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SAMPLING AND ANALYSIS PLAN – ADDENDUM
SITE 40, BAYOU GRANDE
NAVAL AIR STATION – PENSACOLA, FLORIDA

SOUTHNAVACENGCOM
CONTRACT NUMBER: N62467-89-D-0318
CTO - 0036

Prepared for:

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY
NAVAL AIR STATION
PENSACOLA, FLORIDA

Prepared by:

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

Date: 5-23-97
Signature:
Name: Henry H. Pedro
Title: Task Order Manager

May 23, 1997

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Field	Group	Sub-Group

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19. Abstract

This addendum of the sampling and analysis plan is part of tho remedial investigation at Site 40 for the Naval Air Station Pensacola, Bayou Grande assessing the nature and extent of contaminants resulting from Navy activities which discharge to Bayou Granda. Site 40 represents the estuarine ecological resources at NAS Pensacola requiring additional study. The sampling and analysis plan amendment for Site 40 provides the objectives and methodology in order to complete the Phase IIB sampling.

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List of Acronyms

The following list contains many of the acronyms, initials, abbreviations, and units of measure used in this report.

ASTM	American Society for Testing and Materials
BW	Body Weight
E/A&H	EnSafe/Allen & Hoshall
Florida WQS	state of Florida Water Quality Standards
IR	Ingestion Rate
IRP	Installation Restoration Program
kg BW/Day	Kilogram of body weight per day
mg	Milligram
mg/L	Milligrams per Liter
mg/kg	Milligrams per Kilogram
NAS Pensacola	Naval Air Station Pensacola
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PDE	Potential Dietary Exposure
PSEP	Puget Sound Estuary Program
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
SSV	[Draft] EPA Region IV sediment Screening Value
SVOCS	Semivolatile Organic Compounds
TAL/TCL	Target Analyte List/Target Compound List
TAL	Target Analyte List
TCL	Target Compound List
TEL	Threshold Effects Levels
TOC	Total Organic Carbon
TRV	Toxicity Reference Value
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WQC	Water Quality Criteria

EXECUTIVE SUMMARY

This addendum of the sampling and analysis plan is part of the remedial investigation at Site 40 for the Naval Air Station Pensacola, Bayou Grande, assessing the nature and extent of contaminants resulting from Navy activities which discharge from the base. Site 40 represents the estuarine ecological resources at NAS Pensacola requiring additional study. The sampling and analysis plan amendment for Site 40 provides the objectives and methodology in order to complete the Phase IIB sampling. Completing the ecological risk assessment requires three sources of information. The first is chemical analyses to establish the presence, concentrations, and distribution of any chemical contaminants. The second is data from toxicity tests and diversity studies to link exposure effects with observed chemical concentrations. The third is tissue concentrations which *can* further define ecological impacts and suggest whether impacts may be occurring in higher trophic levels of the food chain. All of this information is critical to establishing a causal link between contaminants and ecological effects (U.S. EPA, 1992).

The information gathered will be integrated, using a weight-of-evidence approach, into a risk characterization. A weight-of-evidence approach considers all available infomation to predict ecological impact. Each result will be considered in relation to the others to determine the extent and severity of impact. All factors will be considered to yield an overall picture of risk needed to develop remedial options.

1.0 INTRODUCTION

This Sampling and Analysis Plan *(SAP)* Addendum for Naval Air Station (NAS) Pensacola amends the previous EnSafe/Allen and Hoshall (E/A&H) Sites 40 and 42 *SAP* (E/A&H, 1995). These changes result from sediment data provided during Phase IIA of this Remedial Investigation (RI). Topics addressed by this addendum include bayou-specific assessment and measurement endpoints, proposed sample locations for Phase IIB, and a proposed food *chain* model to predict exposure to assessment endpoint species. The Final Sites 40 and 42 Work Plan and *SAP* (E/A&H, 1995) describes the approach for *assessing* Site 40. Included are the results from previous investigations, the history of particular Installation Restoration Program (IRP) sites of concern, and key terms applicable to the ecological risk assessment process.

Pensacola Bay Phase IIA sediment data were analyzed in conjunction with the Phase IIA data review for Bayou Grande. The RI report for Pensacola Bay has been published under a separate cover (E/A&H, May 1997).

2.0 ECOLOGICAL RISK ASSESSMENT (ERA) APPROACH

Bayou Grande, its assessment zones, NAS Pensacola IRP sites, and other sites of concern are shown on Figure 1-1. Assessment zones were based on habitat, sediment, and contaminant similarities.

2.1 Ecological Receptors

In addition to chemical stressors identified within the bayou, organisms potentially impacted by these chemicals is necessary to predict potential ecological impacts. *General* ecological receptors in the bayou are described in the Sites 40 and 42 *SAP* (E/A&H, 1995).

