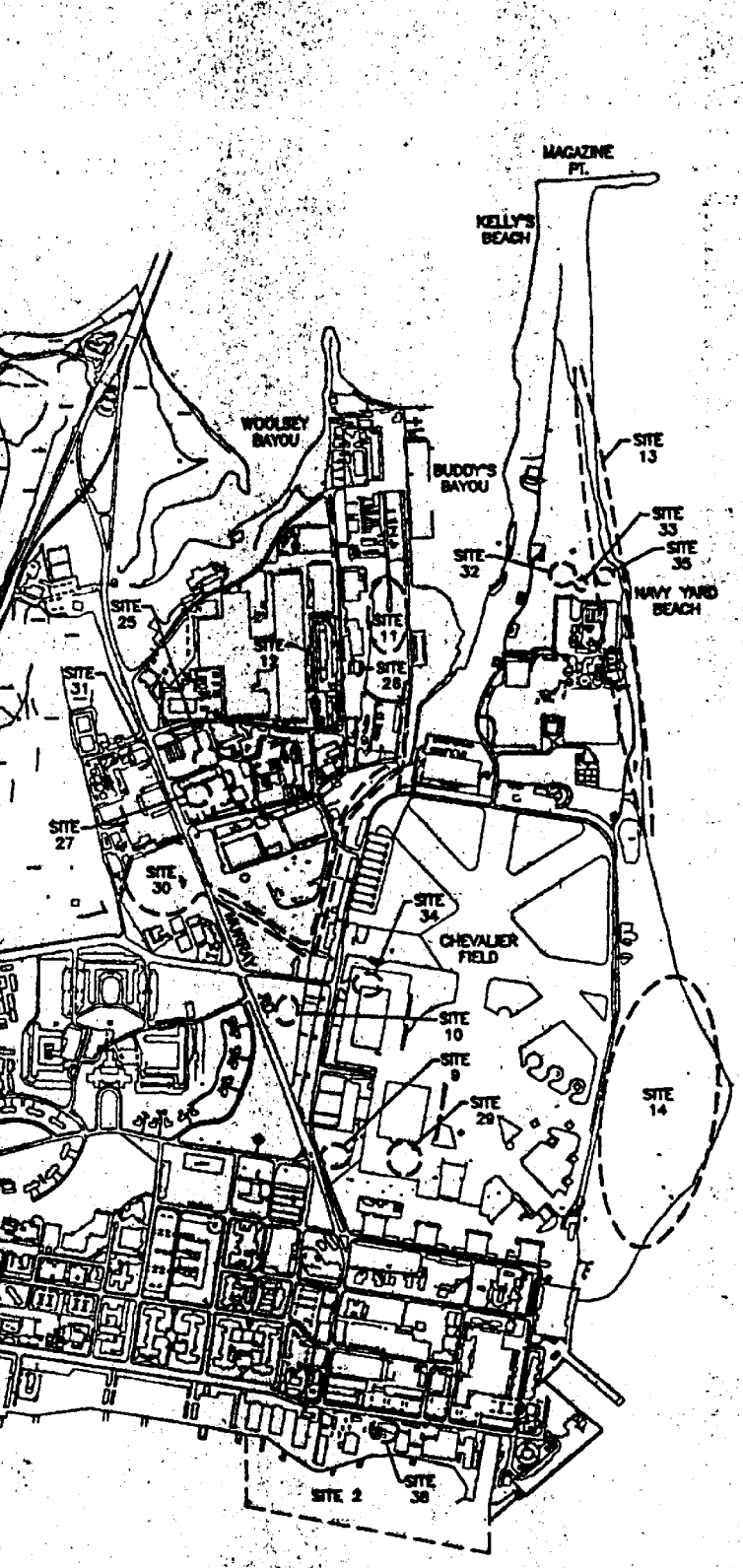
SITE 3
RADFORD BLVD.
SHERMAN


BAYOU GRAN
DEEPWATER PT.
TOMMY'S PT.
REDOUBT BAYOU
SITE 16
FORREST SHERMAN FIELD
SITE 5
SITE 6
SITE 7
SITE 3
SITE 4
SAN CARLOS BEACH
LIGHTHOUSE COVE
SITE 39
BLVD.

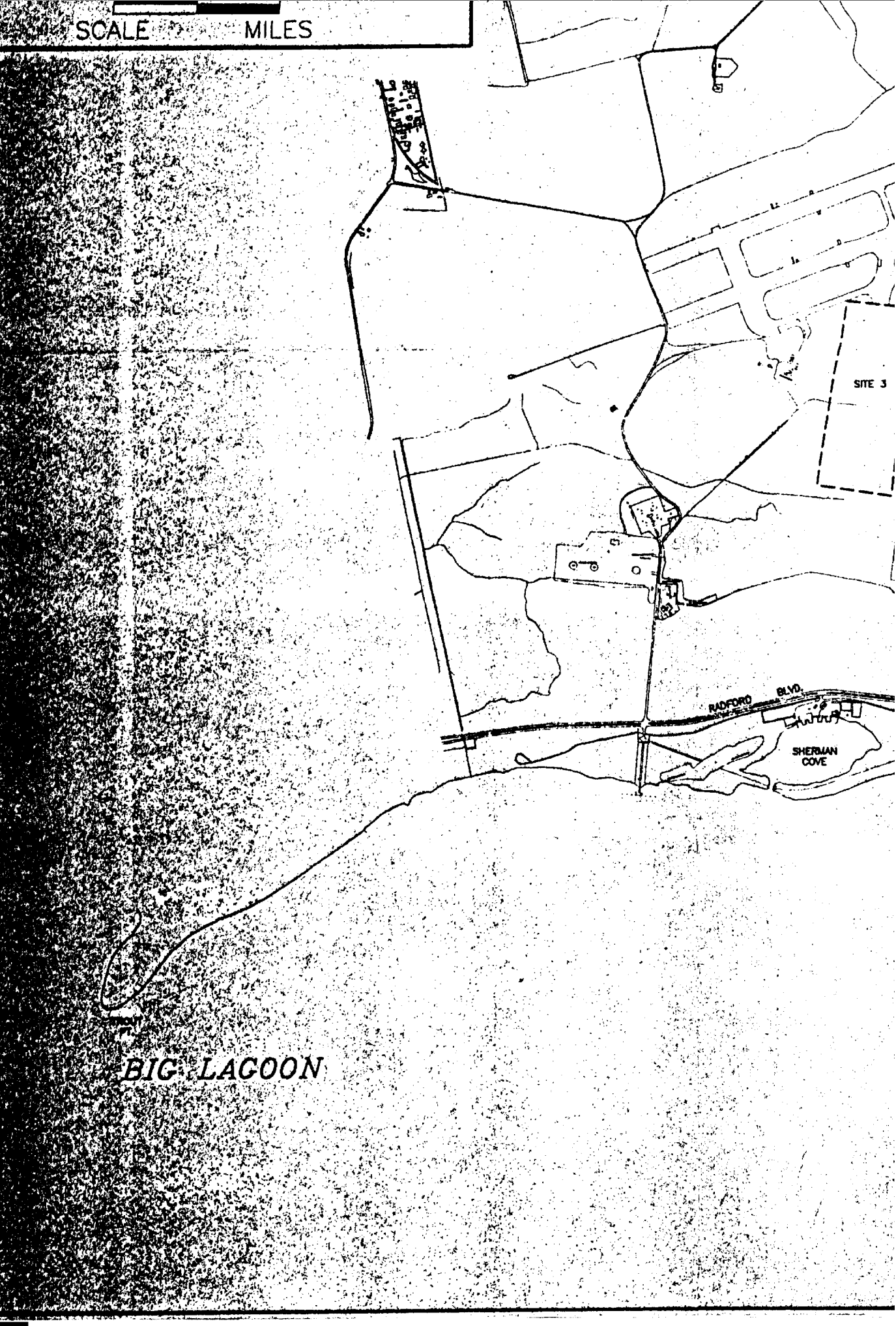
BAYOU GRANDE



PENSACOLA BAY


MAGAZINE PT.
KELLY'S BEACH
WOOLSEY BAYOU
BUDDY'S BAYOU
SITE 13
SITE 33
SITE 35
SITE 32
NAVY YARD BEACH
SITE 25
SITE 11
SITE 26
SITE 31
SITE 27
SITE 30
SITE 34
CHEVALIER FIELD
SITE 10
SITE 9
SITE 29
SITE 14
SITE 2
SITE 36
N

