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CONTAMINATION ASSESSMENT/ REMEDIAL ACTIVITIES INVESTIGATION SANITARY LANDFILL (SITE 1) NAVAL AIR STATION PENSACOLA PENSACOM, FLORIDA

INTERIM DATA REPORT VOLUME I

October 1991

Contract N62467-88-C-0200

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RECORD OF DOCUMENT CHANGES

Revisions to this document were made based on comments received from the U.S. Environmental Protection Agency, Florida Department of Environmental Regulation, Florida Department of Natural Resources, and National Oceanic and Atmospheric Administration. All revisions are in bold and enclosed in brackets to denote changes to the last version of this document.

EXECUTIVE SUMMARY

As part of the U.S. Navy's Installation Restoration Program, Phase I of the Contamination Assessment/Remedial Activities Investigation was conducted for the Sanitary Landfill (Site 1), located on the Naval Air Station in Pensacola, Florida. This work was performed by Ecology and Environment, Inc., (E & E) under contract to the Southern Division, U.S. Navy, Naval Facilities Engineering Command.

The Sanitary Landfill occupies nearly 80 acres and is located approximately 0.5 mile northeast of Sherman Field (see figures 1-1 and 1-2). The landfill is inactive and currently has a dense vegetative cover of planted 15-foot pine trees and naturally occurring scrub vegetation. A Boy Scout Camp, two ponds, a picnic area that includes buildings *3554* and *3487*, and Bayou Grande are located north of the site; the A.C. Read Golf Course is located east of the site; a wooded area and Site 16--Brush Disposal Area are located west of the site; and Taylor Road and naturally occurring scrub vegetation are located south of the site.

The purpose of the Phase I investigation was to identify principal areas and primary contaminants of concern at the site and to provide recommendations for subsequent phases of investigation. The Phase I fieldwork included a site reconnaissance, habitat/biota survey, asbestos survey, surface emissions survey and particulate air sampling, radiation survey, geophysical survey, utilities survey, and the collection and analysis of surface water, sediment, surface soil, and groundwater samples. In addition, a hydrologic assessment, which included the determination of groundwater and surface water elevations, groundwater flow direction, and hydraulic gradient, was performed at the site The recommendations for additional work at this site are presented with this submittal under a separate cover.

[Bold items enclosed in brackets denote changes to the last version of document]

Sediment, surface soil, and groundvater contamination are present on and in the vicinity of Site 1 at clearly or potentially significant levels. Only low levels of surface water contamination (chromium, zinc, and chlorobenzene) were detected locally; however, iron contamination at levels exceeding Florida standards, as well as manganese contamination, ray also be present. Host of the detected contamination is clearly associated vith disposal activities on or leachate migration from the landfill. However, additional, perhaps ambient, sources of contamination also appear to be present. Overall, the results of E & E's Phase I investigation and those of previous rite investigations (Naval Energy and Environmental Support Activity [NBBSA] *1983;* Geraghty and Hiller [G & M] *1984;* and *G & M 1986)* do not clearly indicate that extensive off-site migration of significant levels of contamination from the landfill has occurred. However, sediments in adjacent surface vater bodies (including Bayou Grande) appear to have been impacted by leachate migration, and significant levels of soil and shallov groundwater contamination are clearly present, at least locally, vithin and immediately adjacent to the landfill boundaries. The Phase I investigation results also suggest that more extensive off-site migration of groundvater contaminants may be occurring in the deeper portions of the surficial zone of the Sand-and-Gravel Aquifer.

Elevated levels of metals (primarily chromium, zinc, and lead), total recoverable petroleum hydrocarbons (TRPHs), polynuclear aromatic hydrocarbons (PAHs), and/or phenols were detected in the sediment samples; iron and manganese may also be present at elevated levels. Host of the detected contamination, especially in the pond sediments, can be attributed to leachate migration from the landfill via discharge of contaminated groundvater. However, PAH and TRPH contamination, especially in Bayou Grande sediments, could reflect the presence of other, perhaps ambient, sources of contamination in the site vicinity.

Significant levels of surface soil contamination (volatile organic compounds [VOCs], TRPHs, PAHs, and/or phenols) were detected at only two locations: the "tar pit" (northvest corner of *1970s* landfill area) and the "collapse-feature depression" (northvest corner of *1950s* landfill area). These data suggest that significant levels of subsurface soil contamination may be present not only in these areas, but also in three

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other areas, identified on the aerial photographs but now covered over, where "concentrated" disposal of wastes might have occurred: two "pits" along the western landfill boundary, south of the identified "tar pit," and a large stained area in the north-central part of the 1970s landfill area. Based on the EM-31 and EM-34 survey data and groundwater sample analytical results, leachate migration beyond the landfill boundaries may be impacting subsurface aquifer matrix sediments below the water table.

Metals (iron, manganese, and, in one sample only, arsenic), VOCs (benzene, chlorobenzene, vinyl chloride, trichloroethene, and tetrachlorethene), PAHs-base/neutral extractables, and phenols-acid extractables represent the primary shallow groundwater contaminants. Several of the detected contaminants were present at concentrations that exceed Florida standards or guidance concentrations. Shallow groundwater organic contamination was restricted primarily to areas immediately adjacent to the landfill boundary (in particular, near the 1970s landfill area). This distribution indicates limited off-site migration and the potential for greater levels of contamination, at least locally, within the landfill. However, the distribution of volatile halocarbon occurrences in the shallow groundwater samples was more sporadic and more likely to be associated with wells located further from the landfill boundaries. Given that these contaminant species have higher specific gravities than water, the somewhat anomalous distribution identified could indicate off-site migration within deeper zones of the Sand-and-Gravel Aquifer.

It is not clear whether contaminants have migrated below the surficial zone of the Sand-and-Gravel Aquifer into at least the upper part of the main producing zone. A downward hydraulic gradient appears to exist between these zones across most of the site, and G & M (1986) detected high levels of benzene in two on-site deep well samples. In contrast, only low levels of mostly volatile and base/neutral acid extractable organic tentatively identified compounds (TICs) appear to have been present in E & E's Phase I samples from the on-site deep wells.

However, the presence of even low levels of these TICs, in combination vith the G & M 1986 data, the somevhat anomalous distribution of volatile halocarbons in E & E's Phase I groundvater samples, and the presence of elevated electromagnetic conductances revealed by the deeper En-31 and En-34 surveys in areas adjacent to the landfill, all suggest the potential presence of deeper groundvater contamination below and adjacent to the landfill.

Additional assessment activities will be required at and in the vicinity of Site 1.