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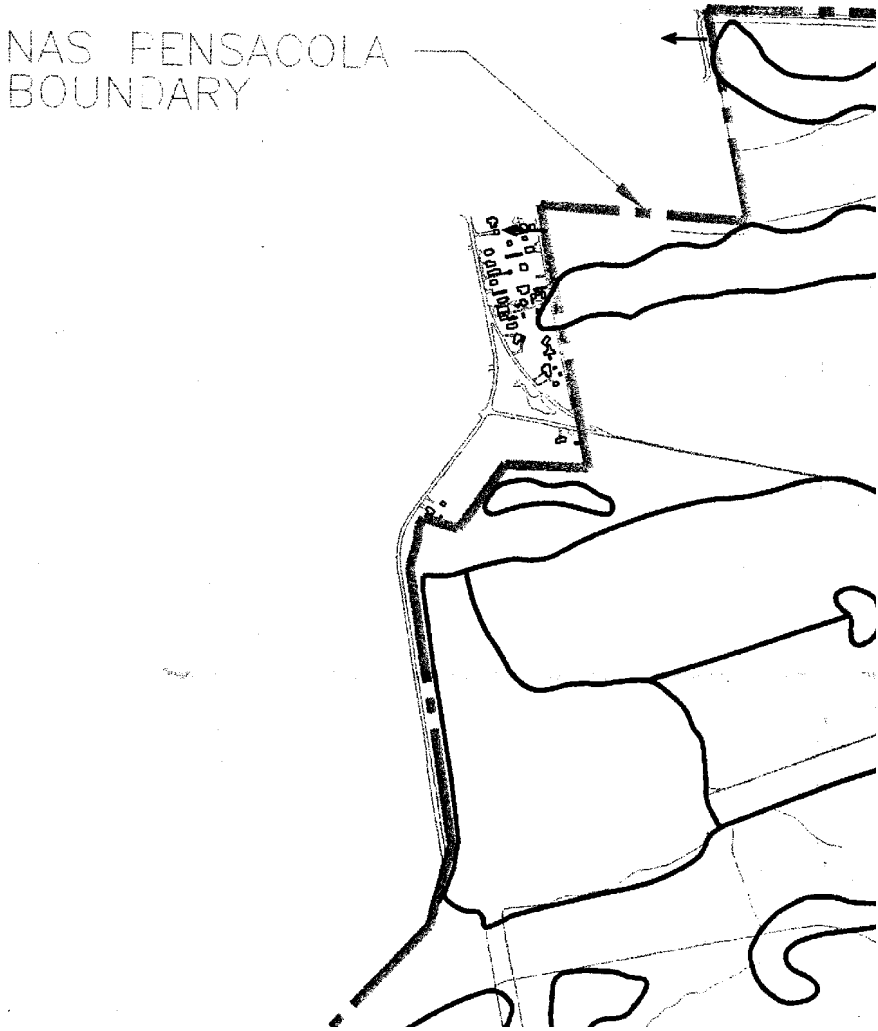
Attachment A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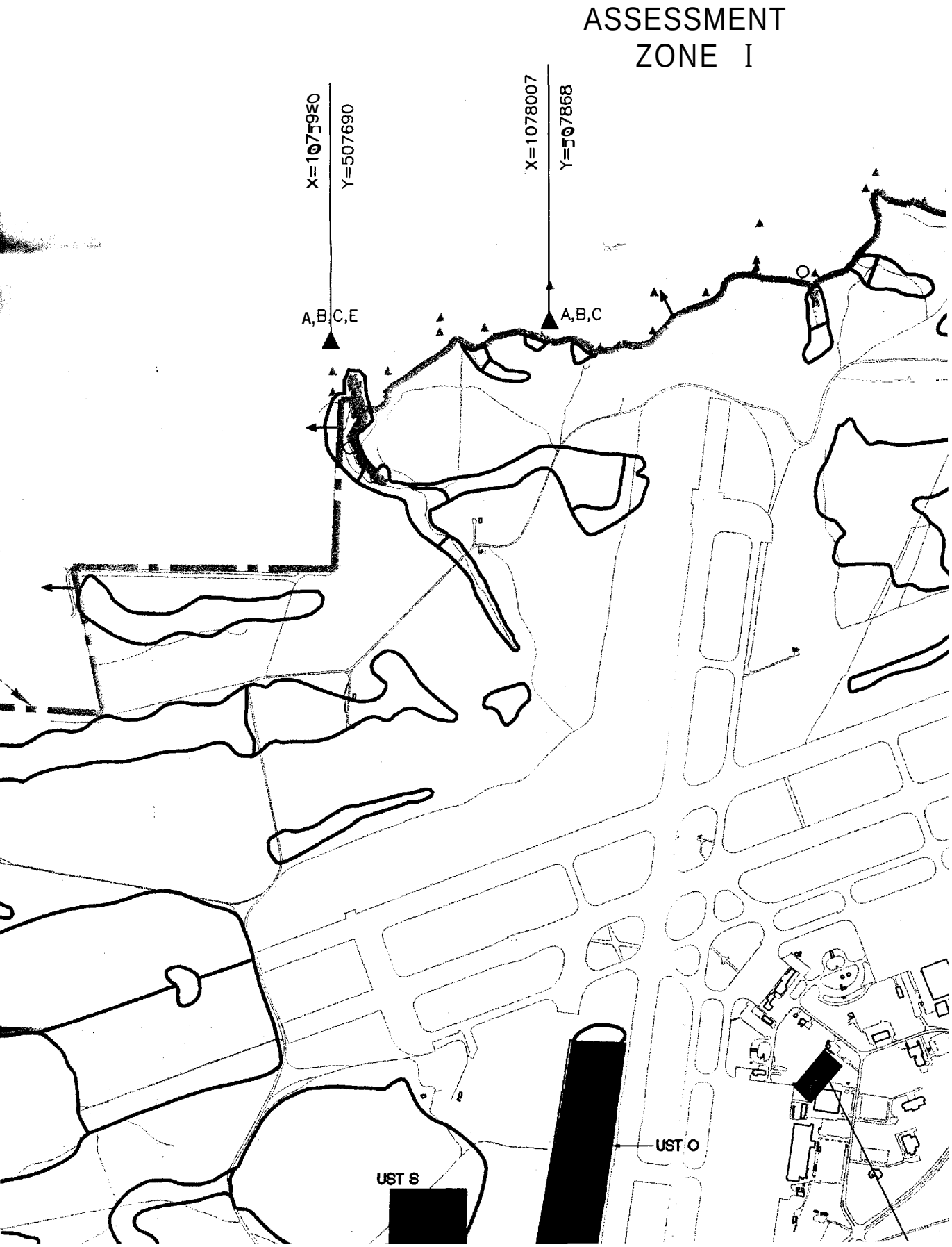
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Y=507868
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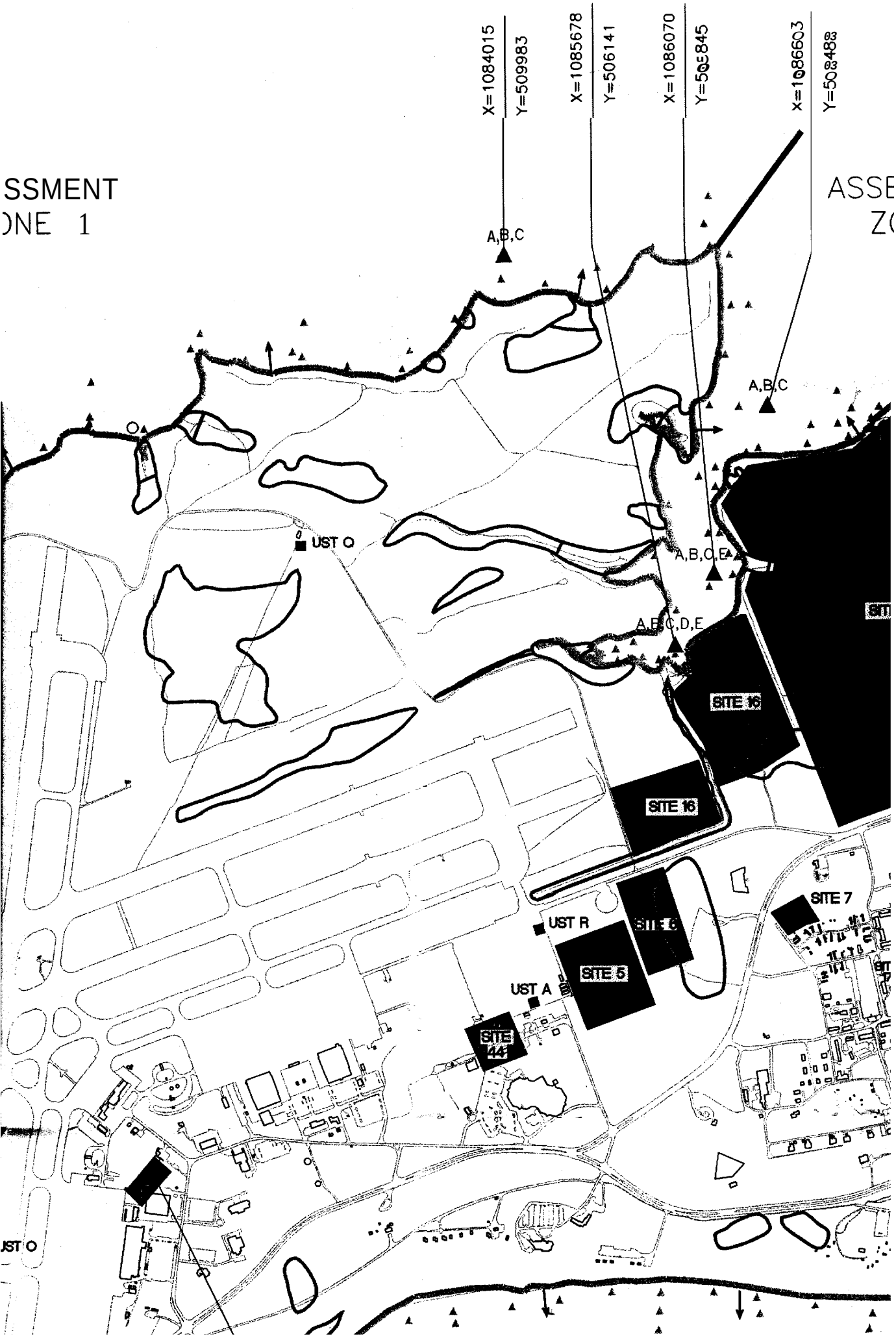
A,B,C
UST O
UST S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ONE 1
ASSE
ZO
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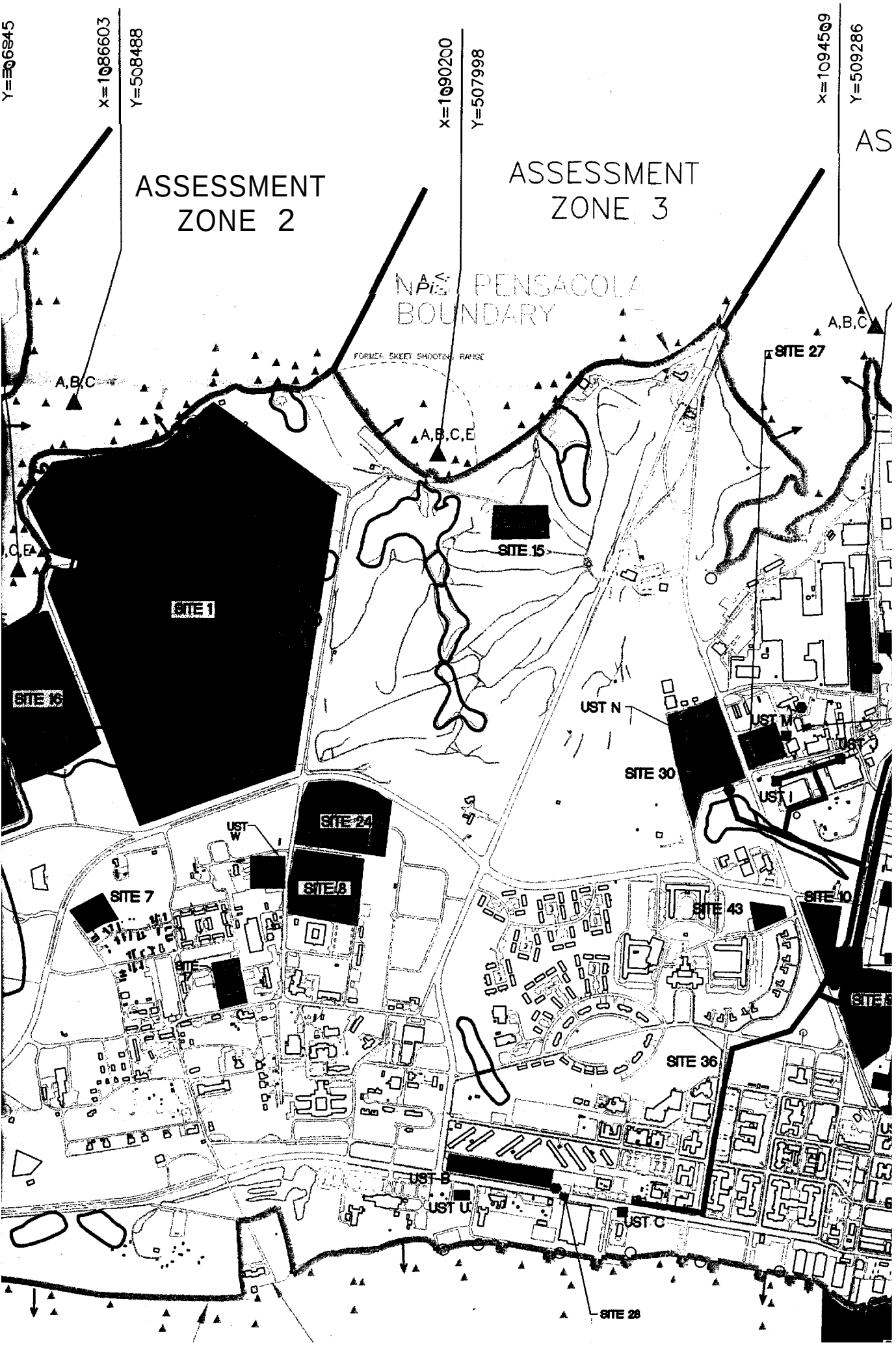