OLA BAY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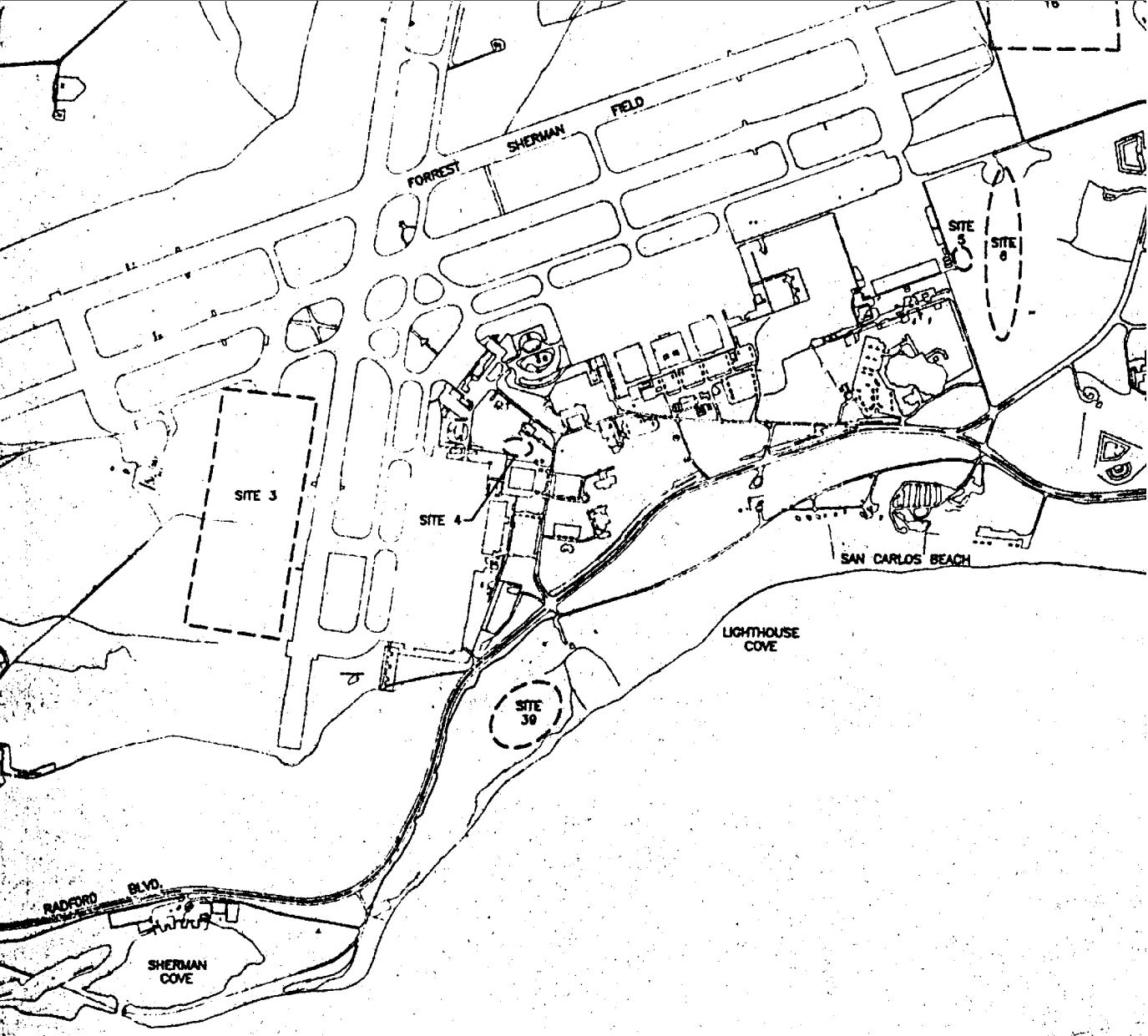
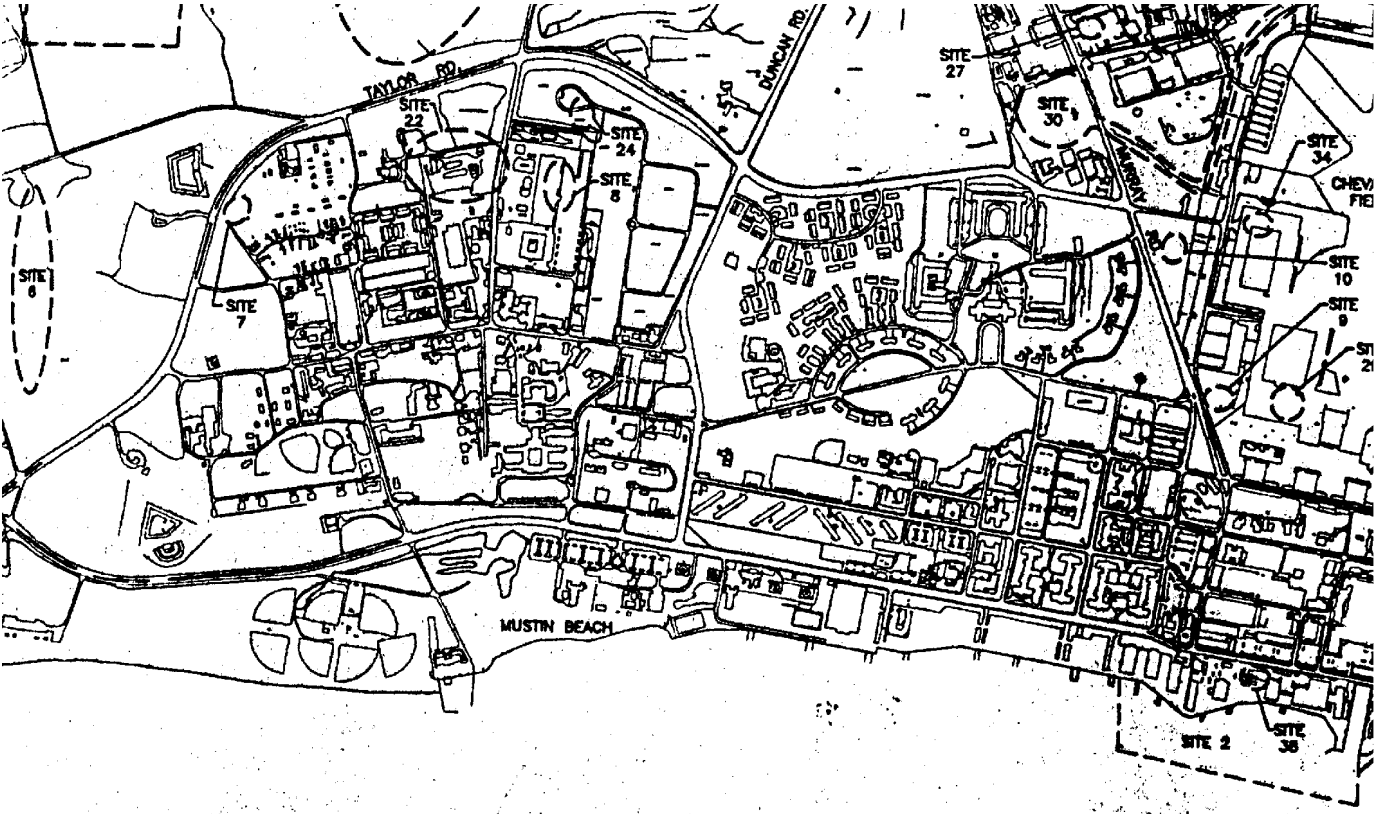
MILES
SITE 3
RADFORD
BLVD.
SHERMAN
COVE
BIG LAGOON



LEGEND

Approximate limits



PENSACOLA BAY

LEGEND

Approximate limits of site

GRAPHIC SCALE

2000 0 1000 2000 4000

(IN FEET)
1 inch = 2000 ft.

LA BAY

PHIC SCALE

(IN FEET)
inch = 2000 ft.

WORK PLAN
SITES 40 & 42
NAS PENSACOLA

FIGURE 3-1

SITE LOCATIONS POTENTIALLY IMPACTING BAYOU GRANDE AND PENSACOLA BAY

DWG DATE: 5/15/95 | DWG NAME: 42FIG3-1

Table 3-1 describes the discharge locations, suspected contaminants, duration of discharge, and potential pathways for the 16 IR sites identified as possibly impacting the Bayou Grande. Although sites addressed under the UST program will not be addressed during this investigation, UST-related contaminants detected in Bayou Grande that may have mixed with contaminants from an IR site will be addressed as part of the RI for Sites 40 and 42. The following is a discussion of the activities performed at each of these IR sites relating to the potential discharge of contaminants into Bayou Grande.

Yacht Basin — The 12 sites potentially discharging into Bayou Gmde in the area of the Yacht Basin do so via groundwater to surface water discharge. The North Chevalier Disposal Area (Site 11) potentially discharges contaminants to Bayou Grande via surface drainage and groundwater migration. Site 11 is an area the Navy used as a landfill for unknown quantities and types of waste during the 1930s and 1940s. Elevated concentrations of metals, TRPHs, VOCs, PAHs, and phenols were detected at Site 11.

Site 12 (Scrap Bins) is located on the bluff to the west side of Site 11, approximately 600 feet from the southern end of the Yacht Basin. Four stormwater drains are present on the site; the outfall for the drainage system is unknown but presumed to be into Bayou Grande or the drainage ditch emptying into the bayou. Metals, TRPHs, PAHs and PCB contamination were detected in the soil from the stormwater drains (E&E 1991d).

Site 30 (Building 649 and 755) includes a wetland and channelized stream, discharging into a stormwater drainage ditch, then into Bayou Grande near Site 11. Metal-plating wastes were periodically discharged from Buildings 649 and 755 for 30 years (1940s to 19709) into the wetland area adjacent to these buildings. The sediments in the wetland, stream, and Bayou

[Bold items in brackets denote changes to the first draft of document.]

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Table 3-1
Summary of Contamination Sources, Pathways, and Discharge Locations at NAS Pensacola Potentially Impacting Bayou Grande

Source (Site)	Site Name	Known or Suspected Contaminants	Duration of Discharge (years)	Potential Pathway(s)	Location of Discharge
1	Sanitary Landfill	Metals, TRPHs, VOCs, PAHs, phenol8	30 (1950-1980)	Surface runoff, groundwater	Central Bayou Grande
3	Crash Crew Training Area	Metals, TRPHs, VOCs, PAHs, phenols	37 (1955-present)	Stormwater drain	Western Bayou Grande
9	Navy Yard Disposal Area	Metals, TRPHs, PAHs	13 (1917-1930s)	Groundwater, surface runoff	Yacht basin
10	Commodore's Pond	Metals, TRPHs, PAHs, phenols	Unknown (1800s)	Groundwater, surface runoff	Yacht basin
11	North Chevalier Disposal Area	Metals, TRPHs, VOCs, PAHs, phenols	Unknown (1930s-1940s)	Groundwater, surface runoff, direct discharge	Yacht baoin
12	Scrap Bins	Metals, TRPHs, PAHs, PCBS	60 (early 1930s-present)	Stormwater drain	Yacht basin
15	Perticide Rinsate Disposal Area	Metals, TRPHs, VOCs, PAHs, pesticides	16 (1963-1979)	Groundwater, surface runoff	Central Bayou Grande
16	Brush Disposal Area	Metals	Unknown (1960s-1973)	Groundwater, surface runoff	Sherman Field embayment
29	Soil South of Building 3460	Metals, TRPHs, PAHs, VOCs	Unknown (1970s-1980s)	Groundwater	Yacht baoin
30	Building8 649 and 756	Metals, TRPHs, VOCs, PAHs, phenols	30 (1940s-1970s)	Direct discharge, surface runoff, groundwater	Yacht basin
32, 33, 35	Industrial Wastewater Treatment Plant	Metals, VOCs, BNAs	11+ (1981-prorant)	Groundwater, surface runoff	Yacht basin (Magazine Point)
34	Solvent North,of Building 3557	Metals, TRPHs, PAHs, phenols	Single incident (1984)	Groundwatar, surface runoff	Yacht basin
36	Industrial Waste Sewer	Metals, TRPHs, PAHs, phenols	21+ (1971-present)	Groundwater	Yacht basin
38	Building 71	Metals, VOCs, PCBs	40 (1935-1973)	Wastewater, rurface runoff	Yacht basin

Source: Ecology and Environment, Inc., 1992b

Key:
TRPHs = Total recoverable petroleum hydrocarbons
VOCs = Volatile organic compounds
PAHs = Polynuclear aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
BNAs = Base/neutral and acid extractable compounds

[Bold items in brackets denote changes to the first draft of document.]