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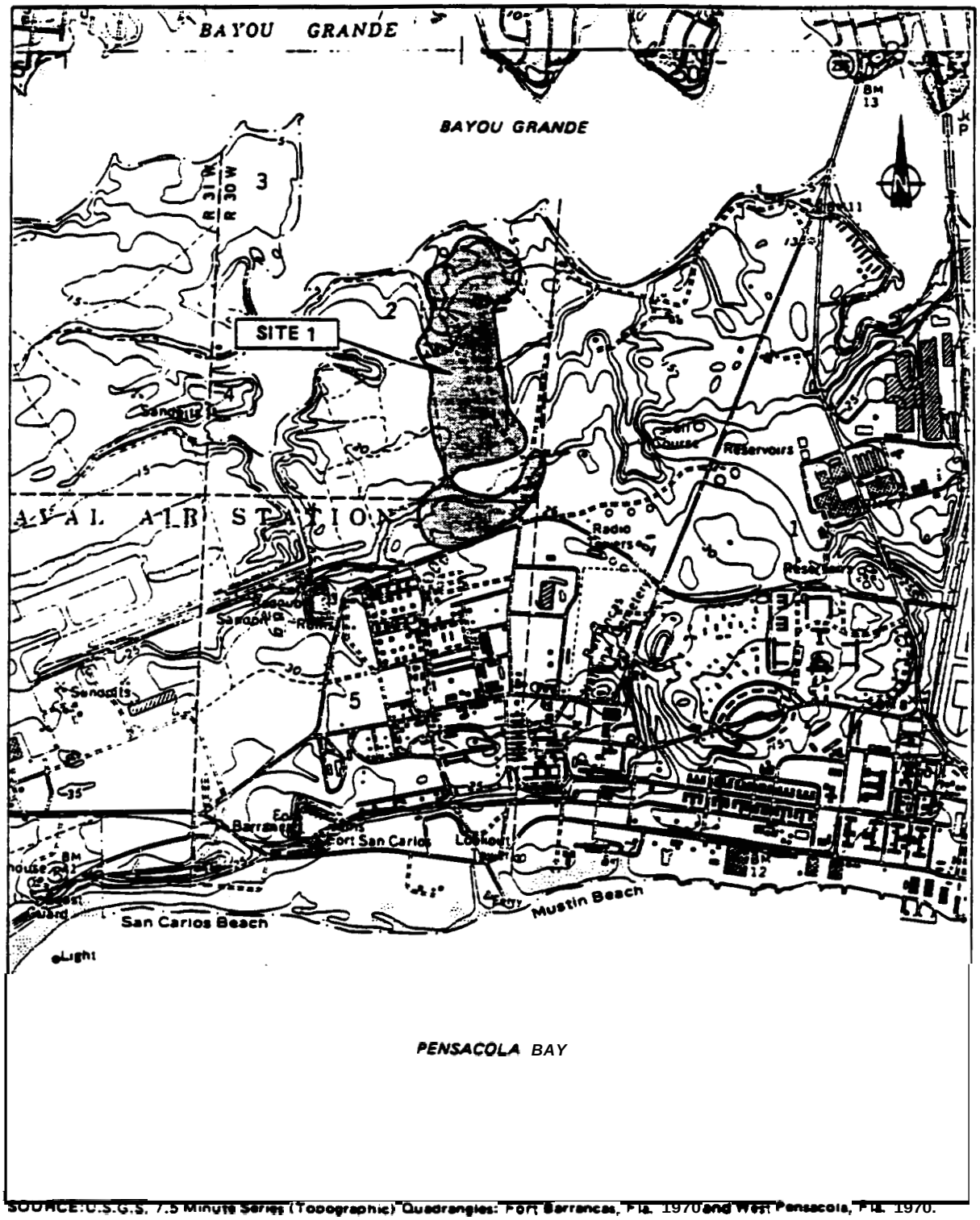
1. INTRODUCTION

This Interim Data Report presents the findings of the Phase I investigation activities performed for the Sanitary Landfill (Site 1), located at the Naval Air Station (NAS) in Pensacola, Escambia County, Florida. This report has been prepared by Ecology and Environment, Inc., (E 6 E) for the Southern Division, U.S. Navy, Naval Facilities Engineering Command, under Contract No. N62467-88-C-0200. The information presented in this report is based on information and file documents provided by the Navy and on information gathered during the Phase I fieldwork conducted at the site from October 1990 to February 1991. The investigation was conducted in accordance with the administrative documents prepared by E 6 E for this project, which include the Project Management Plan, Site Management Plan, Generic Quality Assurance Project Plan (GQAPP), General Health and Safety Plan, and Contamination Assessment/Remedial Activities Investigation Work Plan--Group A with appended Site-Specific Health and Safety Plan and Site-Specific Quality Assurance Plan.

The Sanitary Landfill occupies nearly 80 acres and is located approximately 0.5 mile northeast of Sherman Field (see figures 1-1 and 1-2). The landfill is inactive and currently has a dense vegetative cover of planted 15-foot pine trees and naturally occurring scrub vegetation. A Boy Scout Camp, two ponds, a picnic area that includes buildings 3554 and 3487, and Bayou Grande are located north of the site; the A.C. Read Golf Course is located east of the site; a wooded area and Site 16--Brush Disposal Area are located west of the site; and Taylor Road and naturally occurring scrub vegetation are located south of the site.



SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: Fort Barrancas, Fla. 1970 and West Pensacola, Fla. 1970. Photorevised 1987

SCALE

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0 — 1 KILOMETER

Figure 1-1 LOCATION MAP — NAS PENSACOLA SITE 1

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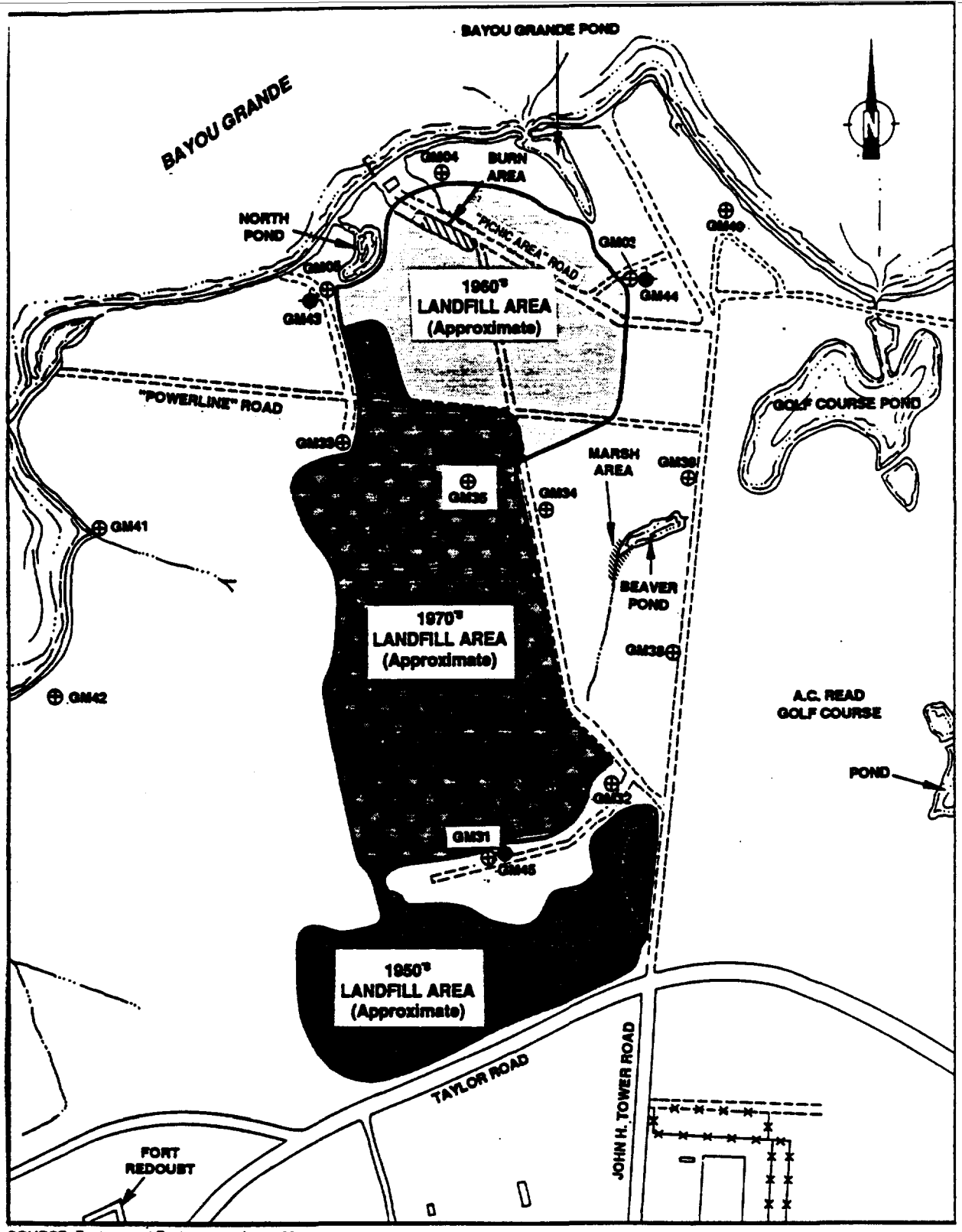