Y=503483
A,B,C
A,B,C
A,B,C,E
A,B,C,D,E
UST Q
SITE 16
SITE 16
SITE 7
UST R
SITE 6
SITE 5
UST A
SITE 44
UST O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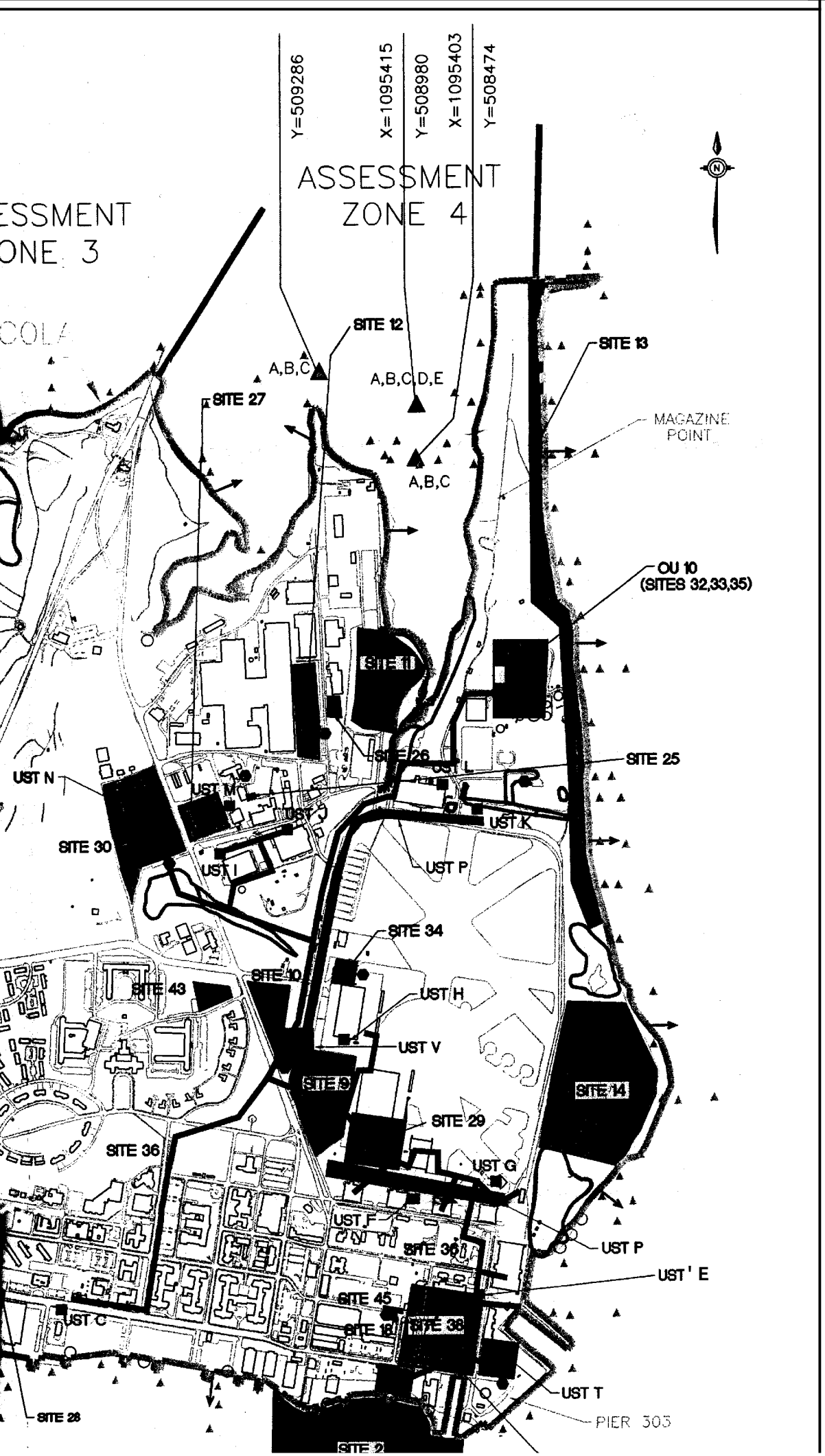
ASSESSMENT ZONE 2
ASSESSMENT ZONE 3
NAS PENSACOLA BOUNDARY
FORMER SKEET SHOOTING RANGE
A,B,C
A,B,C,E
A,B,C
SITE 27
SITE 15
SITE 1
SITE 16
UST N
UST M
SITE 30
UST I
SITE 24
UST W
SITE 8
SITE 7
SITE 43
SITE 10
SITE 36
UST B
UST U
UST C
SITE 28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ASSESSMENT