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Grande act as a sink for the plating wastes. Metals, TRPHs, VOCs, PAHs, and phenols were detected at Site 30.

The other nine sites discharging into the Bayou Grande Yacht Basin (9, 10, 29, 32-36, and 38) are concentrated around Chevalier Field or associated with the industrial water treatment plant (IWTP) and/or the sewer line serving this plant. The main pathways from these sources are groundwater discharge to Bayou Grande and/or surface water runoff into the drainage ditch and Bayou Grande.

Central and Western Bayou *Grande* — The four sites potentially discharging into central and western Bayou Grande do so through a stormwater drainage system (Site 3) or by groundwater discharge and surface water runoff (Sites 1, 15, and 16). Of these four, Sites 1 and 3 are the greatest sources of potential contamination. Stormwater from Site 3, the Crash Crew Training Area, is discharged to an inlet in western Bayou Grande via an underground stomwater drainpipe and drainage ditch; Metals, TRPHs, PAHs, VOCs, and phenols were identified in sediment and surf water collected in the stomwater drain (E&E 1992c).

Site 1, the Sanitary Landfill, encompasses 80 acres adjacent to Bayou Grande. Evidence of metals, TRPHs, PAHs, VOCs, and phenol contamination was found in soil and groundwater on the landfill, and in the surface water and sediments of adjacent brackish and freshwater ponds and Bayou Grande. Pathways include groundwater discharge and surface water runoff with Bayou Grande acting as a *sink* (E&E 1991c).

other Potential Sites

Based on proximity to the bay and bayou and low *to* moderate concentrations of contaminants (identified as part of Phase I assessments), eight additional sites were identified as having a possible impact on either Bayou Grande or Pensacola Bay.

These sites include.

- Site 7 — Firefighting School Training Area
- Site 8 — Rifle Range Disposal Area
- Site 22 — Refueler Repair Shop
- Site 24 — Mixing Area
- Site 25 — Radium Spill Area (Preliminary Site Characterization cumntly underway)
- Site 26 — supply Department Outside storage Area
- Site 27 — Radium Dial Shop Sewer (RI cumntly underway)
- Site 31 — Soil North of Building 648 (combined with Site 30, RI currently underway)

8

Although these sites have been identified as possibly impacting the bay or bayou, the potential impact of the above sites will be studied during Phase IIA of the RI and more extensively, if necessary.

3 3 Potential Contaminants and Sources — Pensacola Bay

Numerous activities and industrial Operations at NAS Pensacola have led to the production, handling, or disposal of hazardous materials and/or wastes. Of the 42 sites identified at NAS Pensacola by the Navy for investigation regarding possible contamination, 14 of these sites have been identified during a preliminary scoping study performed by E&E as potentially discharging or having previously discharged pollutants into Pensacola Bay (E&E 1992b). Known or suspected contaminants associated with these 14 sites include metals, VOCs, base/neutral acid extractable organic compounds (BNAs), and pesticides/PCBs (E&E 1992b). Figure 3-1 illustrates the locations of these 14 sites at NAS Pensacola.

Three general areas of contaminant discharge, along with the number of sites potentially contributing contaminants to each area, were identified and are listed below.

- Southeast waterfront sewer discharge area (six sites have previously discharged to the storm water/industrial sewer system).

- Eastern shore of Magazine Point and Chevalier Field (five sites discharge groundwater or surface water to this area).

- Sherman Inlet and Sherman cove (three sites discharge groundwater or surface water to this area).

Table 3-2 summarizes the contaminant sources, pathways, and discharge locations for the 14 sites potentially impacting Pensacola Bay. Each site is discussed below. Unless noted, the discussion is synthesized from E&E (1992b). Although sites addressed under the UST program will not be addressed during this investigation, UST-related contaminants detected in the bay that

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Table 3-2
Summary of Contamination Sources, Pathways, and Discharge Locations at NAS Pensacola Potentially Impacting Pensacola Bay

Source Site	Site Name	Known or Suspected Contaminants	Duration of Discharge (years)	Potential Pathway(s)	Location of Discharge
2	Waterfront Sediments	**Metals, TRPHs, VOCs, PAHs**	38 (1935-1973)	Storm sewer, **surface** runoff	**Southeastern waterfront**
3	**Crash Crow** Training Area	Metals, TRPHs, **VOCs,** PAHs, phenolr	37 **(1955-present)**	Stormwater drain, surface runoff	Sherman Inlet
4	Army Rubble **Disposal** Area	Unknown	Unknown	Groundwater	Sherman Inlet
13	**Magazine Point Rubble Disposal Area**	**TRPHs, VOCs, PAHs, phenols***	Unknown	Groundwater, surface runoff	Magazine Point
14	**Dredge Spoil** Fin **Area**	Metals, TRPHs, **VOCs,** PAHs	17 **(1975-present)**	Groundwater, stormwater overflow	Chevalier Field
17	Transformer Storage **Yard**	Metals, TRPHs, **VOCs,** PAHs, **PCBs**	12 (1964-1976)	storm sewer	**Southeastern** waterfront
18	PCB Spill Area	**Metals, TRPHs, VOCs, PAHs, PCBs**	**Single incident (1966)**	Groundwater, surface runoff	**Southeastern** waterfront
28	**Transformer Accident**	Metals, TRPHs, VOCs, PAHs, PCBs	**Single incident (1969)**	storm sewer	**Southeastern waterfront**
32, 33, 35	Industrial Wastewater Treatment Plant	Metals, **VOCs, BNAs**	**11 +** (1981-**present)**	Groundwater, **surface** runoff	**Magazine** Point
38	**Industrial Waste Sewer**	Metals, **TRPHs,** VOCs, PAHs, **phenols**	**21 +** (1971-present)	Groundwater	**Southeastern** waterfront

(Bold items in brackets denote changes to the first draft of document.]

Table 3-2
Summary of Contamination Sources, Pathways, and Discharge Locations at NAS Pensacola Potentially Impacting Pensacola Bay

Source Site	Site Name	Known or Suspected Contaminants	Duration of Discharge (years)	Potential Pathway(s)	Location of Discharge
38	Building 71	Metals, VOCs, PCBs	~40 (1935-1973)	Wastewater drain, surface runoff	Southeastern waterfront
39	Oak Grove Campground	TRPHs, VOCs	Unknown	Groundwater, surface runoff	Sherman Inlet

Source: E&E 1992b.

Key:
TRPHs = Total recoverable petroleum hydrocarbons
VOCs = Volatile organic compounds
PAHs = Polynuclear aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
BNAs = Base/neutral and acid extractable compounds
a = Suspected source of these contaminants in the Industrial Wastewater Treatment Plant (sites 32, 33, and 35).

may have mixed with contaminants from an IR site will be addressed as part of the Sites 40 and 42 RI. The following is a discussion of the activities performed at each of these IR sites relating to *the* potential discharge of contaminants into Pensacola Bay.

Southeastern Waterfront — Six sites are potential sources of contamination because of past or present influences from the NAS Pensacola sewer system. Before being diverted to the Industrial Waste Water Treatment Plant (IWTP) in 1973, the sewer system discharged untreated stormwater and industrial wastes into Pensacola Bay along the southeastern water front (Site 2).

Building 71 (Site 38), an aircraft paint stripping facility since 1935, was the primary source of untreated industrial wastes discharged to Site 2. Analytical results from Site 2 showed concentrations of metals, TRPHs, and PAHs to be highest in sediments offshore of Building 71 (Site 38). Site 2 bas undergone an RI and has been evaluated separately from other portions of Pensacola Bay in the vicinity of NAS Pensacola.

The Dredge Spoil Fill Area (Site 14), located m the southeastern portion of NAS Pensacola, had detected concentrations of chromium, cadmium, and nickel in groundwater. 'Chevalier Field (Site 9, 29, 34, and 36) to the west of Site 14 is another potential source of contamination. Metals, TRPHs, and PAHs were detected in the nearshore sediments in the vicinity of Site 14.

Another source in the southeastern portion of NAS Pensacola is the PCB Spill A m (Site 18). The site has not been investigated, but was the location of a 50-gallon spill of possible PCB-containing transformer oil in 1966.

Magazine Point and the Eastern Shore of Pensacola Bay — Malfunctions at the IWTP facilities (Sites 32, 33 and 35) have impacted groundwater, which potentially discharges into Pensacola Bay. Groundwater samples collected at the IWTP have detected elevated concentrations of metals, VOCs, and BNAs exceeding either Florida Primary Drinking Water Standards or Florida Secondary Drinking Water Standards. The Magazine Point Rubble Disposal Area (Site 13) is located hydraulically downgradient of the IWTP and had detected concentrations of TRPHs, VOCs, PAHs, and phenols in the groundwater.

Sherman Inlet and Sherman Cove — Sherman Inlet and Sherman Cove are embayments of Pensacola Bay. Site 3, the Crash Crew Training Area, is the only investigated site in the vicinity of Sherman Inlet and Sherman Cove. A stormwater surface drain directs surface water runoff from the Site 3 vicinity into an intermittent stream discharging into Sherman Inlet. Metals, TRPHs, VOCs, PAHs, and phenols were detected at Site 3.