SOURCE: Ecology and Environment, Inc., 1991

KEY:

Landfill Boundary
Unpaved Road
Fence
Existing Permanent Shallow Monitoring Well
Existing Permanent Deep Monitoring Well
GM04 Existing Permanent Monitoring Well Number

SCALE
0 500 1000 FEET

Figure 1-2 SITE VICINITY MAP — NAS PENSACOLA SITE 1

The purpose of the Phase I investigation vas to identify principal areas and primary contaminants of concern at the site and to provide recommendations for subsequent phases of investigation. The Phase I fieldwork included a site reconnaissance, habitat/biota survey, asbestos survey, surface emissions survey and particulate air sampling, radiation survey, geophysical survey, utilities *survey,* and the collection and analysis of surface water, sediment, surface soil, and groundvater samples. In addition, a hydrologic assessment, which included the determination of groundvater and surface water elevations, groundvater flov direction, and hydraulic gradient, was performed at the site The recommendations for additional work at this site are presented with this submittal under a separate cover.

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2. INVESTIGATION METHODOLOGY

2.1 *AERIAL* PHOTOGRAPH *AND* EXISTING DATA ANALYSIS

Prior to the initiation of fieldwork, E & E personnel examined all available aerial photographs of NAS Pensacola for past and present conditions, features, and developments that might have had direct relevance to the fieldwork methodology. The aerial photograph analysis task involved assembling and stereoscopically analyzing historical photographic imagery and topographic maps available for the site area. Photographs were analyzed for past and present surface conditions, drainage, and land use. The aerial photographs and maps used in the analysis are listed in Table 2-1. The photographs and maps were analyzed to obtain information regarding the evolution of site features that might have affected hydrologic conditions and to aid in the performance of such tasks as field reconnaissance and monitoring well placement.

2.2 SITE RECONNAISSANCE

A field reconnaissance survey was conducted on and around the site. Available aerial photographs and maps were used as guides in locating surface features. Visual inspections were made of surface conditions, stressed vegetation, surface drainage patterns, areas of exposed site debris, and leachate seeps. These observations of surface conditions on the site were used to update the site map. During the reconnaissance survey, the field team identified areas that presented the most suitable conditions for the establishment of survey grid baselines. The use of a grid system as part of the Phase I field investigation is discussed in Section 2.7.

Table 2-1

PHOTOGRAPHS AND MAPS USED IN THE AERIAL PHOTOGRAPH ANALYSIS
NAS PENSACOLA SITE 1

Source	Photograph/Map Number	Date	Scale
NAS Pensacola Public Works Department	1276833*	2/5/90	1:2,400
	1276835*	2/5/90	1:2,400
	1276836*	5/22/06	1:2,400
	1276912*	9/29/06	1:2,400
Florida Department of Transportation	FD-3886-12-03	10/26/89	1:24,000
	FD-3886-11-04	10/26/89	1:24,000
	FD-3618-12-03	11/21/06	1:24,000
	FD-3618-12-04	11/21/06	1:24,000
	FD-3109-12-03	9/22/03	1:24,000
	FD-3109-12-04	9/22/03	1:24,000
	FD-2684-10-04	3/9/81	1:24,000
	FD-2684-10-05	3/9/81	1:24,000
	FD-1888-11-03	4/28/76	1:24,000
	FD-1888-11-04	4/28/76	1:24,000
	FD-1331-11-03	5/4/73	1:24,000
	FD-1331-11-04	5/4/73	1:24,000
	FD-868-4-08	4/6/70	1:24,000
	FD-868-4-09	4/6/70	1:24,000
	FD-616-8-04	3/25/60	1:24,000
	FD-616-8-05	3/25/68	1:24,000
	FD-285-6-03	10/8/64	1:12,000
	FD-285-6-05	10/8/64	1:12,000
	PHS-7054-2-1	10/12/61	1:24,000
	PHS-7054-2-2	10/12/61	1:24,000
U.S. Department of Agriculture	CPF-2V-78	1/3/50	1:24,000
	CPF-4H-17	1/22/51	1:24,000
West Florida Regional Planning Council	FD-3618-12-05	11/21/86	1:4,800

14[NASP]UN6017:T0260/298/23

*Map.

Source: Ecology and Environment, Inc., 1991.

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The reconnaissance survey team utilized radiation and air monitoring equipment during walkovers of site areas, in accordance with sections 6.1.1 and 6.3.2 of the GQAPP. Areas with readings above background were flagged and identified on a site map for future reference. All findings of the physical reconnaissance were mapped in detail and recorded in the field logbook.

2.3 HABITAT/BIOTA SURVEY

A habitat/biota survey was conducted for the site, and existing literature pertaining to NAS Pensacola was examined to identify probable on-site biota. During the physical reconnaissance, an E & E biologist/ecologist determined the on-site terrestrial and aquatic habitats and the surrounding habitats that could be affected by off-site contaminant migration. During the walkover survey, rare, threatened, and endangered species and their potential habitats were identified, and general site conditions were evaluated regarding the site's ability to support viable populations of plants and animals.

2.4 ASBESTOS SURVEY

An asbestos survey was conducted on site during the habitat/biota survey. This survey consisted of [visually] locating and identifying suspect building materials [(i.e., insulation, tiles, and shingles)] that could potentially contain asbestos.

2.5 HNu/OVA SURFACE EMISSIONS SURVEY AND PARTICULATE AIR SAMPLING

Following the establishment of the survey grid network (discussed in Section 2.7), a surface emissions survey was conducted using HNu and/or organic vapor analyzer (OVA) air monitoring equipment. The survey was conducted in accordance with Section 6.1.1 of the GQAPP. Measurements were made at each established grid point, and readings were recorded in the field logbook. In addition, preliminary air screening was conducted using a Mini-Ram particulate monitor to determine if the site represents a source of particulates in the air. The air sampling was conducted in accordance with Section 6.1.[1] of the GOAPP.

[Bold items enclosed in brackets denote changes to the last version of document]

2.6 RADIATION SURVEY

Following the establishment of the survey grid network (discussed in Section 2.7), a radiation survey was conducted using a Bicron micro-R-meter. The survey was conducted in accordance with Section 6.3.[6] of the GQAPP. Measurements were lade at each established grid point, and readings were recorded in the field logbook.

2.7 GEOPHYSICAL SURVEY

Metal detector, magnetometer, and electromagnetic terrain conductivity surveys were conducted across the site and surrounding areas. The metal detector survey was conducted using a standard, portable metal detector/pipe locator; the magnetometer survey was conducted using a Geometrics G-856AX proton precession magnetometer; and the electromagnetic surveys were conducted using Geonics, Ltd., En-31 and *En-34* instruments. (The electromagnetic surveys will be discussed in this report as the En-31 and EM-34 surveys.)