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ESSMENT
ONE 3
COLA
SITE 12
A,B,C
A,B,C,D,E
A,B,C
SITE 27
SITE 13
MAGAZINE
POINT
OU 10
(SITES 32,33,35)
SITE 11
SITE 26
SITE 25
UST N
UST M
UST K
SITE 30
UST I
UST P
SITE 34
SITE 10
SITE 43
UST H
UST V
SITE 9
SITE 14
SITE 29
SITE 36
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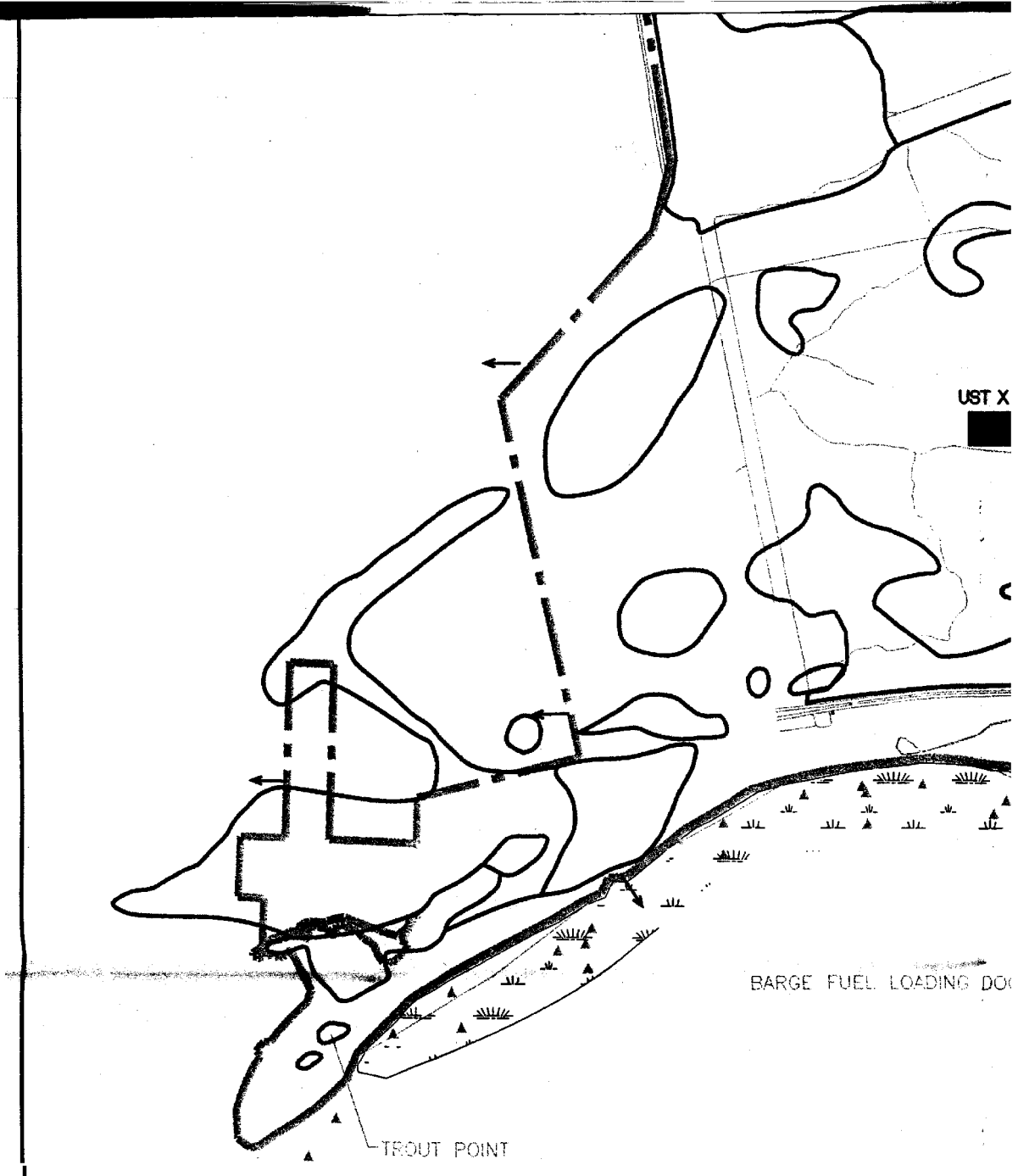
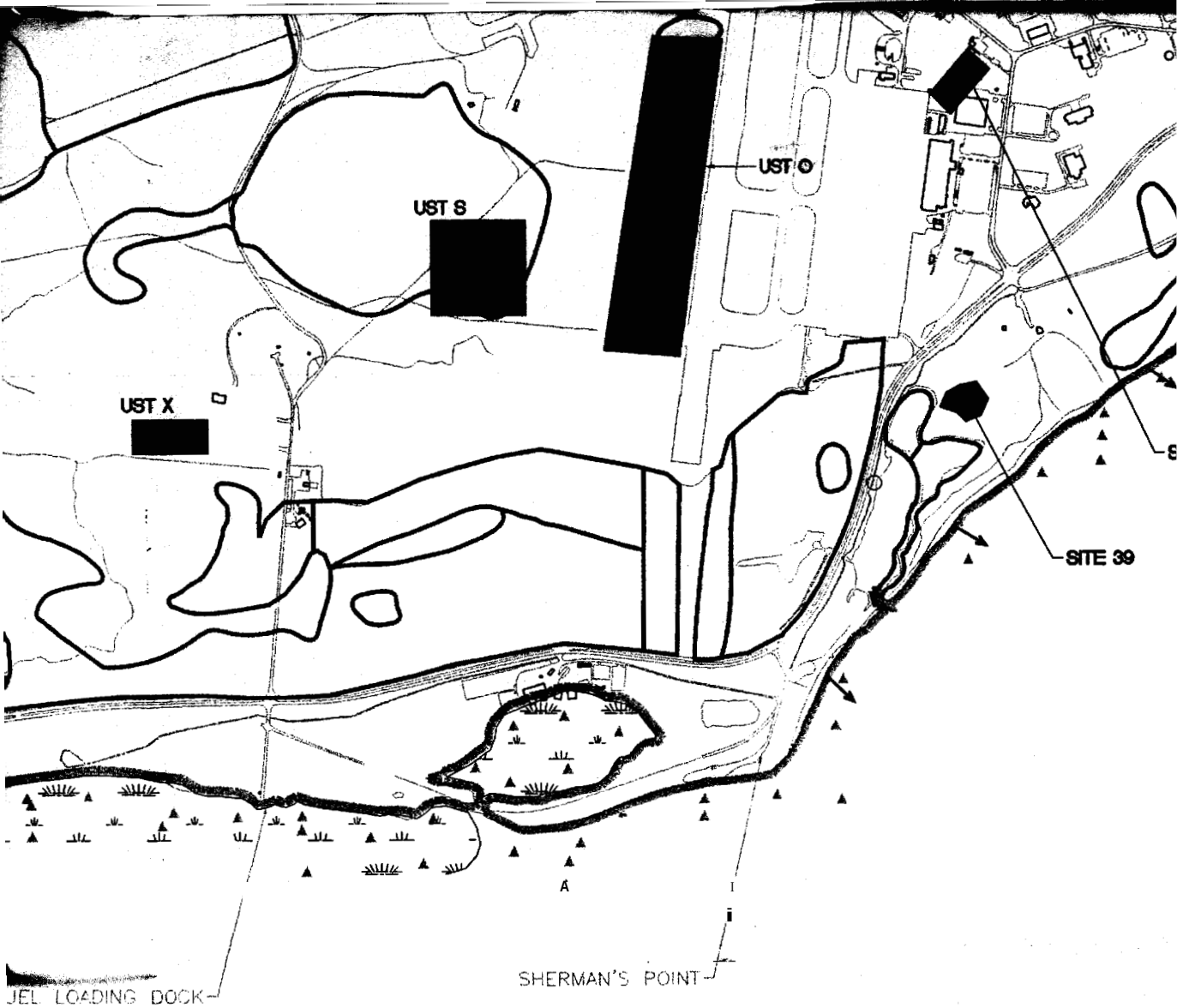
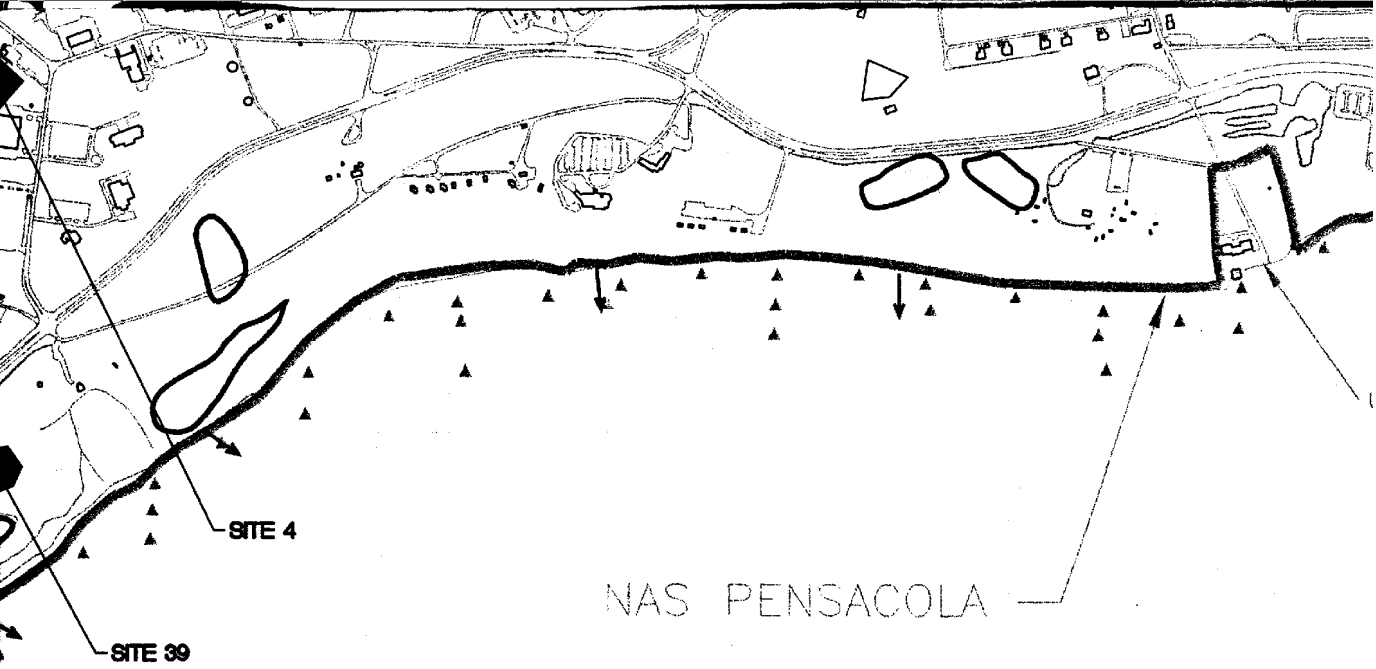
PIER 303
SITE 2