Four other sites (Sites 4, 19, 37 and 39) are located in the area and are potential contaminant sources for Pensacola Bay. The Army Rubble Disposal Area (Site 4) was the location of nonhazardous waste and rubble disposal in the early 1950s. The Fuel Farm Pipeline Leak Area (Site 19) was the location of a reported 360,000-gallon JP-4 fuel oil spill in 1958. The Sherman Field Fuel Farm Ana (Site 37) was the site of a reported 48,000-gallon JP-4 fuel oil spill in 1983. Free product and petroleum compounds were detected during groundwater monitoring in 1984 and 1985. The Oak Grove Campground (Site 39) has been mediated via a removal action.

3.4 Potential Contaminant Migration Pathways and Preliminary Public Health and Environmental Impacts — Bayou Grande and Pensacola Bay

Both Pensacola Bay and Bayou Grande surface water bodies are likely to have been affected by surrounding industrial and commercial activities. This discussion will not include pathways from

sources other than NAS Pensacola (i.e., non-NAS Pensacola tributary surface waters) potentially transporting contaminants to Bayou Grande and Pensacola Bay.

In the following discussion, organisms residing in Bayou Grande and Pensacola Bay are defined as the primary receptors, while potential secondary receptors are defined as those transient organisms potentially affected by contaminants as they migrate through the ecosystem and food chain. Other potential receptors of contaminants from the 24 source sites will be addressed in each site-specific investigation.

Since numerous other contaminant sources (at least 24 sites at NAS Pensacola) have been identified as potentially impacting Bayou Grande and Pensacola Bay, this section will generally discuss secondary contaminant sources, primary and secondary release mechanisms, migration pathways, and receptors potentially common to more than one primary source.

Figure 3-2 is a conceptual site model for Bayou Grande and Pensacola Bay. Discharges to the bay or bayou via drainage features, miscellaneous contaminant spills and leaks, and fill material leachate are the primary release mechanisms at these sites. Groundwater is affected by the infiltration and percolation of contaminants, while facility surface waters and sediments are affected by over-land stormwater runoff. Once received by these water bodies, contaminants dissolve into the water column, absorb onto suspended particulate matter in the water column, or accumulate in the sediment of the bay or bayou. Surface waters and sediments are transporting media to receptor areas as contaminants adsorb onto suspended particulate matter in the water column. Currents, tides, and flushing actions of the bay and bayou act as release mechanisms, transporting both the dissolved and adsorbed contaminants through the water and sediment. Throughout the transportation process, bioaccumulation occurs as plants and animals are exposed to the contaminants. Exposed biota continue and often accelerate the transportation

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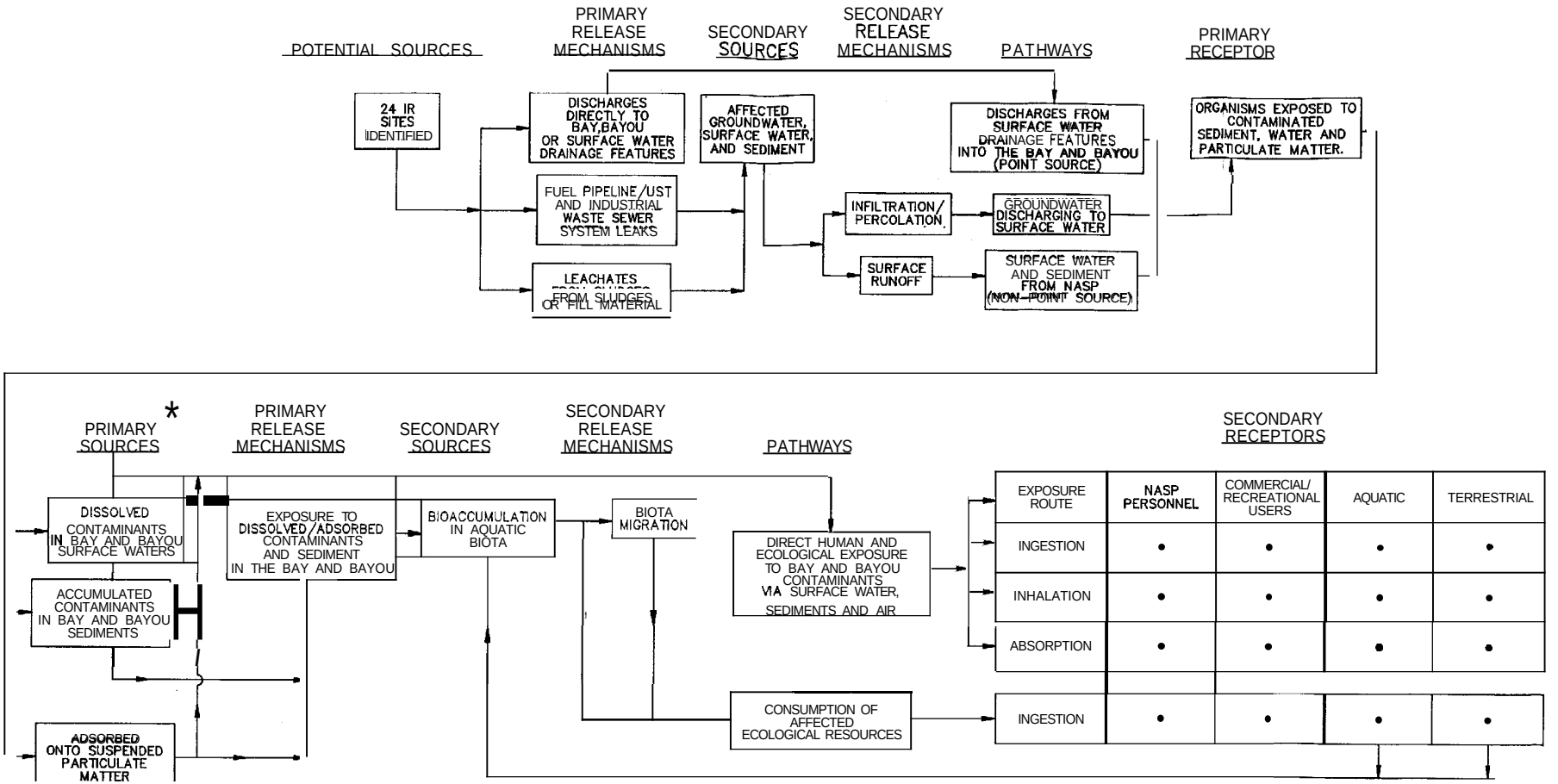


* CONTAMINANT CONCENTRATIONS AND MEDIA CHARACTERISTICS CAN DETERMINE WHETHER CONTAMINATED SEDIMENT ACTS AS A SOURCE OR PATHWAY OF CONTAMINATION

RI/FS WORK PLAN
SITES 40 AND 42
BAYOU GRANDE AND
PENSACOLA BAY
PENSACOLA, FLORIDA

FIGURE 3-2
CONCEPTUAL SITE MODEL

DATE: 04/21/95 | DWG. NAME 36SCSM3

process through *the* food chain. Human contact occurs through direct exposure to contaminated waters and/or sediments, or the consumption of exposed seafood. Meanwhile, the bioaccumulation process continues as exposed biota are consumed by other biota and recycled within the system's food chain.

3.5 Remedial Objectives, Actions, and Alternatives — Bayou Grande and Pensacola Bay

Given the initial conceptual model and list of potential ARARs for Bayou Grande and Pensacola Bay, preliminary objectives and approaches for remediation have been identified in Table 3-3. *Appropriate* remedial alternatives will be developed further as the RI/FS proceeds and the sites are more fully characterized. Any of the *general* response actions or medial technology types listed in Table 3-3 *can* be used to achieve a desired remedial action objective for either human health or ecological concerns.

Table 3-3
Preliminary Remedial Action Objectives, Response Actions, and Technologies

Medium	Remedial Action Objectives	General Response Actions	Remedial Technology Types
Surface Water/ Sediment	**For Human Health:** Prevent human exposure to surface water/sediment containing site contaminants possibly resulting in a 10^{-6} excess cancer risk level, or in excess of reference doses.	**No Action/ Institutional Actions:** No action, access restriction. **Containment Actions:** Containment. **Excavation/Treatment Actions:** Excavation, Surface Collection; Treatment; **Disposal,** on or **offsite.**	Fencing, deed restrictions. **Capping,** sediment control barriers, surface water controls. Dredging/excavation; Dewatering; **fixation, solidification, stabilization,** immobilization; chemical, **physical,** biological, thermal **(ex-** or in-situ) treatment; Landfilling, or discharge.
	For Environmental Protection: Prevent migration of contaminants resulting in surface water levels in **excess** of ambient water quality criteria; protect biota affected by conteminants in sediment.		

[Bold items in brackets denote changes to the first draft of document.]

4.0 WORK PLAN RATIONALE

The objective of the RI at Sites 40 and 42 is to quantitatively characterize the actual or potential effects of contamination in Bayou Grande and Pensacola Bay to human health and the environment.