Additional information on surface conditions, stressed vegetation, areas of exposed site debris, and leachate seeps was obtained during the actual cstablishwnt of the survey grid network. This additional information was wed to further update the site up.

The survey effort required the initial establishment of a grid system over the study *area.* To construct the grid, the site was subdivided into four subsections (grids A through D) so that subgrid baselines could be established along existing roadways. Each subsection was then gridded vith spacings based on 100-foot centers. Baseline transects were established using a transit survey instrument and flagged at 100-foot intervals. Each grid subsection was referenced to an arbitrarily established origin point using a Brunton compass and tape measure. Grid points were flagged and numbered as follows:

Grid X, N (or S) n_1 + yy, E (or V) n_2 + zz,

where:

X = Grid letter;

n_1 = Distance in 100-foot increments north (N) or south (S) of the origin point;

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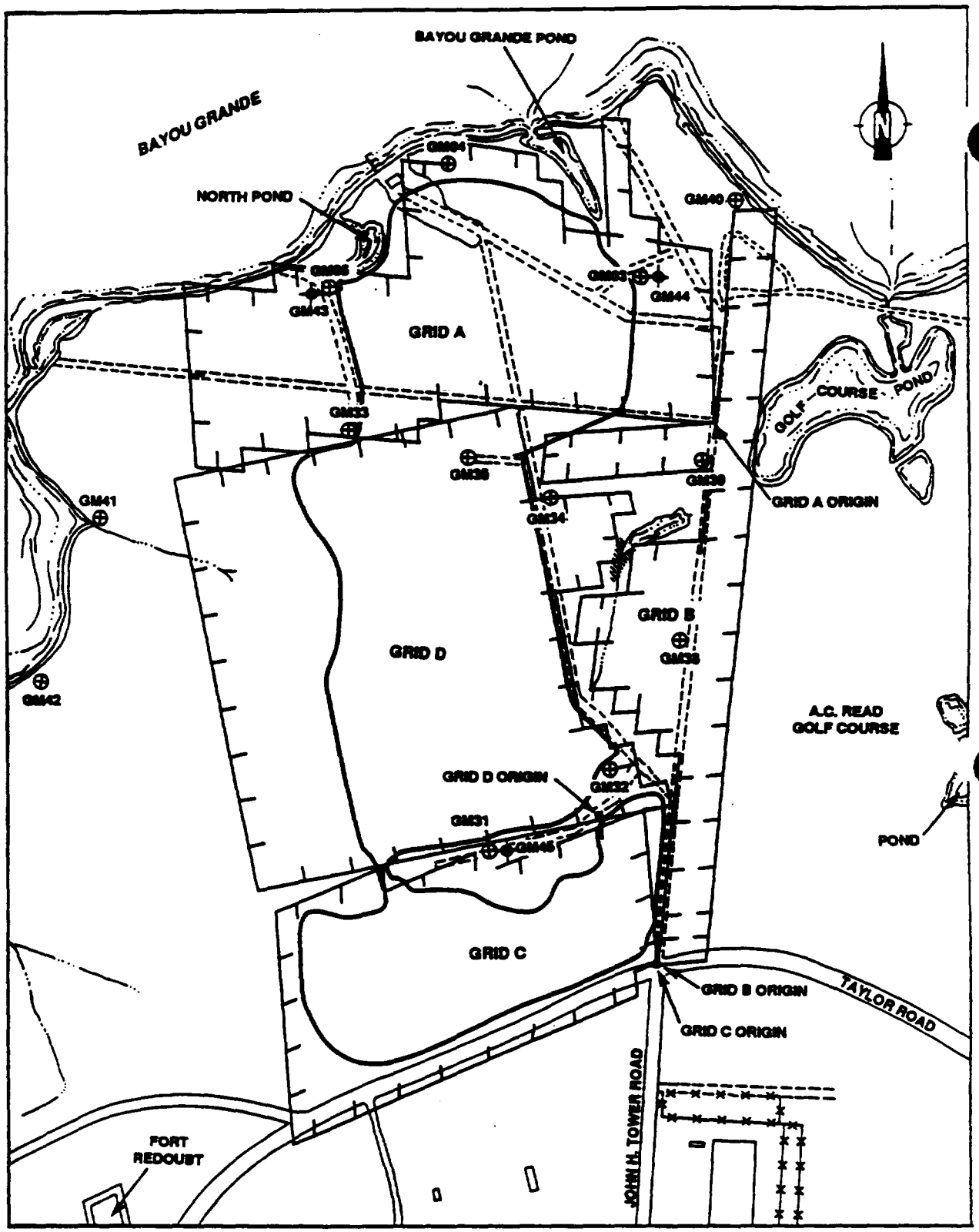
n_2 = Distance in 100-foot increments east (E) or west (W) of the origin point;

Figure 2-1 shows the location of the four survey grids and origin points established on Site 1 and surrounding areas. The metal detector, magnetometer, and EM-31 surveys were conducted by obtaining measurements at each 100-foot-interval grid coordinate. The EM-34 readings were obtained at alternating grid coordinate locations with a spacing of 200 feet. The geophysical survey was performed in accordance with field methodologies and data interpretation techniques discussed in Section 6.2.1 of the GQAPP, with two exceptions: 1) during performance of the EM-31 survey, readings were taken only parallel to the survey grid traverses in each of the modes (horizontal coplanar and vertical coplanar); and 2) during performance of the EH-34 surveys, readings were recorded at intercoil spacings of 10 and 20 meters only, rather than the 10- , 20- , and 40-meter spacings specified in the GQAPP.

The effective exploration depth of the En-31 is approximately 3 meters (9.8 feet) in the horizontal coplanar mode and approximately 6 meters (19.7 feet) in the vertical coplanar mode. The effective exploration depth of the En-34 is approximately 7.5 meters (24.6 feet) during the horizontal coplanar mode 10 meter intercoil spacing survey and approximately 15 meters (49.2 feet) during the horizontal coplanar mode 20 meter intercoil spacing survey.

2.8 UTILITIES SURVEY

Prior to conducting any augering, boring, or drilling, E & E located all underground cables, pipes, utilities, and other subsurface features that could potentially be damaged, create a safety hazard, or otherwise hinder fieldwork. The appropriate authorities (e.g., NAS Pensacola Public Works and Southern Bell) were contacted to identify the location of all underground utilities in the site area. In addition, E 6 E examined available maps and documents and conducted a metal detector survey to determine the presence of any other potentially hazardous subsurface features on site. The locations of all underground utilities and other obstructing features were marked with surveyor flags, fluorescent paint, or by other methods, as appropriate.