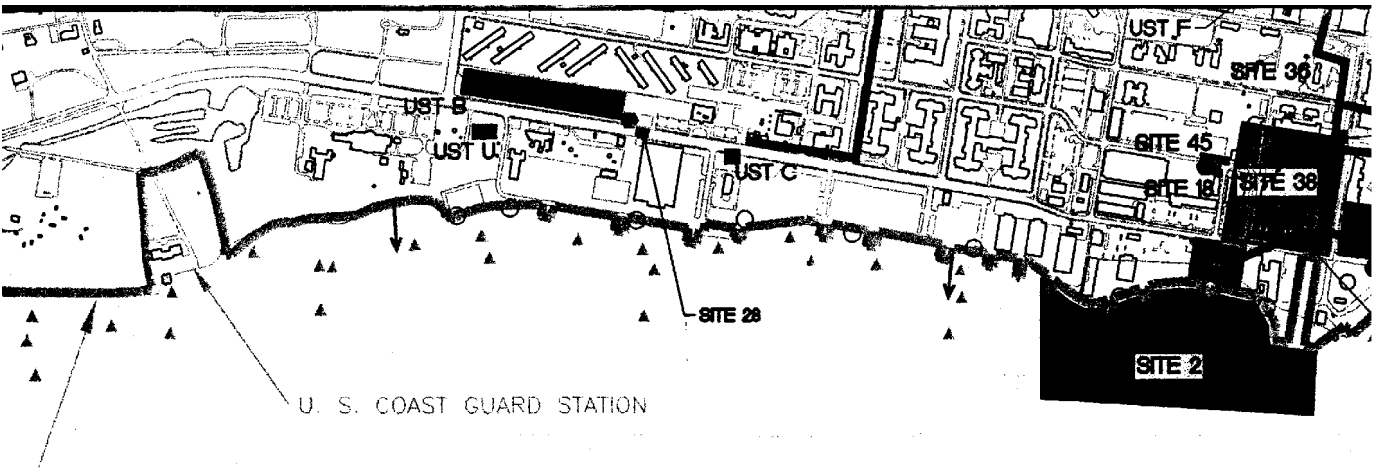

UST X
BARGE FUEL LOADING DO
TROUT POINT


UST S
UST X
SITE 39
SHERMAN'S POINT
JEL LOADING DOCK



PETROLEUM SITES POTENTIALLY IMPACTING THE BAY AND BAYOU [1]				
MAP LABEL	SITE NAME	TANKS/SIZE	CONTENTS	GROUNDWATER CONTAMINANTS
UST A	3221SW	1/1000 GAL.	WASTE OIL, PD-680	TCE, PCE, METHYLENE CHLORIDE
UST B	PWC SITE 4	SLUDGE DISPOSAL	WASTE OIL, JET FUEL	PETROLEUM HYDROCARBONS
UST C	PWC SITE 1	PIPELINE	JP-5	PETROLEUM HYDROCARBONS
UST D	BUILDING 604	UNKNOWN	TCE	CHLORINATED SOLVENTS
UST E	DFM PIPELINE	PIPELINE	DIESEL	NONE
UST F	607NE	2/500 GAL.	WASTE OIL, JET FUEL	LEAD
UST G	2662W	1000 GAL.	USED OIL, JP-5	BTEX
UST H	3557	2/500 GAL.	WASTE OIL	NONE
UST I	3220	MULTIPLE TANKS/UNKNOWN SIZE	DIESEL, WASTE OIL, TCE	UNKNOWN
UST J	2450W	MULTIPLE/1000 GAL.	GASOLINE	UNKNOWN
UST K	PWC SITE 3/3810N	1/500 GAL.	FUEL OIL	TRPHs, PAHs
UST L	3644	2/8000 GAL.	DIESEL	PETROLEUM HYDROCARBONS
UST M	709N,S	2/2000 GAL.	FUEL OIL	UNKNOWN
UST N	647, 648, 649, 692	3/1000 GAL., 3/500 GAL.	WASTE OIL, KEROSENE	UNKNOWN
UST O	UST 18	OPEN PITS	JET FUEL, WASTE OIL	BTEX, LEAD
UST P	SITES 1 TO 13	AVGAS LINE AND 12 TANKS/500 GAL.	JET FUEL	LEAD, PETROLEUM HYDROCARBONS
UST Q	RADAR SITE 3255	1/300 GAL.	DIESEL	PETROLEUM HYDROCARBONS
UST R	3221NE	1/500 GAL.	WASTE OIL, WATER TAINTED JP-5	NONE
UST S	SITE 19	PIPELINE	JET FUEL	PETROLEUM HYDROCARBONS
UST T	SITE 20	1/1,511,580 GAL., AST	JP-5	PETROLEUM HYDROCARBONS
UST U	SITE 26	UNKNOWN	JET FUEL	-
UST V	SITE 23	UNKNOWN	JET FUEL	-
UST W	SITE 26	UNKNOWN	JET FUEL	-
UST X	SITE 27	UNKNOWN	JET FUEL	-

POTENTIAL IMPACTS TO NEARSHORE WATERS FROM SOIL/GROUNDWATER [2] CONTAMINANTS AT NAS PENSACOLA SITES INVESTIGATED BY E/A&H			
SITE	SOIL CONTAMINANTS	GROUNDWATER CONTAMINANTS	IMPACT
1	METALS, PCBs, SVOCs	METALS, SVOAS, VOAs	BAYOU GRANDE
5	(NO EXCEEDANCES)	METALS	BAYW GRANDE
8	METALS, PESTICIDES, SVOCs	METALS	BAYW GRANDE (FROM STORY DRAINS)
9	METALS, PESTICIDES, SVOCs	METALS	BAYOU GRANDE
10	PESTICIDES, SVOCs	METALS	BAYOU GRANDE
11	METALS, PCBs, SVOCs	METALS, PESTICIDES	BAYOU GRANDE
12	METALS, PESTICIDES, PCBs, SVOCs	METALS, PESTICIDES	BAYW GRANDE
13	METALS	METALS	PENSACOLA BAY
14	METALS	METALS	PENSACOLA BAY
15	METALS,PBS,SVOCs	METALS	BAYOU GRANDE
16	METALS, PESTICIDES, SVOCs	METALS	BAYOU GRANDE
17	METALS, PESTICIDES, PBS, SVOCs	METALS,	BAYOU GRANDE (FROM STORM DRAINS)
18	METALS, PBS, SVOCs	METALS	PENSACOLA BAY
24	METALS, PESTICIDES, PBS, SVOCs	METALS	BAYOU GRANDE (FROM STORY DRAINS)
25	METALS, PESTICIDES	METALS	BAYOU GRANDE
26	SVOCs	METALS, SVOAs, VOAs	BAYOU GRANDE
27	METALS, PESTICIDES, SVOCs	METALS, RADIATION	BAYOU GRANDE
28	METALS, SVOCs	METALS, SVOAs, VOAs	PENSACOLA MY
29	METALS, PESTICIDES, SVOAs	(GW NOT INVESTIGATED)	BAYOU GRANDE
30	METALS, PESTICIDES, PBS, SVOCs	METALS, PESTICIDES	BAYOU GRANDE
31	METALS, SVOCs, PESTICIDES	METALS, PESTICIDES, SVOAs, VOAs	PENSACOLA BAY, BAYOU GRANDE
32	METALS, SVOCs, PESTICIDES	METALS, VOLATILES	PENSACOLA MY, BAYOU GRANDE
33	METALS, SVOCs, PESTICIDES	METALS, VOLATILES	PENSACOLA BAY, BAYOU GRANDE
34	(NO SURFACE SOIL CONTAMINANTS)	METALS, SVOAs	
38	METALS, PESTICIDES, PBS, SVOCs	METALS, SVOCs, VOAs	PENSACOLA BAY
39			PENSACOLA BAY