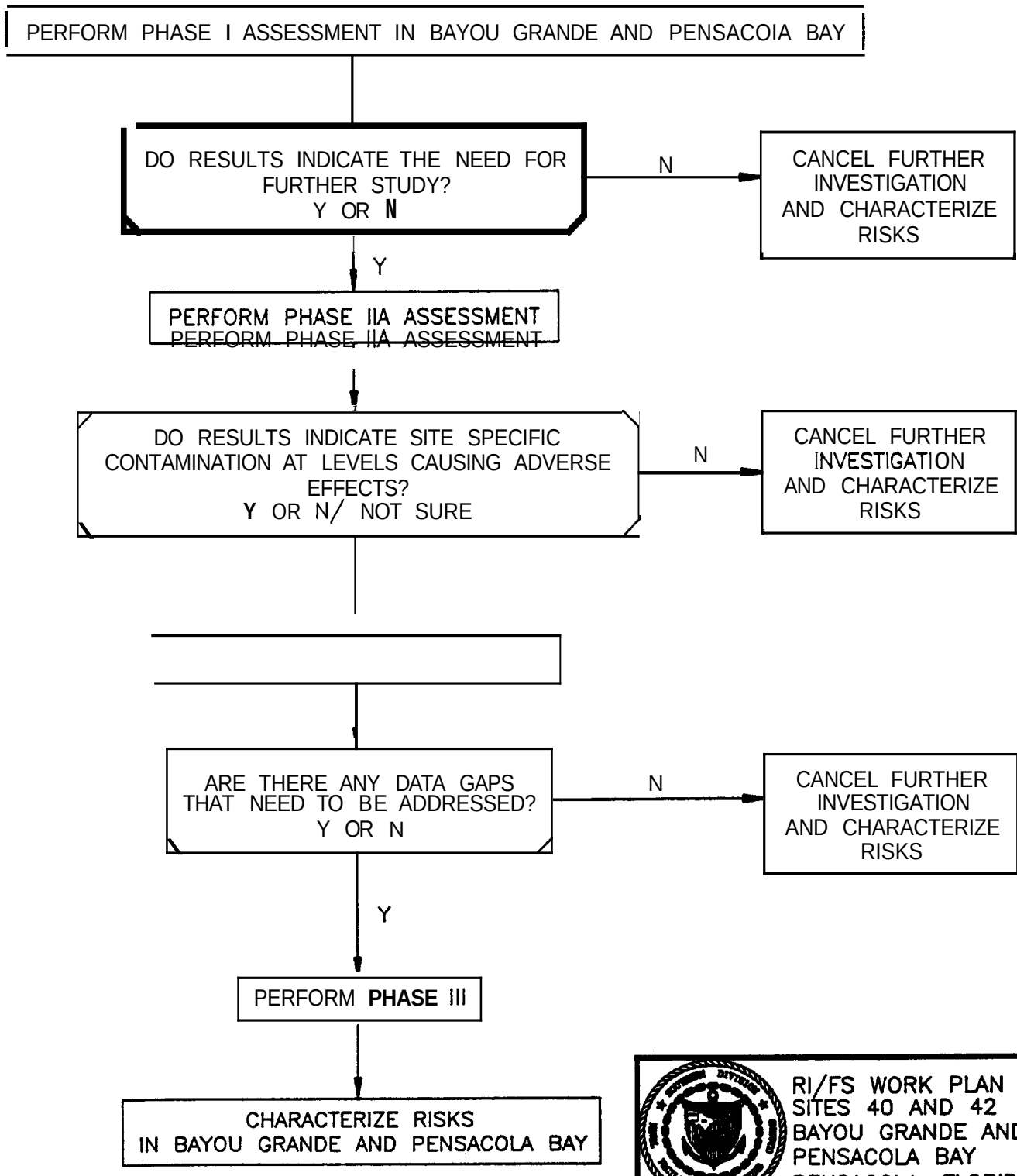
Although the bay and bayou are unique, the procedures used to analyze them will be consistent with the Site 41 investigation. As given in Figure 4-1, the RI approach is divided into three phases. The first phase focuses on qualitatively reviewing the bay and bayou and developing a sampling strategy for the Phase 11 investigation. Phase II involves collecting specific quantitative chemical data from each portion of the bay and bayou to complement the qualitative data from Phase I. Phase III is planned in case there are any other important data needs after Phase II is completed.

4.1 . Work Plan Organization

This plan is organized similar according to Site 41 RI, in a phased approach. The data gathering method for each phase of the assessment will be described, followed by a discussion of the data objectives to be achieved from each phase. Areas of the bay and bayou requiring further study after Phase I and their proposed sample locations are described in the SAP for Sites 40 and 42.

4.2 Phase I

Phase I is a qualitative review of any information needed in part to help determine sample locations for Phase IIA of the investigation. Two principal objectives were met during Phase I: (1) Identification of all sediment and surface water sampling location required in the initial Phase IIA sampling and (2) a description of the framework for the human health and ecological risk assessments. Phase I included a review of sample results from IR sites and data already collected in the bay and bayou through Phase I sediment mapping.



* CURRENT STATUS OF SITES 40 AND 42 INVESTIGATION

RI/FS WORK PLAN
SITES 40 AND 42
BAYOU GRANDE AND
PENSACOLA BAY
PENSACOLA, FLORIDA

FIGURE 4–1
REMEDIAL INVESTIGATION
PROCEDURE FLOWCHART

DWG DATE 06/28/95 DWG NAME 36RIPF2

After Phase IIA, Phase IIB may be performed. Phase IIB involves the use of diversity studies and toxicity tests to quantify impact occurring in particular areas of the bay and bayou. If additional data is required after Phase IIB, Phase III may be implemented to determine possible contaminant bioaccumulation in the food chain.

4.2 Phase I

4.2.1 Contaminant Source Survey

Information from the habitat and biota survey will be used to produce a contaminant source diagram of each potential area of concern. The contaminant source diagram will be developed to identify any potential contaminant sources and any present or past waste streams from any IR site. The diagram will include a review of previous investigative reports, interviews with present and former NAS Pensacola personnel, aerial photo analysis and a utility survey.

The diagram will include the identification and mapping of the following:

- Past and present chemicals used at an IR site.
- Locations of any known surface spills.
- Locations of any known historical outfalls.
- Locations and contents of any known present or former underground storage tanks.
- Contaminant distribution from an IR Site.

4.2.2 Sediment Mapping/Site Reconnaissance

Within Bayou Grande and Pensacola Bay, water depth and overall distribution of grain size and total organic carbon in the sediments will be mapped. After mapping is completed, it may be possible to judge how contaminants and organisms are distributed. Distribution of sediments

will be compared to the contaminant source diagrams to help relate source to receptor. This will enable E/A&H to determine the areas with the highest probabilities of contaminant accumulation and overall ecological effect. Simultaneous.with sediment mapping, the field team will conduct a site reconnaissance recording habitats and biota observed.

4.23 Sampling Strategy

After the above information has been identified and mapped, it will be possible to accurately establish sampling locations for chemical analysis in Bayou Grande and Pensacola Bay; sampling for chemical analysis will be performed in Phase IIA.

The initial Phase II sampling locations at each site will involve areas where contaminants are thought most likely to accumulate, or *hot* spots. These areas will be primarily based on downgradient surface features, drainage patterns, and fine-grained sediment and TOC distribution where contaminants are most likely to be located. If the hot spot samples exceed two times the mean reference value determined through a reference comparison and exceed a particular benchmark for either surface water or sediment, then those areas may be sampled further using *focused sampling.*

Focused sampling will involve biased sample locations in. areas surrounding any contaminated hot spots. Its purpose is to characterize the extent of contamination through limited sampling. Focused sample locations will be based on levels of contaminati'on or possible contaminant migration routes most likely to characterize the extent of contamination.

This approach increases the efficiency and cost effectiveness of the investigation in two ways: Sampling can be cancelled after only a few selected sampling locations. In addition, if analysis of hot spots indicates site related contamination, subsequent sampling can be targeted for the

contaminant(s) of concern. Both of these considerations will save time and money in field work and laboratory analysis.

4.2.4 Phase I Data Objectives

The following data objectives are categorized more broadly than the individual Phase I tasks described previously. The objectives of the individual Phase I tasks overlap the objectives explained below.

Site History Data Objectives

- Determine when and what activities were occurring which may have impacted the a portion of the bay or bayou.

- Determine what changes may have been made to the bay or bayou as a result of human activities.

- Determine what compounds may have been disposed of in and around that portion of the bay or bayou.

Resources such as aerial photographs, topographic maps, records of disposal actions, people familiar with the history of the IR site or its associated portion of the bay or bayou, and any other relevant information can be used to achieve the above objectives. These tasks are normally accomplished during the habitat and biota survey and in development of the contaminant source diagram.

Contaminant Release, Migration, and Fate Data Objectives

- Determine what compounds have already been shown to be present in the environment.

- Determine where potential contaminants would most likely be deposited in the sediment.

- Determine where groundwater is directly discharging to surface water of the bay or bayou and in what direction it is flowing.

- Determine the direction in which surface water is migrating.

- Determine the location of outfalls or other potential point sources of contamination.

- Determine key receptors of contamination.

Data from previous sampling investigations, sediment mapping, groundwater contour and topographic maps, species of concern listings, *etc., can* be used to achieve these objectives. These tasks are normally accomplished during the habitat and biota survey, development of the contaminant source diagram, and sediment mapping.

Reference Area Establishment Data Objectives

- Determine which areas of the bay and bayou to use as a reference for the areas of concern based on biological, chemical, and physical characteristics.

A site visit to all potential reference areas is *necessary* to determine the best reference location. These tasks are normally accomplished during the site reconnaissance.

Sampling Strategy Data Objectives

- Recommend measurement and assessment endpoints requiring further study.

- Estimate the locations of hot spots and the number of samples required.

- Plan for possible additional sample locations to better characterize the extent of contamination.

A review of all Phase I information is necessary to determine the best reference locations.

4.3 Phase II — Chemical, Diversity and Toxicity Sampling

Phase II sampling is required to establish a link between any observed effects and possible contamination noted in Phase I. Phase IIA includes sampling for chemical constituents only. The main objective in Phase IIA is to better characterize the nature and extent of contamination in areas of concern in the bay and bayou. However, through the use of models and analytical methods described in this Section, the potential for impact may also be determined after Phase IIA. If the results of Phase IIA *can* be used to determine the impact, the investigation *can* end at this phase. However, if questions remain about impact, Phase IIB diversity studies and toxicity tests may be implemented to refine estimations of impacts occurring within the bay and bayou.

43.1 Phase IIA Chemical Parameters

Selected sediment and surface water sample locations within each portion of the bay and bayou and its reference area will initially be sampled for the presence of contaminants using full *TCUTAL*. TCL/TAL is defined as all analytical parameters associated with the Contract Laboratory Program (CLP) parameters based on the CLP statement of work (SOW) for organic and inorganic analysis.

These samples will first be collected from potential hot *spots* identified during Phase I. *Once* these samples are analyzed, contaminant concentrations can be compared *to* those from reference areas, sediment screening values, and water quality criteria. Results of the comparison will help

determine the likelihood of site-specific impact and the need to perform expanded sampling. If benchmark values do not exist for a contaminant, bioaccumulation modeling in the food chain or other methods may be used to estimate the potential impact. If bioaccumulation values can be predicted, it may be possible to calculate endpoints such as the LD_{50} — the administered dose or environmental concentration where 50% of the experimental organisms die in a specified period of exposure time. However, if contaminant levels or modeling leave doubt about the potential environmental impacts from a particular IR site, then the Phase IIB portion of the investigation may be necessary.