SOURCE: Ecology and Environment, Inc., 1991

KEY:

- Existing Permanent Shallow Monitoring Well
- Existing Permanent Deep Monitoring Well
- Landfill Boundary
- Fence
- Geophysical Survey Grid Boundary
- Unpaved Road

SCALE: 0 500 1000 FEET

Figure 2-1 SURVEY GRID MAP — NAS PENSACOLA SITE 1

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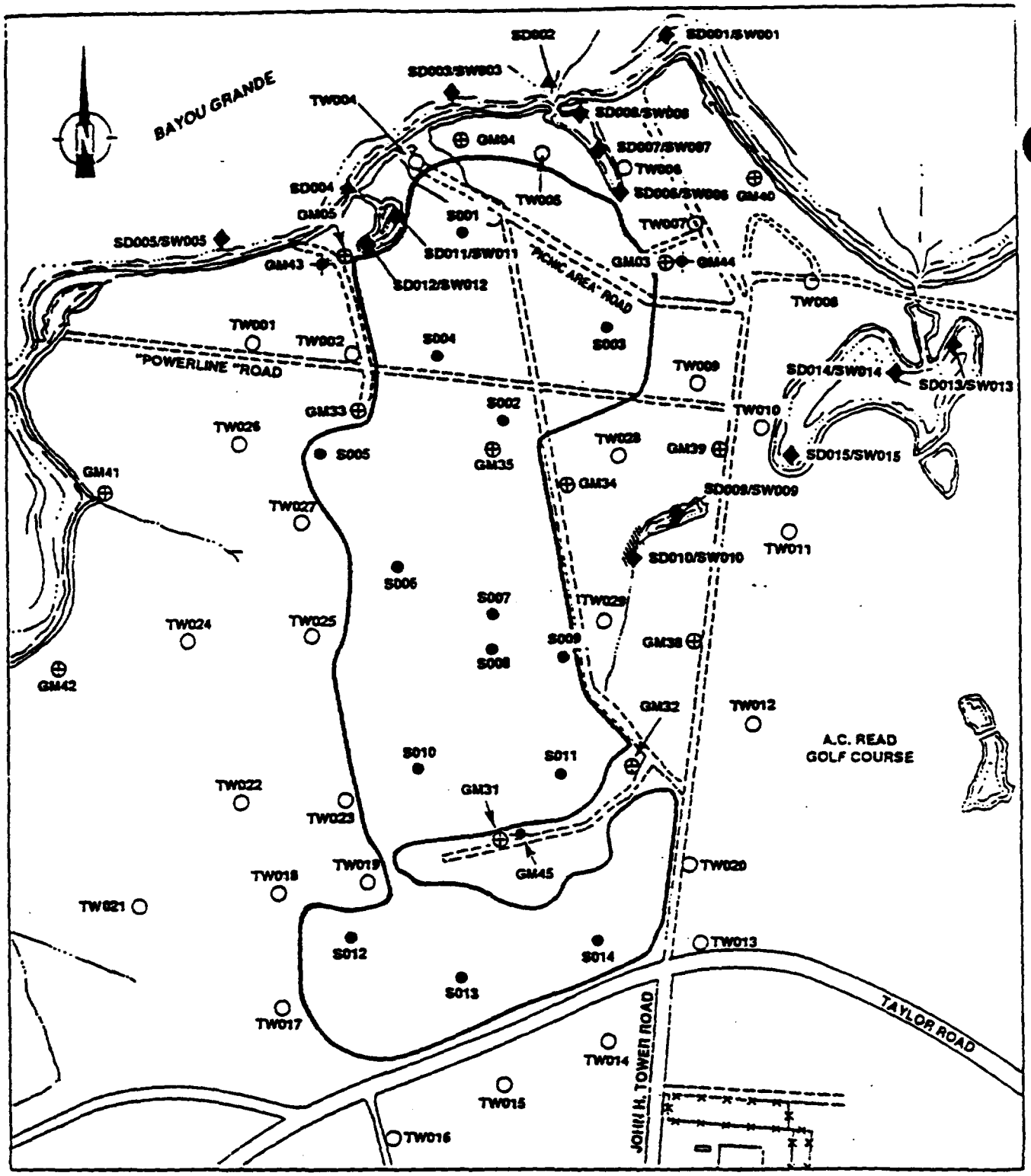
2.9 DATA ANALYSIS

Information obtained from the results of the above-described physical surveys was given primary consideration in the development of placement strategies for the Phase I temporary monitoring wells and surface water, sediment, and surface soil samples. Prior to establishing the Phase I temporary monitoring well locations or other sampling points, the results of the aerial photograph analysis, site reconnaissance, asbestos survey, surface emissions survey and particulate air sampling, radiation survey, geophysical survey, and utilities survey were evaluated to identify landfill area boundaries, areas of potential surface or subsurface contamination, leachate seeps, and areas of stressed vegetation. The Phase I temporary monitoring well locations and other sampling points, shown on Figure 14-2 of the work plan, were then revised, as appropriate upon approval by Southern Division..

2.10 SURFACE WATER SAMPLING

Thirteen surface water samples, plus one duplicate sample, were collected during the Phase I investigation: three from Golf Course Pond east of the landfill; two from Beaver Pond and the adjacent marshy area west of Golf Course Pond; two from North Pond and three from Bayou Grande Pond north of the landfill; and three from Bayou Grande in the vicinity of the northern end of the landfill (see Figure 2-2). When necessary, a small boat was used to access desired sampling locations.

[During collection of surface water samples from the four ponds and the marshy area adjacent to Beaver Pond, various methods were used.] Where the water depth was greater than 1 foot, surface water samples were collected from a zone approximately 1 foot above the bottom of the water body using stainless steel bowls; where the water depth was less than 1 foot, samples were collected from the surface using stainless steel bowls. [Bayou Grand surface water samples were collected from a zone 1 foot above the bottom. All sample bottles were transported to the sampling zone by scuba divers. The sample bottles were then inverted, slowly uncapped, and slowly filled in order to minimize agitation of the sample. After filling, all sample bottles were tightly capped prior to transport to the surface.] All sampling and equipment



SOURCE: Ecology and Environment, Inc., 1991

SCALE

0 500 1000 FEET

KEY:

- Landfill Boundary
- Unpaved Road
- Fence
- Permanent Shallow Monitoring Well
- Permanent Deep Monitoring Well
- Temporary Monitoring Well
- GM04 Permanent Monitoring Well Number
- TW001 Temporary Shallow Monitoring Well Number
- Sediment Sample Location
- Sediment and Surface Water Sample Location
- Surface Soil Sample Location
- SW001 Surface Water Sample Number
- SD001 Sediment Sample Number
- S001 Soil Sample Number

Figure 2-2 TEMPORARY MONITORING WELL LOCATIONS AND SURFACE WATER, SEDIMENT, AND SURFACE SOIL SAMPLING LOCATIONS — NAS PENSACOLA SITE 1

decontamination activities were conducted in accordance with sections 6.9.1 and 6.10 of the GQAPP. All surface water samples collected as part of this investigation were shipped to E & E's Analytical Services Center (ASC) in Buffalo, New York, and analyzed for the screening parameters listed in Table 2-2.

2.11 SEDIMENT SAMPLING

Fifteen sediment samples, plus one duplicate sample, were collected: three from Golf Course Pond, two from Beaver Pond and the adjacent marshy area, two from North Pond, three from Bayou Grande Pond, and five from Bayou Grande (see Figure 2-2). At each location, the sediment sample was collected from the sediment surface to a depth of approximately 4 inches. In areas where the water depth was greater than 8 inches, the samples were retrieved using either a stainless steel sediment corer or a bucket-type mud auger; in areas where the water depth was less than 8 inches, a stainless steel trowel was used. The composition of bottom materials retrieved during sampling was recorded in the field logbook. All sediment sampling and equipment decontamination activities were conducted in accordance with sections 6.9.2 and 6.10 of the GQAPP. All sediment samples were shipped to E & E's ASC and analyzed for the screening parameters listed in Table 2-2.