	SPILLS FROM NAS PENSACOLA ENVIRONMENTAL SITES	
SITE	NATURE OF SPILL	YEAR
3	FUEL FROM THE CRASH CREW TRAINING AREA	1955–PRESENT
15	PESTICIDE RINSEATES FROM THE GOLF COURSE	1963–1979
17	PCBs FROM TRANSFORMERS STORED AT SITE	ONGOING
18	PCBS FROM A RUPTURED TRANSFORMER	1967
19	FUEL OIL FROM A PIPELINE BREAK	1958
20	FUEL OIL FROM A PIPELINE LEAK	1981
22	DISPOSAL OF FUEL FROM REFUELER TRUCKS	1958–1977
23	FUEL OIL FROM A PIPELINE BREAK	1965
24	PESTICIDES FROM A DDT MIXING AREA	1960s
25	WASTE FROM RADIUM REMOVAL	1978
26	LEAKS FROM CHEMICAL CONTAINERS	1956–1964
28	TRANSFORMER FELL FROM A TRUCK AND LEAKED	1969
29	SKIN BURNS FROM A SUBSTANCE IN SOIL	1961
OU–10	80,000 GALLONS OF INDUSTRIAL WASTE	1979
	SULFURIC ACID SPILL	1989
	FUEL OIL FROM THE BILGE WATER PLANT	1992
30	WASTE DUMPED INTO NEARBY WETLANDS	1940s–
34	SOLVENT DETERGENT SPILL	1960s
44	PAINTS/SOLVENTS STORED AT BUILDING 3360	1972–1981
38	SOLVENTS/METAL PLATING WASTES	1972–1979

ATER CONTAMINANTS
ETHYLENE CHLORIDE
HYDROCARBONS
HYDROCARBONS
SOLVENTS
HYDROCARBONS
LEUM HYDROCARBONS
HYDROCARBONS
HYDROCARBONS
HYDROCARBONS

RM DRAINS)
RM DRAINS)
RM DRAINS)
ANIDE
ANIDE
ANIDE

LEG
– CI
– PI
– WI
– SI
BA
– SI
– SU
– SI
– ES
– SI
A – LE
B – BI
C – NI
D – BI
E – W

REFERENCES:

1. PETROLEUM SITE INFORMATION BASED ON REPORTS FROM ABB ENVIRONMENTAL SERVICES, INC. AND PUBLIC WORKS CENTER, NAS PENSACOLA.
2. I R AND OTHER ENVIRONMENTAL SITE INFORMATION BASED ON ENSAFE/ALLEN&HOSHALL REPORTS.
3. SPILLS INFORMATION BASED ON NEESA, 1983 AND HISTORICAL DATA COMPILED IN E/A&H SITE SPECIFIC R I REPORTS.

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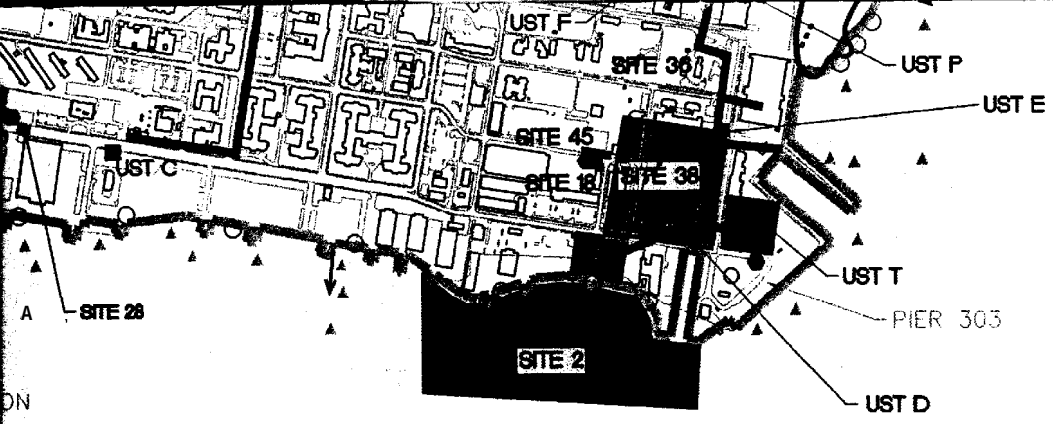
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME
Rev Number: 000	Rev Date: 00/00/00	Rev By: NAME
Rev Number: 001	Rev Date: 09/16/96	Rev By: C. TRIPLETT

Dr by: E/AH
Ck by: C. TRIPLETT
Date: 06/02/97



PENSACOLA ENVIRONMENTAL SITES [3]	
URE OF SPILL	YEAR
CRASH CREW TRAINING AREA	1955–PRESENT
ATES FROM THE GOLF COURSE	1963–1979
NSFORMERS STORED AT SITE	ONGOING
UPTURED TRANSFORMER	1967
A PIPELINE BREAK	1958
A PIPELINE LEAK	1981
EL FROM REFUELER TRUCKS	1958–1977
A PIPELINE BREAK	1965
A DDT MIXING AREA	1960s
NUM REMOVAL	1970
EMICAL CONTAINERS	1956–1964
ELL FROM A TRUCK AND LEAKED	1969
OM A SUBSTANCE IN SOIL	1981
OF INDUSTRIAL WASTE	1979
PILL	1989
THE BILGE WATER PLANT	1992
INTO NEARBY WETLANDS	1940s–
ENT SPILL	1960s
S STORED AT BUILDING 3380	1972–1981
L PLATING WASTES	1972–1979

LEGEND

- CERCLA SITE
- PETROLEUM SITE OR UST
- WETLAND
- SURFACE DRAINAGE DISCHARGE POINT, BASED ON DRAINAGE BASIN ANALYSIS
- STORMWATER OUTFALL PIPE
- SURFACE SPILL
- SEDIMENT SAMPLE
- ESTUARINE AQUATIC BED
- SITE 36

A – LEPTOCHEIRUS 10–DAY TOXICITY TEST
B – BENTHIC DIVERSITY
C – NEANTHES 20–DAY TOXICITY TEST
D – BIOACCUMULATION IN FISH
E – WATER QUALITY

REFERENCES:

PETROLEUM SITE INFORMATION BASED ON REPORTS FROM ABB ENVIRONMENTAL SERVICES, INC. AND PUBLIC WORKS CENTER, NAS PENSACOLA.

I R AND OTHER ENVIRONMENTAL SITE INFORMATION BASED ON ENSAFE/ALLEN&HOSHALL REPORTS.

SPILLS INFORMATION BASED ON NNESA, 1983 AND HISTORICAL DATA COMPILED IN E/AH SITE SPECIFIC IR I REPORTS.

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00/00/00	Rev By: NAME
00/00/00	Rev By: NAME
00/00/00	Rev By: NAME
09/16/96	Rev By: C. TRIPLETT

SITE 40 SAP ADDENDUM
NAVAL AIR STATION BAYOU GRANDE PENSACOLA
PENSACOLA, FLORIDA

FIGURE 1–1
PROPOSED PHASE II B
SAMPLE LOCATIONS AND ANALYSES

Dr by: E/AH	Tr by: 0036–00130	
Ck by: C. TRIPLETT	App by: S. PARKER	Sheet 1
Date: 06/02/97	DWG Name:36PPSL1	Of 1

2.2 Screening Values

Sediment chemical data from Phase IIA of the Site 40 investigation were collected from January to February, 1996. Data were initially compared to screening values to rank areas within assessment zones for further study and to develop a general conceptual model. If screening levels were exceeded, biological effects were to be tested during Phase IIB to determine if ecological impacts may be occurring.