Sediment samples may be collected using either a Ekman or Petite Ponar dredge in accordance with the procedures outlined in Sections 4 and 7 of the CSAP. Surface water samples can be collected in accordance with Section 7 of the CSAP either by placing the sample bottle in the surface water or by using a Kemmerer sampling device (depending on the depth to the sediment).

To associate groundwater contamination with a particular IR site, it may be necessary to install shallow monitoring wells, piezometers, rain gauges, or staff gauges around particular portions of the bay and bayou and IR sites of concern. Data from these monitoring tools can be used to help determine remedial strategies for the bay and bayou and its associated terrestrial IR site. All monitoring wells will be installed and sampled according to Sections 5 and 6 of the CSAP. Installation of staff gauges, rain gauges and piezometers is described in Section 4 of the SAP for Sites 40 and 42. The number and locations of monitoring wells is not known at this point. However, justification for placement and locations of monitoring wells will be detailed in a Technical Memorandum if and when they are planned for installation.

4.33 Evaluating Contaminant Levels

Once results from Phase IIA hot spot sampling are analyzed, two fundamental questions must be answered: (1) Are the compounds detected site-specific or man-induced, or are they within reference levels? (2) If the compounds are site-related or man-induced, are they at a concentration to cause adverse effects? The following method relies on several studies from various agencies to answer these two questions. This procedure is a compilation of guidance written by the State of Florida, the EPA, and other resource trustees. Like other procedures in this document, it follows a format, with each step of the procedure determining whether to proceed into the next level of detail. It is also specific for particular media and classes of compounds, each unique in its fate and transport. The flowchart outlining this procedure is shown in Figure 4-2.

Because of the many factors that affect how a contaminant behaves in the sediment and surface water, professional judgement is important when evaluating contaminant levels and their possible impacts. E/A&H plans to use a weight-of-evidence approach when assessing contaminant levels. Weight-of-evidence refers to evaluating all possible factors that govern the influences of a particular contaminant in the surface water or sediment. Some of these factors are explained in the remainder of this section.

Note from Figure 4-2 that the procedure described below is initially performed for those samples collected during hot-spot sampling. If hot-spot samples show contaminants above two times mean reference values and a particular benchmark, expanded sampling may be required. Once an area of sediment and surface water contamination that exceeds either two times mean reference values or a benchmark has been characterized, the investigation can move into Phase IIB, if necessary. Any sites having values below a benchmark may still be studied further, particularly if contaminants in the substrate are markedly bioavailable.

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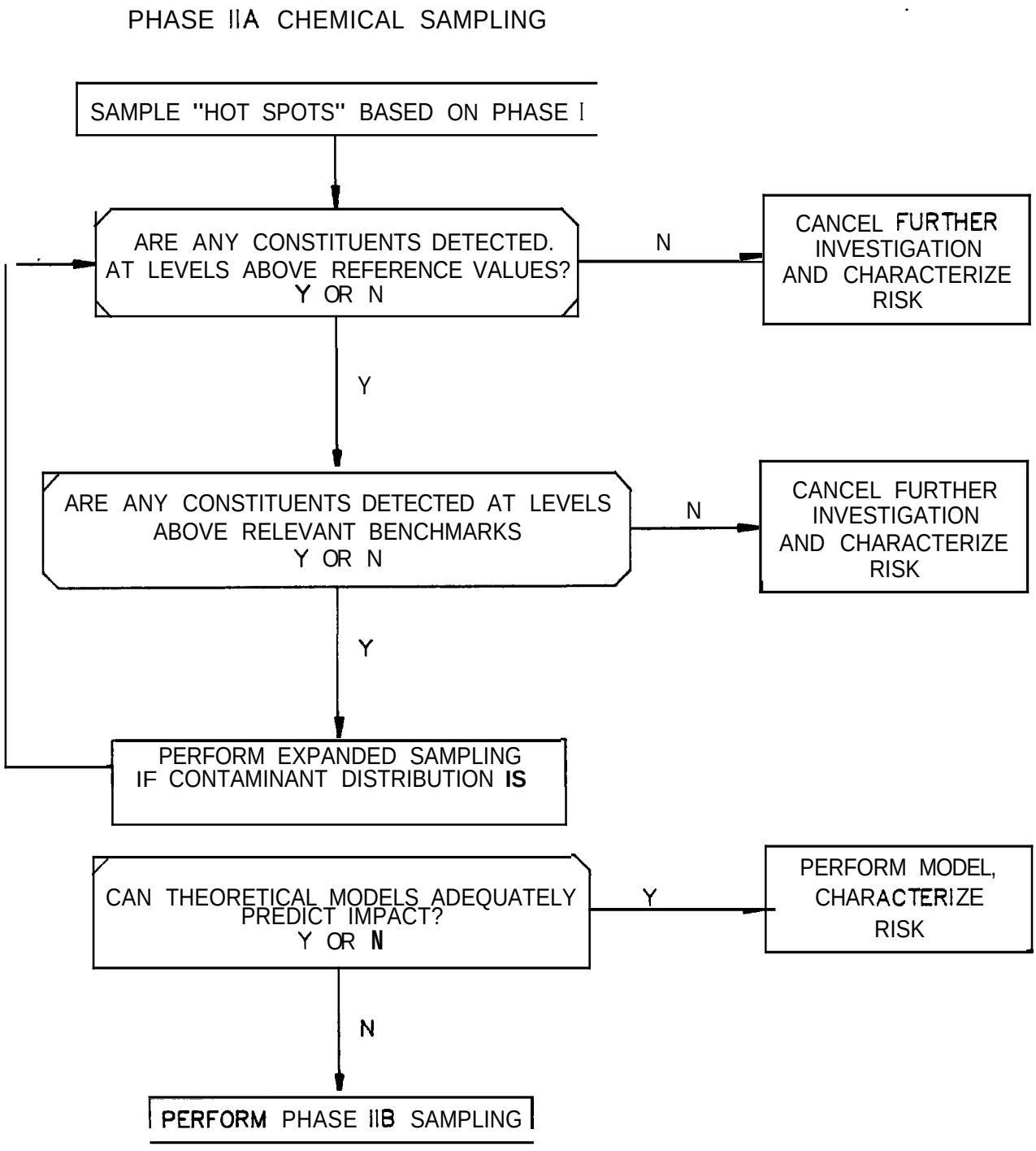

RI/FS WORK PLAN
SITES 40 AND 42
BAYOU GRANDE AND
PENSACOLA BAY
PENSACOLA, FLORIDA

FIGURE 4–2
PHASE IIA RI
PROCEDURE FLOWCHART

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Reference Levels *Comparison* — The initial step is to determine whether constituents within the surface water or sediment have resulted from man-induced site-specific impacts or occur throughout the area based on natural influences. This determination is made by comparing the area of concern in the bay and bayou to its reference area. If it is determined that any constituents within the study area are less than the reference concentration, the area will not be considered to be impacted by its associated IR site.

For sediments, another method to determine the *source* of some metals to be used in support of determining reference concentrations is the A *Guide to the Interpretation of Metal Concentrations in Estuarine Sediments* (FDER 1988). It states that naturally occurring aluminum is found within a certain proportion to other metals found in Florida coastal sediments. By normalizing all metals[, **except mercury,]** detected in sediment to the aluminum concentration in that sediment, metals occurring above this predicted proportion are considered to have resulted from human influences. Metals concentrations within this proportion are considered to represent natural conditions. Although this method incorporates studies from many areas within Florida, it is not applicable to all situations. There may be site-specific instances of man induced elevated aluminum concentrations. However, since this procedure was written and endorsed by the State of Florida, it will be considered a useful tool in determining the potential presence of metal contamination.

If it is determined that the suspected surface water or sediment constituents are naturally occurring or within **two** times **[the]** mean reference values [for **inorganic constituents,]** based on the above methods, the investigation will terminate at this stage. If contaminants are shown to be greater than two times the mean reference values [for inorganics,] it may be required to determine whether the contaminants can cause an adverse effect. This in part depends on the contaminant concentrations in comparison to the effects levels described below.

Ecological Effects Levels — If contaminant concentrations are identified as above two times mean reference values, they must be shown to cause or not cause an adverse effect. There are several approaches used to determine this, which often vary with the class of compounds to be analyzed. These methods have been integrated to produce a scientifically valid approach to estimate the extent of impact and determine the need for further investigation. This method is outlined as it pertains to surface water and sediment. Again, professional judgment is required when evaluating effects values. Contaminant concentrations must be compared to other environmental influences as part of the weight-of-evidence approach.

Surface Water — The EPA and the State of Florida have developed separate surface water criteria for the protection of aquatic organisms. There are several different benchmarks for each compound, including acute and chronic values. If a contaminant in surface water exceeds the lowest applicable benchmark, further study may be required. However, it is recognized that some of these values are dependent on pH, temperature, and other factors. These will have to be considered in determining the potential for adverse effects within the surface water.

Sediment — The EPA and the State of Florida have developed sediment screening values which may be used as an initial screening after Phase IIA. However, it should be recognized that the applicability of these screening values is influenced by total organic carbon, grain size, and other site-specific influences. The shortcoming of this approach is that these benchmarks exist for a limited number of compounds. Several contaminants may be detected that may not have a benchmark. In these situations, biological effects levels may be determined using sediment partitioning values. This approach is usually applicable only to those contaminants which are non-ionic organic compounds. It is based on surface water quality standards and the equilibrium coefficient (K_{oc}) between the sediment and sediment pore water. It uses a predictive equation to determine safe contaminant concentrations in the sediment based on water quality criteria final

chronic values. This assumes that contaminant concentrations in the pore water can be directly correlated with concentrations in the sediment and compared to overlying surface water based on equilibrium partitioning. However, K_{oc} values are not known for every potential contaminant that may be found in the sediment. The EPA has recently started a project to determine acceptable sediment quality criteria using this method. However, as of this writing, the project has only addressed five compounds of concern. Until the EPA addresses other compounds, the K_{oc} values that are published in the current literature can be used to supplement data for contaminants published by EPA.

Data Gaps — Much of the information needed to determine acceptable concentrations of a given constituent within the surface water and sediment does not exist or may not be reliable. In these situations, other methods such as modeling techniques can be used.