2.12 SURFACE SOIL SAMPLING

Fourteen surface soil samples, plus one duplicate sample, were collected at the locations shown on Figure 2-2. Eleven of the samples were collected as composites of five aliquots taken from within a 50-foot-diameter area. Each aliquot was collected from a depth interval of 0 to 6 inches belov land surface (BLS). At each location, the five aliquots were composited to yield a single surface soil sample. Two samples, S009 and S012, were composited from five, 0- to 6-inch BLS aliquots collected within an approximately 20-foot-diameter stressed vegetation area and within a 30-foot-diameter "collapse-feature depression" where elevated organic vapor concentrations had been recorded during the surface emissions survey, respectively. The remaining sample, S005, was composited from aliquots of a tar-like

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Table a-2

SAMPLING AND ANALYTICAL SUMMARY
NAS PENSACOLA SITE 1

Medium	No. of Samples	Duplicates	Total	Analytical Suite[a,b]
Surface Water	13	1	14	A
Sediment	15	1	16	A
Soil	14	1	15	A
Groundwater[d]	28	2	30	A

Medium	No. of Samples	Dupli-cates	Trip Blanks[f]	Field Blanks	Rinsate Blanks	Preservative Blanks[g]	Total	Analytical Suite[a,c]
Groundwater[e]	15	2	2	1	2	1	23	B

[NASP]UN6017:T0260/299/10

Key:

[a]Analytical suite designations are as follows:

A = Volatile organic compounds (VOCs), including chlorobenzene, polynuclear aromatic hydrocarbons (PAHs), phenols, pesticides and total polychlorinated biphenyls (PCBs), total recoverable petroleum hydrocarbons (TRPHs), and metals (total, unfiltered).

B = Target Compound list (TCL) VOCs plus xylene and ketones (EPA 8240), TCL base/neutral and acid extractable organic compounds (BNAs; EPA 8270), TCL pesticides and PCBs (EPA 8080), TRPHs (EPA 410.11, [Target Analyte List (TAL)] metals (total [i.e., unfiltered] and dissolved [i.e., millipore-filtered]; EPA 6010/7060/7421/7471/7740/7841), cyanide (EPA 9010), gross alpha (EPA 900), total organic carbon (EPA 415.11, hardness (water only; EPA 130.2), and alkalinity (water only: EPA 310.1).

[b]Specific constituents encompassed by the various chemical groups included within analytical suite A are identified in tables 9-1 through 9-4 of the GQAPP.

[c]Specific constituents encompassed by tho various chemical groups included within analytical suite B are identified in tables B-5 through 9-13 of tho GQAPP.

[d]Groundwater samples and analyses shown are for temporary wells only.

[e]Groundwater samples and analyses shown are for existing permanent wells only.

[f]Trip blanks analyzed for TCL VOCs only.

[g]Preservative blanks analyzed for TCL VOCs, TRPHs, dissolved [TAL] metals, and cyanide.

Source: Ecology and Environment, Inc., 1991.

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substance exposed in a trench near the northwest corner of the central portion of the landfill (1970s landfill area). The aliquots were collected from the surface to the base of the material within the trench (a depth of approximately 15 inches).

All sampling and compositing activities were performed in accordance with Section 6.6 of the GQAPP. Equipment decontamination was performed in accordance with Section 6.10 of the GQAPP. All soil samples were shipped to E & E's ASC and analyzed for the screening parameters listed in Table 2-2.

2.13 TEMPORARY MONITORING WELL INSTALLATION

Twenty-eight temporary stainless steel monitoring wells were installed at the locations shown on Figure 2-2. It should be noted that originally planned temporary well TW003 was not installed because the data analysis and site reconnaissance tasks revealed that the originally planned well location was in proximity to permanent shallow monitoring well GM05 in a submerged marshy area adjacent to North Pond. Each well was constructed with 5 feet of 0.01-inch slotted screen and installed to a depth that allowed the well screen to bracket the water table. The wells were installed using solid-stem augers powered by a drill rig. Lithologic characteristics of materials encountered during well installation were recorded in the field logbook. All lithologic logging and equipment decontamination activities were performed in accordance with sections 6.6 and 6.10 of the GQAPP.

2.14 GROUNDWATER SAMPLING

2.14.1 Temporary Monitoring Wells

Twenty-eight groundwater samples, plus two duplicate samples, were collected from the 28 temporary monitoring wells shown on Figure 2-2. Weather conditions; water levels; purge volumes; and groundwater pH, specific conductance, and temperature measurements were recorded in the field logbook prior to sampling. In addition, prior to purging, each well was checked for the presence of floating and/or sinking immiscible hydrocarbons using an MMC International oil-water probe. Each groundwater sample was collected immediately following well purging. All well purging and sampling activities were performed in accordance

vith sections 6.8 and 6.11 of the GQAPP. Equipment decontamination vas performed in accordance with Section 6.10 of the GQAPP. All of the groundwater samples collected from the temporary monitoring wells were shipped to E & E's ASC and analyzed for the screening parameters listed in Table 2-2.

2.14.2 Existing Permanent Monitoring Wells

Fifteen groundvater samples, plus two duplicate samples, were collected from 15 of the 16 existing permanent monitoring wells located on or in proximity to Site 1 (see Figure 2-2). The sixteenth well (GM03) contained no water during the sampling period; therefore, it could not be sampled. Weather condftions; water levels; purge volumes; and groundvater pH, specific conductance, and temperature measurements were recorded in the field logbook prior to sampling. Each groundwater sample was collected immediately following well purging. All well purging and sampling activities were performed in accordance with sections 6.8 and 6.11 of the GQAPP. Equipment decontamination was performed in accordance vith Section 6.10 of the GQAPP. All of the groundvatcr samples collected from the existing **wells** were analyzed according to U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) protocol for the **[Target Analyte** List (TAL) **and]** Target Compound List (TCL) and other parameters listed in Table 2-2. Gross alpha radioactivity analyses were performed by Controls for Environmental Pollution, Inc., (CEP) located in Santa Fe, New Mexico. All other analyses were performed by E & E's **ASC.**

2.15 HYDROLOGIC ASSESSMENT

The hydrologic assessment of Site 1 and surrounding areas included the determination of water level elevations in the temporary monitoring wells and existing permanent monitoring vells; the determination of surface water elevations in Golf Course Pond, Beaver Pond, North Pond, Bayou Grande Pond, and Bayou Grande; and the monitoring of precipitation levels near Bayou Grande.

Vellhead top-of-casing (TOC) elevations and static water levels measured in each existing permanent well were referenced directly to an established benchmark. Static groundwater levels in the permanent

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monitoring wells were measured on February 26, 1991, over a 2-hour period.

Wellhead TOC elevations for the temporary monitoring wells were measured, using a spirit level and tape measure, relative to the top of a driven reference stake located adjacent to each well. Static groundwater levels in the temporary monitoring wells were measured relative to the wellhead TOC over a five-day period (January 16 through 20, 1991). Following groundwater sampling and removal of the temporary monitoring wells, the elevations of the driven reference stakes were surveyed using a transit with reference to a previously established elevation at permanent monitoring well GM39.

Reference stakes were established in Beaver Pond, North Pond, Bayou Grande Pond, and Bayou Grande for determination of surface water elevations. A staff gauge was placed in Golf Course Pond to monitor surface water level elevations in this water body. One set of surface water elevations was recorded at the same time as static groundwater levels in the permanent monitoring wells (February 26, 1991). In addition, a rain gauge station was established in a salt marsh bordering Bayou Grande, near the northwestern corner of the site, to monitor precipitation during fieldwork activities.

2.16 FIELD QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

All field tasks performed during the investigation were documented in the field logbooks according to the procedures specified in Section 7.2 of the GQAPP.

2.16.1 Field QA/QC Samples

Field QA/QC samples were prepared for all samples collected at Site 1 during the Phase I investigation according to the procedures described in Section 6.12 of the GQAPP. Chain-of-custody was maintained for all samples collected, packaged, and shipped to CEP and E & E's ASC for analysis. Sample management was performed as specified in Section 7 of the GQAPP. The collected field QA/QC samples and corresponding analytical parameters are listed in Table 2-2.