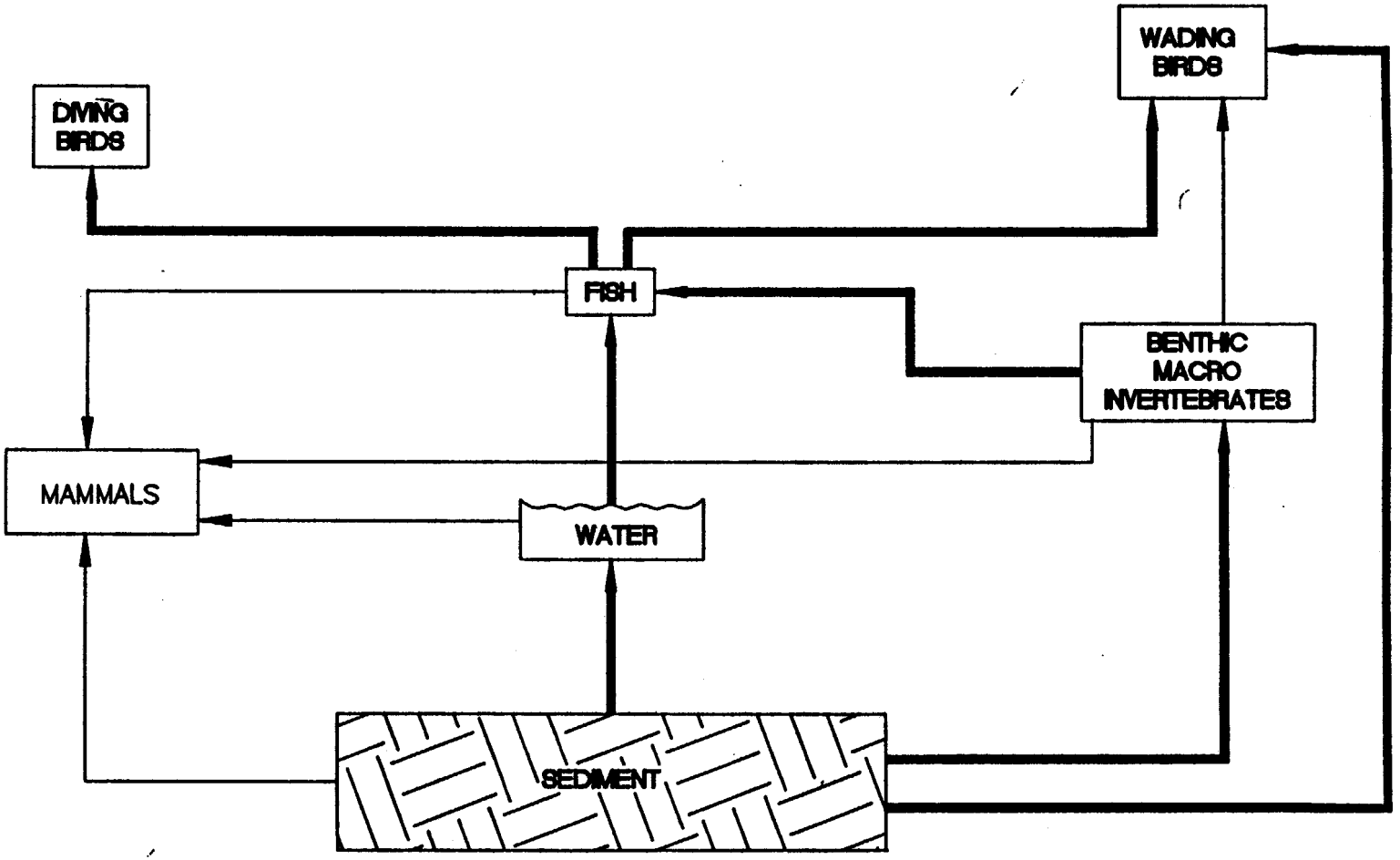
Contaminant levels were compared to the draft USEPA Region IV Sediment Screening Values and state of Florida Sediment Quality Assessment Guidelines.

23 Conceptual Model

A general conceptual model on sources, pathways, and potential receptor groups was provided in the Sites 40 and 42 SAP (E/A&H, 1995). This general conceptual model, along with specific contaminant information obtained during Phase IIA of the RI, was used to develop a site-specific conceptual model which identifies appropriate assessment endpoints for the bayou (Figure 1-2).

2.4 Assessment and Measurement Endpoint Development

Ecological risk is the primary focus of the Site 40 RI. Assessment and measurement endpoint selection focuses risk assessment goals and can be critical for subsequently proposed remedial options. Assessment and measurement endpoints are characteristics of ecological components that may be affected by exposure to a stressor. Assessment endpoints are defined as the ecological components that are of value in the risk assessment and allow for the prediction and measurement of explicit expressions of environmental values to be protected. They are the ultimate focus in risk characterization, and link the measurement endpoints with the risk management process. Measurement endpoints are measurable responses to a stressor that can be related to the valued characteristics chosen as the assessment endpoints (USEPA, 1992).



NOTE: BOLD LINES INDICATE COMPLETE PATHWAY

SITE 40 SAP ADDENDUM
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

FIGURE 1-2
RECEPTOR SPECIFIC CONCEPTUAL MODEL

DWG DATE: 05/14/97 | DWG NAME: 36RCSP40

2.4.1 Assessment Endpoints

Assessment endpoints were chosen by the NASP Tier I Partnering Team Eco-subcommittee (member affiliation: USEPA, FDEP, NOM, Navy, and E/A&H) and were based on the following assumptions:

- Contaminants present in the bayou sediment may impact the overall benthic ecosystem, and other lower food-chain organisms.

- Primary consumers and organisms higher in the food chain can be exposed to elevated concentrations of contaminants in sediment and lower trophic food sources (Pascoe and DalSoglio 1994).

Assessment endpoints, representing different levels of the food chain and specific for the bayou, are: (1) protection of the benthic macroinvertebrate community, (2) protection and reproductive viability of piscivorous birds, (3) protection of nursery habitat for aquatic resources, and (4) protection of fish viability. These assessment endpoints were chosen because they represent critical components of an estuarine ecosystem and may exhibit effects from contamination. Selection criteria for these assessments endpoints are described below.

protection of the Benthic Macroinvertebrate Community: This assessment endpoint is easily measurable and may significantly affect higher trophic level organisms. Benthic macroinvertebrates are an important biomonitoring tool, They are relatively sessile, have long life cycles, and represent a range of ecological niches. In addition to showing acute and chronic toxic effects, benthic organisms also accumulate metals and other contaminants at several orders of magnitude above ambient concentrations in the sediment or surface water. Benthic macroinvertebrates are also very localized in their habitat, meaning that effects to benthic organisms can usually be directly related to contamination in that area. The ability to focus on

effects in particular areas may help focus remedial decisions. Impacts to the survival, reproduction, and growth of benthos will be measured through acute and chronic toxicity tests, population parameters, and tissue concentration studies.

Piscivorous Bird Health and Reproduction: The great blue heron (*Ardea herodias*) is chosen for several factors relevant to assessing risk to in Bayou Grande. The great blue heron is common throughout NAS Pensacola and data are readily available on its habitat use and feeding characteristics. The heron is considered an ideal assessment endpoint species for assessment of aquatic food chain contaminant transfer based on its diet, feeding characteristics, and limited home range. For example, the heron feeds on some of the measurement endpoint species chosen. Any impacts to these measurement endpoint species, either through toxicity or body burden effects, may help establish a correlation between effects to the measurement endpoint and effects in the heron. Specific factors making the heron an attractive assessment endpoint species include:

- Diet —The great blue heron feeds primarily on fish, but it also eats amphibians, reptiles, and other organisms. Fish consumed by the heron are small (less than 20 centimeters) with small home ranges. The limited home range of the fish prey species simplifies the 'prediction of sediment impacts from these fish species. The limited migration increases the certainty in predicting impacts to species consuming fish in their diet from specific portions of the bayou. Food, body weight, and water ingestion rates for the heron are also readily available.

- Feeding Characteristics — Herons consume fish in shallow waters by slowly wading to catch their prey. This characteristic makes the shallow areas of Bayou Grande ideal for catching prey and thus an area of high exposure potential.

- Limited Home Range — The great blue heron is widely distributed in both saltwater and freshwater environments, making the bayou a suitable, attractive habitat. Herons have a limited home range and do not venture far from their nesting sites, thus it is assumed that they spend a significant amount of time in portions of the bayou where they have been observed. Also, herons do not appear to be sensitive to human presence, feeding in portions of the bayou near the more developed parts of the base.

- Correlation with Accepted Measurement Endpoints — Based on their diet, feeding wits, and feeding range, effects to the great blue heron may be correlated with a measurement endpoint. For example, body burdens in particular fish species may be used to predict reproductive impacts to herons. Toxicity results on amphipods and fish can also be related to losses in potential food sources.

Protection of Nursery Habitat for Aquatic Resources: Bayou Grande is an important nursery habitat for many commercially and recreationally important fish species, as well as a viable breeding ground for other organisms. Younger organisms in a nursery habitat have a limited home range and are exposed to contamination either through diet or direct adsorption. The ability to focus on effects in particular areas may help to focus remedial decisions.

Protection of Fish Viability: Fish were chosen as an assessment endpoint species based on their potential for exposure through diet and/or absorption. They occupy a significant niche in an estuarine community and effects to populations can alter overall community structure. Body burden and toxicity data from fish species will be important for these reasons:

- Higher Food Chain Impacts — Fish are prey for a variety of other species, such as the great blue heron, an assessment endpoint. Tissue data may be correlated to impacts to heron.

- Biotransfer — Fish may ingest sediment *during* feeding and thus become a *direct* transfer pathway for contaminants present in the sediment to other species.