Mathematical models include the Thermodynamic Bioaccumulation Potential developed by the USACE (USACE 1991). These models incorporate variables such as contaminants and their chemical properties and physical and chemical characteristics of the surrounding environment to predict contaminant bioaccumulation in the food chain. Whenever possible, a model will be used with the available chemical data rather than undertaking additional investigation to estimate the bioaccumulation of certain contaminants.

The goal of Phase IIA is to characterize where adverse effects may be occurring in the areas of concern based on contaminant level benchmarks and modeling techniques. The phased approach described is a very efficient and cost effective manner to determine this. The investigation will end if site-related contamination is not identified at selected hot spots. However, if site-related impacts are noted, the investigation may continue with expanded sampling. Once expanded

sampling has better characterized the extent of contamination and shown which areas have a potential for adverse impacts, the investigation may move into Phase IIB.

4.3.3 Phase IIA Data Objectives

The information below will be viewed in relation site *history,* the site visit, and the reference areas identified during Phase I. Results may be compared with benchmarks and contaminant modeling to determine ecological and human health impact. Based on these results, a site-by-site decision *can* be made to either cancel further study or perform diversity studies and toxicity tests in Phase IIB to better characterize the effects occurring within a portion of the bay or bayou. Conclusions, results and recommendations from Phase IIB will be provided in a Technical Memorandum.

Sediment Chemistry Data Objectives

- Characterize the nature, magnitude, and extent of sediment contamination in the bay and bayou and in relation to reference areas using hot *spot* or expanded sampling techniques.

- To provide sufficient data to either adequately characterize or predict effects or determine the need for further testing.

Surface Water Chemistry Data Objectives

- To characterize the nature, magnitude, and extent of contamination within the surface water of the bay and bayou.

- To provide sufficient data to adequately characterize or predict the effects on the ecosystem or establish the need for further testing.

4.3.4 Phase IIB

If impact cannot be quantified after Phase IIA, Phase IIB may be implemented. Phase IIB incorporates diversity studies and toxicity tests to quantify impact in particular areas of concern in the bay and bayou. Descriptions of this phase and the data objectives are described below.

Phase IIB Diversity Studies — When necessary, species diversity studies can be performed within the sediments of each area of interest in the bay and bayou and a corresponding reference area. Benthic macroinvertebrates can be used for analysis because they are relatively stationary and serve as continuous monitors of the ecological health in the bay and bayou. Samples will be collected from the upper 6 inches of the sediment using a Petite Ponar Dredge or stainless steel spoon or scoop. All samples will have a uniform and consistent amount of substrate sampled to achieve an accurate comparison. Diversity studies will not be performed on the organisms within the surface water because of the high degree of variability of these organisms based on factors such as precipitation, tides, and other non-site related factors. The results of the diversity studies will be analyzed to determine if there is a statistical difference in benthic macroinvertebrate diversity between the reference area and *the* area of concern. This may be done using analysis of variance (ANOVA) to test the hypothesis that mean species diversity and richness is not different from the reference locations when compared to potentially impacted areas of the bay ani bayou. other statistical correlations may also be used if additional information is needed to establish diversity trends.

It is recognized that them are many factors which *can* influence the diversity of benthic macroinvertebrates in sediment, such as substrate composition, tidal influence, temperature, and many other factors not related to *effects* from an IR site. In making diversity comparisons to reference locations, these other possible factors must be considered when evaluating trends in species diversity. ANOVA and other approaches *can* be used to help determine what factors are

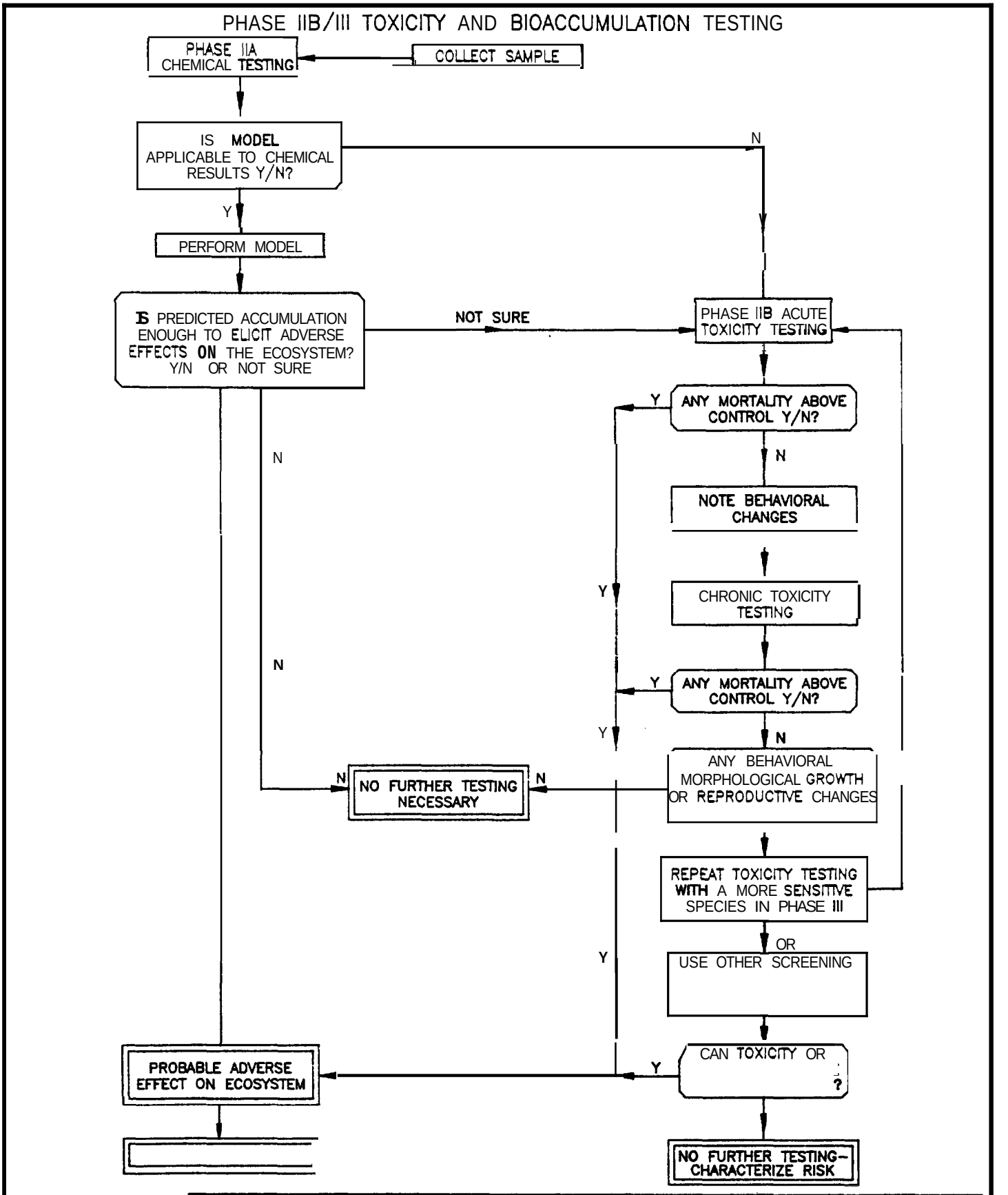
most important in influencing species diversity. If it is not clear what factors may be contributing to trends in species diversity, more emphasis will be placed on the Phase IIB toxicity tests described below.

Phase IIB Toxicity Tests — Toxicity tests *can* be used to establish a quantitative link between the diversity studies and any toxicological effects on any organisms. Toxicity tests measure the effect of contaminated media on the survival, growth, or reproduction of aquatic and terrestrial organisms. These tests provide an integrated index of the of the bioavailable toxic contaminants within the sediment and *surface* water. Selected test organisms *are* chosen based on their wide acceptance in laboratory analysis and the wealth of information available about their behavior. The use of either sediment or surface water toxicity tests depends on the type of contaminants suspected in the area sampled and the amount of available surface water. Samples for diversity studies and toxicity testing will be collected from the same sample locations as samples collected for chemical parameters.

Both acute and chronic toxicity tests may be performed. Results from the area of concern may be compared with the reference area. Samples will be collected according to procedures outlined in Section 4 and 7 of the *CSAP*. Section 8.2.4 of the *CSAP* outlines the organisms planned to be analyzed within each substrate and the types of tests possibly run. Figure 4-3 shows a flowchart of the procedures to be performed during Phase IIB toxicity testing.

43.5 Phase IIB Data Objectives

Data from Phase IIB will be usedto establish a link with thechemical analyses from Phase IIA.



RI/FS WORK PLAN
SITES 40 AND 42
BAYOU
PENSACOLA BAY
PENSACOLA, FLORIDA

FIGURE 4-3
PHASE IIB/III TOXICITY AND BIOACCUMULATION TESTING FLOWCHART

DWG DATE: 04/18/95 | DWG NAME: 036PITF1

Diversity Study Data Objectives

- To characterize the biological community.

- To assess the effects of contaminants on the assemblage, distribution, and diversity of the biotic community compared to a reference area.

Toxicity Test Data Objectives

- To assess the toxicity of the contaminants present in the sediment and surface water of the bay and bayou.

- To determine the potential effects of contaminants in select organisms.

After Phase IIB is completed, quantitative measures of contaminant levels and any correlations with species diversity or toxicity should be known. Also, modeling techniques and other means of predicting impacts to higher food-chain organisms will have been performed, if needed. Therefore, after Phase IIB, the impact occurring within a particular portion of the bay and bayou may be adequately characterized and no further investigation may be needed. However, if there are any data gaps remaining or more in depth studies which may yield important information, then the investigation may move into Phase III.

4.4 Phase III — Assessment of Bioaccumulation

Phase III is designed to provide specific information that will be important in making final risk management decisions. Phase III involves a more refined determination of whether contaminated media are either toxic to organisms or bioaccumulating in the food chain. Phase III tests may be performed if further information is needed to gauge the impact occurring within a portion of the bay and bayou or if Phases I and II do not yield sufficient information (Figure 4-3).