2.16.2 Decontamination Procedures

All equipment used during field activities was decontaminated in accordance with Section 6.10 of the GQAPP.

2.17 INVESTIGATION-DERIVED WASTE MANAGEMENT

Excess soil material generated during temporary monitoring well installation activities was temporarily contained adjacent to the well and then backfilled into the borehole after the temporary well casings had been removed following sample collection. Any soil material remaining after completion of borehole backfilling was placed in 55-gallon drums, sealed, labeled, and moved to a central area on the site. Each drum has a painted-on label listing the site number and the type of material contained in the drum.

All water generated during purging of the existing permanent monitoring wells was placed in 55-gallon drums, sealed, labeled, and moved to a central art. on the site. Each drum has a painted-on label listing the site number and the type of material contained in the drum.

All water generated during development and purging of the temporary monitoring wells was temporarily contained adjacent to the well and then poured back into the well following collection of samples.

Potentially contaminated clothing and disposable materials, wastes generated during decontamination activities, and other potentially contaminated, investigation-derived materials were placed in 55-gallon drums, labeled, and moved to a central area on the site. These drums are sealed and labeled "trash." All drummed investigation-derived materials were subsequently picked up and disposed of by NAS Pensacola.

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3. RESULTS

3.1 AERIAL PHOTOGRAPH AND EXISTING DATA ANALYSIS

Review of the January 22, 1951, aerial photograph revealed that no landfill activities had been performed on the site. At this time, the site appears to have been undisturbed and covered with sparse vegetation.

Review of the January 3, 1958, aerial photograph indicated that landfill activities were being performed at the southern end of the site in an area bounded to the south by Taylor Road and extending westward along Taylor Road for approximately 1,700 feet from the intersection of Taylor Road and John E. Tower Road. The landfill area extended northward from Taylor Road for about 700 feet at the western boundary and northward about 500 feet from Taylor Road at the eastern boundary near John E. Tower Road. This area comprises the portion of the site covered by Geophysical Survey Grid C (see Figure 2-1). Filled and capped disposal cells are visible in the southwestern portion of the disturbed area where landfill activities were being conducted.

Review of the October 12, 1961, aerial photographs indicated that landfill activities had been completed on the southern portion of the site along Taylor Road. Thin, patchy vegetation was present on the disturbed area. At this time, landfill activities were being conducted at the northern end of the site in an area between North Pond and Bayou Grande Pond. This area is represented by the northern portion of Geophysical Survey Grid A (see Figure 2-1). No other landfill activities were being performed at this time.

Review of the October 8, 1964, and March 25, 1968, aerial photographs indicated that landfill activities were being conducted in an area extending from the approximate midpoint between North Pond and Bayou Grande Pond along the southern boundary of the 1961 landfill area

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eastward and southward from Bayou Grande Pond to the approximate location of the baseline of Geophysical Survey Grid A (see Figure 2-1). The remainder of the site vas unused at this time. The landfill area at the southern end of the site continued to become increasingly covered by lov-lying vegetation during this period.

Review of the April 6, 1970, aerial photographs revealed that a dirt road ("poverline" road), corresponding to the location of the Geophysical Survey Grid A baseline (see Figure 2-1), had **been** constructed through the northern portion of the site from John E. Tover Road vestward to Bayou Grande. Landfill activities had been completed in the area near North Pond and Bayou Grande Pond vved during the 1960s, and an area in the central portion of the site vas being used for landfill purposes. This area is represented by the northernmost third of Geophysical Survey Grid D (see Figure 2-1). These aerial photographs shov the presence of a dark, linear feature subsequently identified during the establishment of the geophysical survey grids as a shallov trench containing a black tar-like substance and located near the northwestern corner of the area represented by Geophysical Survey Grid D **(see** figure[s] 2-1 **[and** 3-11). The location of this "tar pit" is approximately 1,580 feet vest of John E. Twer Road and *420* feet south of "poverline" road. These photographs also reveal two similar, dark, linear features located near the western boundary of the active landfill, south of the identified "tar pit." The northernmost feature is approximately 100 feet long and 15 feet wide and is located approximately 1,450 feet vest of John E. Tower Road and 580 feet south of "poverline" road. The southernmost feature is approximately 40 feet long and 15 feet vide and is located approximately 1,350 feet vest of John H. Tower Road and 1,000 feet south of **"poverline"** road. The above-mentioned aerial photographs also indicated that a linear, marshy-appearing depression extending approximately 800 feet southvard from North Pond vas being filled in with rubble and soil material (as identified during the site reconnaissance). The northern portion of the landfill (1960s landfill area; see Figure 1-2) at this time vas covered by lov-lying vegetation, and small trees vere present in the southern portion of the landfill (1950s landfill area; see Figure 1-2). **These** photographs indicated that approximately 800 feet of the marshy-

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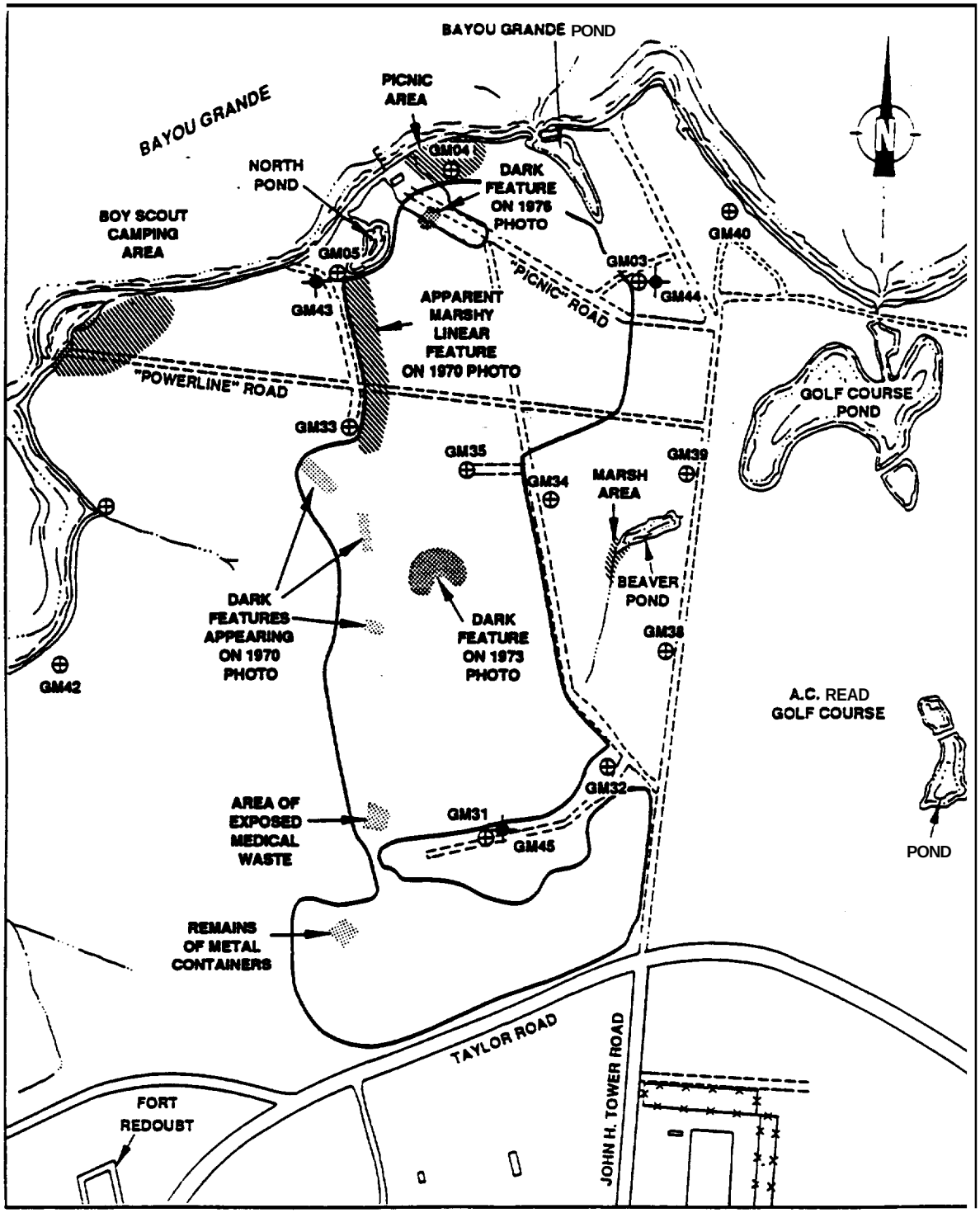