- Toxicity from Direct Exposure — Toxicity to fish species may be correlated with contaminant concentrations in sediment.

2.4.2 Measurement Endpoints

Measurement endpoints provide quantifiable responses to a stressor that can be directly related to the valued characteristic chosen as the assessment endpoint. The NASP Tier I Partnering Team Eco-subcommittee chose measurement endpoints that could best be related to the assessment endpoints. Measurement endpoints for the bayou are listed in Table 1-1.

Effects on measurement endpoint species may be measured through toxicity, diversity, and tissue concentration studies. To evaluate the assessment endpoints, in some cases multiple measurement endpoints were chosen. These measurement endpoints include responses at the organism level via sediment bioassays and community indices for benthic macroinvertebrates (USEPA, 1993a). Decision points related to each measurement endpoint are provided in Table 1-1.

2.5 Modeling Approach

Dietary exposure of chemicals to piscivorous birds will be modeled based on exposure parameters in the *Wildlife Exposure Factors Handbook* (USEPA, 1993a). This document provides information on habitat range, body weight, food and water ingestion rates, population density, and other factors specific to some of the organisms chosen as assessment endpoints. After a dietary exposure is determined, effects *can* be predicted and quantified based on published effects-level threshold values.

Table 1-1
Measurement and Assessment Endpoints Chosen in Bayou Grande

Assessment Endpoints	Measurement Endpoint	Decision Point
1) Protection of benthic macroinvertebrate community.	1a) Acute toxicity using *Leptocheirus plumulosus* 10-day solid phase bioassay test (ASTM, 1994).	Statistically significant difference in mortality, growth, or fecundity compared to a laboratory control with similar grain size.
	1b) Chronic growth and fecundity using a 20-day *Neanthes arenaceodentata* solid phase sediment bioassay (PSEP, 1991).	Statistically significant difference in mortality, growth, or fecundity compared to a laboratory control with similar grain size
	1c) Benthic community indices for qualitative assessment.	Investigate potential for impacts from physical/chemical variables and compare community indices between stations.
2) Protection of reproductive viability of fish-eating birds.	2) Bioaccumulation in native fish species. If sufficient quantity of fish is not available, then use *Neanthes* or caged bivalves (TCL organics/TAL inorganics tissue analysis).	Unacceptable with whole-body tissue concentration which would produce reproductive impairment in assessment endpoint species.
3) Protection of nursery habitat for aquatic resources.	3a) Chronic growth and fecundity using a 20-day *Neanthes arenaceodentata* solid phase sediment bioassay (PSEP, 1991).	Statistically significant difference in mortality, growth, or fecundity compared to a laboratory control with similar grain size
	3b) Acute toxicity using *Leptocheirus plumulosus* 10-day solid phase bioassay test (ASTM, 1994).	Statistically significant difference in mortality, growth, or fecundity compared to a laboratory control with similar grain size
4) Protection of fish viabiity	4) Surface water chemistry (TCL organics/TAL inorganics).	Significant exceedances of state/federal chronic water quality standards.

Food Chain Model

For the assessment endpoint "bird health and reproduction," E/A&H will estimate contaminant uptake resulting from an oral exposure of contamination in fish tissue. Equation 1 presents the model components that will be used to derive a daily *dietary* exposure to a piscivorous bird (heron). Equation 1 predicts that portion of the total potential dietary *exposure* (tPDE) from contaminated prey tissue. The equation assumes that 100% of the contaminant concentration found in tissue is bioavailable to the bird.

(Equation 1)

Bird Exposure via prey tissue:	Food Exposure (mg/kg)	=	% Diet as Prey	X	IR_{diet}	X	Contaminant conc. in fish tissue (mg/kg)

where

IR_{diet} = food ingestion rate of receptor kg of food per day

Equation 2 predicts that portion of the tPDE from contamination in water. The equation assumes 100% contaminant assimilation by the bird.

(Equation 2)

Surface Water Contaminant Uptake to Bird:	Surface Water Contaminant Exposure (mg/kg)	=	Surface Water Contaminant Concentration (mg/L)	X	Water Ingestion Rate (L/day)

Equation 3 predicts that portion of the tPDE from incidental ingestion of contaminated sediment by the bird. This portion of the tPDE also assumes 100% contaminant assimilation. This portion of the tPDE for piscivorus birds applies only to wading species.

(Equation 3)

Sediment Ingestion by Bird:	Sediment Exposure (mg/kg)	=	Sediment as % of Diet	X	IR_{diet}	X	Sediment Contam. Conc. (mg/kg)

Equation 4 predicts the total contaminant dietary exposure via tissue, surface water, and sediment (as applicable). This equation incorporates the products derived in Equations 1, 2, and 3. To normalize to species body weight, the sum of the products from Equation 1,2 and 3 are divided by a mean body weight of the receptor selected as the assessment endpoint.

(Equation 4)

$$\text{Total Contaminant Exposure to Bird:} \quad \text{Total Potential Dietary Exposure (tPDE) (mg/kg)} = \frac{\text{Fish Tissue Exposure (Eq1)} + \text{Water Exposure (Eq2)} + \text{Sediment Exposure (Eq3)}}{\text{BW}}$$

where

BW	=	mean body weight (kg) of receptor
mg	=	milligrams
mg/L	=	milligrams per liter
kg BW/day	=	kilograms of body weight per day
%	=	percent
mg/kg	=	milligrams per kilogram

To assess the potential risk to birds, the tPDE value derived in Equation 4 is then divided by a threshold risk value (TRV) for the endpoint selected (i.e., mortality, reproductive alterations). This will produce a single number, expressed as a hazard quotient, that is a numerical representation of potential risk to the assessment endpoint selected. The TRV will be the lowest observable apparent effects level to a taxonomically related avian species found in the literature, divided by 10, to estimate a no observable apparent effects level.

Other models may be evaluated later in the RI process for use in developing remedial goals.

3.0 SAMPLE LOCATIONS AND METHODS

Sample locations for Phase IIB were selected by the NASP Tier I Partnering Team Eco-subcommittee based on relatively high, medium, and low contaminant concentrations. Comparing

effects and impacts relative to a contaminant gradient yields a better perspective to risk posed throughout the bayou. Sample locations within each assessment zone were selected based on contaminant information provided during Pbase IIA. Sample locations are shown on Figure 1-1.

In conjunction with the Phase IIB sampling event, three additional sediment chemistry samples will be collected to measure metals input from the former Skeet Shooting Range located adjacent to Bayou Grande. The shooting range was identified subsequent to the Phase IIA sampling of the bayou. The general location for these additional samples is presented on Figure 1-1.

At each Phase IIB location selected, sediment samples will be a composite of five grabs taken within a 10 foot radius of the indicated location. Samples will be analyzed for full Target Compound List (TCL) organics (USEPA, 1994a) (less volatile organic compounds), Target Analyte List (TAL) inorganics (USEPA, 1994b), total organic carbon, and grain size.

Sediment sampling for acute and chronic toxicity analysis will follow methods described in Sections 7.2 and 7.3 of the CSAP (E/A&H, July 1994). Samples will be collected using an Ekman dredge. Fish will be collected using standard minnow traps or seines. All fish will be keyed to species and preserved on ice. Whole-body tissue analyses will include TCL organics and TAL inorganics.

4.0 ECOLOGICAL RISK ASSESSMENT FRAMEWORK SUMMARY

Completing the ERA for the bayou requires three sources of information. The first is chemical analyses to establish the presence, concentrations, and distribution of any chemical contaminants. The second is data from toxicity tests and diversity studies to link exposure effects with observed chemical concentrations. The third is tissue concentrations which can further define ecological impacts and suggest whether impacts may be occurring in higher trophic levels of the food chaii.

All of this information is critical to establishing a *causal* link between contaminants and ecological effects (U.S. EPA, 1992).

The information gathered will be integrated, using a weight-of-evidence approach, into a risk characterization. A weight-of-evidence approach considers all available information to predict ecological impact. Each result will be considered in relation to the others to determine the extent and severity of impact. All factors will be considered to yield an overall picture of risk needed to develop remedial options.

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FLORIDA PROFESSIONAL GEOLOGIST *SEAL*

I have read and approve of this Sampling and Analysis Plan - Addendum for Site 40, Bayou Grande at the Naval Air Station Pensacola, Florida, and seal it in accordance with Chapter 492 of the Florida Statutes. In *sealing* this document, I certify the geological information contained in it is true to the best of my knowledge and the geological methods and procedures included herein are consistent with currently accepted geological practices.

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

Henry H. Beiro

Henry H. Beiro 5-23-97

Date