The test organisms selected for Phase III assessments may vary within the bay and bayou, depending on the types of higher trophic level organisms living in and around the particular area in question. The selected organisms may be identified during the Phase IIB diversity studies. Specific procedures for sampling and testing individual organisms may vary but will be in accordance with established EPA and ASTM guidelines. Appropriate organisms, sampling methods, and test organisms may be selected based on the results of the previous studies and consultations with the contracted laboratory.

The additional toxicity testing in Phase III may be performed to determine acute endpoints such as LD_{50} — the administered dose or environmental concentration where 50% of the experimental organisms die in a *specified* period of exposure time. In selecting test organisms, emphasis will be placed on organisms which are lower in the food chain, inhabit the suspected contaminated media of the particular area in question, and are relatively immobile. The percent lipid content of these organisms must also be available to model contaminant uptake. Information on lipid content may be available in the literature. Among the species to be considered are sessile filter feeders such as clams and oysters.

Laboratory controlled, direct-exposure bioaccumulation studies on laboratory cultured organisms and/or the in-situ sampling of various resident biota may be required to firmly assess the potential impact from an IR site on the bay and bayou. Both methods may include analysis for confirmed contaminants. Results of the bioaccumulation analyses *can* determine if these contaminants are bioaccumulating in the test organisms and whether or not higher trophic level *animals* feeding on such organisms could be adversely affected. If both measures of bioaccumulation are implemented, the comparison of bioaccumulation in laboratory cultured organisms to indigenous organisms could assess the influence of natural conditions on the rate and degree of contaminant uptake.

4.4.1 Phase III — Data Objectives

- To provide more refined assessment of contaminant toxicity or bioaccumulation.

- To provide specific ecological endpoints such as LD_{50}, chronic endpoints, or bioaccumulation values.

4.5 Risk Assessment

After all relevant data from the bay and bayou have been assimilated, ecological and human health risk *can* be characterized. The ecological aspect of risk assessment has not yet evolved to where standard risk calculations *can* be made as in human healtb risk assessments. There is much more professional judgement involved. The principal goal of the risk assessment at the bay and bayou is to quantify any adverse effects to human health and the environment resulting from any IR site-associated contamination.

Important issues to be addressed in risk assessment may include the assessment of exposure versus observed or predicted effects, along with their type, extent, and severity. As a conclusion, risks and uncertainties should be summarized and interpreted. The potential for natural recovery should also be addressed to help base decisions for remedial action and mitigation. Sources of contamination might lend themselves to remediation. Alternatives considered appropriate to the bay and bayou will be based on risk decisions. Remediation may be considered if the sediment becomes a source of contamination instead of a pathway, or if the contaminants present in certain portions are determined to pose an unacceptable risk to human health and the environment. Since the bay and bayou are considered to be assets, any remedial approach selected will consider how the approach might damage or further harm the environment.

4.6 Laboratory Analysis

Laboratory analysis will be performed at DQO Level IV for all sediment and surface water samples collected for TCL/TAL in accordance with Section 10 of the CSAP. Laboratory analysis does not apply to the diversity studies or the toxicity tests. However, laboratories performing these tests will be approved by the State of Florida. Species diversity samples will be submitted to the selected laboratory for identification to at least the genus level. Field parameters will be collected at DQO Level II.

5.0 SAMPLE COLLECTION PROCEDURES AND TASKS

This section summarizes the specific parameters and locations of samples to be collected during the RI/FS to fulfill the data objectives listed in the previous section and provide the necessary data for the ecological and human health risk assessment and feasibility study. All of the tasks will be conducted in accordance with the 1991 EPA Region IV SOP/QAM and the CSAP. This information is detailed in Section 4 of the SAPs for Sites 40 and 42.

5.1 Phase IIA — Chemical Sampling

Sediment samples will be collected using a stainless steel hand auger or a Petite Ponar Dredge as outlined in Sections 4.4 or 7.2 of the CSAP. If both surface water and sediment samples are to be collected at the same location, surface water samples will be collected first in accordance with Section 7 of the CSAP either by placing the sample bottle in the surface water or by using a Kemmerer sampling &vice (depending on the depth of the water).

Sediment samples will be collected from the upper 6 inches of the substrate in accordance with Section 7.2 of the CSAP. Surface water samples will be collected at the same depths outlined in Section 7.3 of the CSAP: Sediment and surface water sampling locations are shown in the SAP for Sites 40 and 42.

5.2 Phase IIB — Diversity Studies and Toxicity Tests

Samples will be collected from the upper 6 inches of the sediment using either a stainless steel hand auger or a Petite Ponar Dredge in accordance with Section 7.2 of the *CSAP*. To the greatest extent possible, all samples will have a uniform and consistent amount of substrate sampled to achieve an accurate comparison. Diversity studies will not be performed on the organisms within the surface water because of the high degree of variability of these organisms based on factors such as precipitation, tides, and other non-site related factors. The results of the diversity studies may be statistically analyzed using ANOVA or other statistical comparisons to give a more accurate representation of the differences between the reference area and the area of concern. Some of the sandy sediments may have a naturally low diversity of organisms. In these *cases*, more emphasis may be placed on the toxicity tests described in the next paragraph.

Samples for diversity studies and toxicity testing, if analyzed, will be collected at the same sample locations analyzed for chemical parameters. Results from the areas of concern in the bay and bayou will be compared with the reference area.

5.3 Phase III — *Assessment* of Bioaccumulation

The test organisms selected for Phase III Assessments may vary within the bay and bayou, depending on the types of higher trophic level organisms living in and around the particular area in question. Specific procedures for sampling and testing individual organisms vary and will be done in accordance with established EPA and ASTM guidelines. Appropriate organisms, sampling methods, and test organisms will be selected based on the results of the previous studies and consultations with the contracted laboratory.

The additional toxicity testing in Phase III *can* be used to determine acute endpoints such as LD_{50}. In selecting test organisms, emphasis will be placed on organisms that: (1) are lower in

the food chain, (2) inhabit the *suspected* contaminated media of the particular area in question, and (3) are relatively immobile. The percent lipid content of these organisms must also be available to model contaminant uptake. Among the species to be considered are clams and oysters and other sessile filter feeders. Based on their relatively limited range, various larval midges, fathead minnows, guppies, and other fish and benthic species might also be used.

Laboratory-controlled, direct-exposure bioaccumulation studies on laboratory-cultured organisms and/or the in-situ sampling of various resident biota may be required to firmly assess the impact occurring in the bay and bayou. Both methods may include analysis for confirmed contaminants. Results of the tissue analyses *can* determine if these contaminants are bioaccumulating in the test organisms and whether animals feeding on such organisms could be adversely affected. If both measures of bioaccumulation are implemented, the comparison of bioaccumulation in laboratory-cultured organisms to indigenous organisms could be used to estimate the influence that environmental conditions may have on the rate and degree of contaminant uptake.

5.4 Data Validation, Verification, and Evaluation

After each phase of data collection, the data will be validated. Data validation and verification will be done according to the procedures described in Section 14 of the *CSAP*. Once data is validated and verified, it will be classified according to the criteria in the *CSAP*. All data will then be fully evaluated, within the limits of its classification, for synthesis and inclusion in the RI report.

5.5 Remedial Investigation Report and Ecological and Human Health Risk Assessment

Following the conclusion of all fieldwork activities, an RI report will be prepared providing all of the investigative data, summarizing and integrating the results of the investigation. In

addition, a human health and ecological risk assessment will be included in this report. The risk assessment will appraise the bay and bayou's actual or potential threat to human health and ecological resources if no remedial action is taken and provide a basis for determining if remedial action is necessary.

5.6 Feasibility Study (FS)

The FS will be submitted separately from the RI. As the FS proceeds and the bay and bayou are more fully characterized, the remedial action objectives and technologies will be evaluated for their applicability. The purpose of the FS will be to fully characterize the bay and bayou for potential applicability of remedial action objectives and technologies. Where sufficient data are available to fully develop and evaluate alternatives, a treatability study is not planned. At this stage in the RI/FS process, it is difficult to state a conclusive need for treatability investigations. Treatability studies vary in scope from bench scale testing to pilot or field trials of treatment and containment technologies.

Once bay and bayou characterization and initial risk assessment are complete, a report documenting the applicable technologies will be submitted to EPA and FDEP. The primary criteria in the evaluation of the technologies are (1) the short-term and long-term effectiveness, (2) practicality, (3) cost, (4) protectiveness, and (5) ARAR compliance. The report will document the initial evaluation of all applicable technologies according to these criteria and will provide an initial list of remedial alternatives. Once comment and approval of the initial list of remedial alternatives has been received, the development of a detailed analysis of alternatives can proceed. The selected remedial alternatives will be examined with respect to requirements stipulated in CERCLA as amended in OSWER (1986), and per guidance described in OSWER (1988). The detailed analysis will emphasize the following nine remedy selection criteria:

- short term effectiveness
- long-term effectiveness and permanence
- reduction of toxicity, mobility, or volume
- ability to implement
- cost
- compliance with ARARs
- overall protection of human heath and the environment
- state acceptance
- community acceptance

Each technology will be evaluated according to these criteria. The results of this evaluation will be used to present the alternatives and compare the advantages and disadvantages of each.

The detailed analysis of alternatives consists of the analysis and presentation of the relevant information needed to select a site remedy. This approach to analyzing alternatives is designed to provide sufficient information to adequately compare the alternatives, select an appropriate remedy for the bay and bayou, and demonstrate satisfaction of the CERCLA remedy selection requirements of the Record of Decision (ROD).

The feasibility study for the bay and bayou may be constrained because the contaminants may be at a concentration high enough to be a contaminant pathway and not a source. Analysis of potential remediation activities may focus on transport mechanisms from the IR sites and on existing contamination. Once these have been identified, the FS will focus on the role of the bay and bayou as a source of contamination and potential remedial alternatives for the bay and bayou itself.

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7.0 FLORIDA PROFESSIONAL GEOLOGIST SEAL

I have read and approve of this Final Work Plan for Sites 40 and 42 at NAS Pensacola 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:	Steven J. Parker
License Number:	#1651
State:	Florida
Expiration Date:	July 31, 1996

Steven J. Parker

9/25/95
Date

[Bold items in brackets denote changes to the first draft of document.]