SOURCE: Ecology and Environment, Inc., 1991

Figure 3-1 PRINCIPAL FEATURES IDENTIFIED FROM AERIAL PHOTO ANALYSIS AND SITE RECONNAISSANCE — NAS PENSACOLA SITE 1

appearing depression area had been filled in with rubble and soil material from the southern terminus northvard. Also visible on the April 6, 1970, aerial photographs is a narrow, depressed linear feature that appears to be a dewatering trench. This feature, approximately 700 feet long and 10 feet vide, trends tovard the vest-southvest from a point located approximately 740 feet vest of John E. Tover Road and approximately 380 feet south of "poverline" road.

Reviev of the May 4, 1973, aerial photographs indicated that landfill activities had been completed in the middle third of the area encompassed by Geophysical Survey Grid D in the central portion of the landfill (1970s landfill area; see Figure 1-2). These photographs also indicate that the southernmost of the three dark, linear features visible on the April 6, 1970, aerial photographs was no longer visible. The 1973 aerial photographs also show that the linear depression which trended southvard from North Pond had been filled with rubble and soil material to the edge of North Pond. By this time, the 1950s and 1960s landfill areas were moderately covered vith small trees and lov-lying vegetation, respectively.

The May 4, 1973, photographs also indicate that landfill activities were being conducted in the southern third of the 1970s landfill area within Geophysical Survey Grid D (see Figure 2-1). In addition, ground cover had been removed from the previously undisturbed northern third of the 1970s landfill area in preparation for disposal activities. An irregularly shaped, northeast-southwest oriented dark feature, located in the previously active middle third of the 1970s landfill area approximately 980 feet west of John E. Tover Road and approximately 700 feet south of "poverline" road, is also visible in these photographs [(see Figure 3-1)]. This dark feature covered an area 200 feet long and 75 feet vide.

Reviev of the April 28, 1976, aerial photographs revealed that landfill activities had been completed in the portion of the 1970s landfill area contained within the boundaries of Geophysical Survey Grid D (see Figure 2-11, except for the previously cleared area (1973 photographs) that extended from "poverline" road southvard to the northern boundary of the previously active middle third of the 1970s landfill area. In addition, the dark, linear area, the dark,

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irregularly shaped area, and the narrow, depressed, linear feature visible on the 1973 aerial photographs were not evident on the April 28, 1976, aerial photographs. *An* area extending from the southern border of the 1970s landfill area, corresponding to the Geophysical Survey Grid D baseline (see Figure 2-1), to the approximate boundary of the 1950s landfill area had been cleared of vegetation. This area, however, does not appear to have been used for landfill purposes. The previously active 1970s landfill area was sparsely covered by low-lying vegetation. In addition, an unpaved road ("picnic area" road) is present in the 1976 photographs and extends from the northern end of John H. Tower Road northwestward to a location on Bayou Grande several hundred feet north of North Pond, where a small building was present. A small pier that extended into Bayou Grande was also present near the small building. A dark circular feature was present within a cleared area that extended along the south side of "picnic area" road for approximately 400 feet. The dark feature was located approximately 100 feet southeast of the small building near Bayou Grande.

Review of the March 9, 1981, aerial photographs indicated that no landfill activities were being conducted on the site at that time. The entire 1970s landfill area was sparsely covered with low-lying vegetation, and planted pines were present in the 1950s landfill area. In addition, a row of decommissioned waste containers (confirmed by visual inspection during performance of the site reconnaissance) was located immediately south of the southern border of the 1970s landfill area.

Review of aerial photographs subsequent to 1981 revealed no other obvious changes at the site other than the presence of vegetation on all previously disturbed areas and the construction of a small outdoor pavilion slightly within the landfill boundary at the northern end of the 1960s landfill area sometime between November 21, 1986, and October 26, 1989.

In addition to the primary areas of landfill disposal activities, several potential sources of contamination in the vicinity of Site 1 were observed on the available aerial photographs. These potential source areas include: 1) the "tar pit" located approximately 1,580 feet west of John H. Tower Road and approximately *420* feet south of "powerline" road (1970, 1973, 1976, 1981 photographs); 2) the long,

dark, linear feature located approximately 1,450 feet west of John E. Tower Road and approximately 580 feet south of "powerline" road (1970 and 1973 photographs); 3) the short, dark, linear feature located approximately 1,350 feet west of John E. Tower Road and approximately 1,000 feet south of "powerline" road (1970 photographs); and 4) the dark, irregularly shaped feature located approximately 980 feet west of John E. Tower Road and approximately 700 feet south of "poverline" road (1973 photographs). It should be noted that the review of the 1951 through 1989 aerial photographs revealed no evidence of landfill or other activities in the area encompassed by Grid B.

32 SITE RECONNAISSANCE

During the site reconnaissance, visual inspection vas made of Site 1 and surrounding areas. [Figure 3-1 presents the principal features identified from the aerial photograph analysis and the site reconnaissance.] In general, the 1960s and 1950s landfill areas and surrounding areas are thickly vegetated vith mixed pine and hardwood trees. The 1970s landfill area has been planted vith pine trees. An area within the northeastern portion of the site is covered primarily by brambles and scrub vegetation. The boundary of the entire landfill area was identified on the basis of the location of abrupt vegetation changes, debris piles, scarps, and hummocky terrain. Exposed rubble, metallic debris, and trash are sporadically exposed at the surface over the entire landfill.

The 1950s landfill area is covered with light tan quartz sand. No surface drainage features are present on this portion of the site. Low-lying areas, however, are present near the northvestern corner and along the northern boundary of the 1950s landfill area. Near the eastern boundary of this area of the landfill, adjacent to John E. Tower Road, mechanical debris and rubble are present.

An apparently unexcavated area is present adjacent to the northern boundary of the 1950s landfill area and extends northward approximately 250 feet to the southern boundary of the 1970s landfill area. Scattered planted pine trees and lov-lying vegetation cover this area. In addition, the area contains numerous piles of construction debris, rubble, and metallic rubbish. Immediately south of the 1970s landfill

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area boundary, approximately 30 empty decommissioned waste containers (dumpsters) are present in the vicinity of permanent monitoring wells GH31 and GM45 (see Figure 1-2).

The 1970s landfill area is covered by young planted pine trees in rows oriented approximately 80 degrees north of due east. Soils within this area are light tan quartz sand. Rubbish, industrial debris, and construction debris are exposed sporadically across the area. Near the southwestern corner of the 1970s landfill area, medical waste, consisting of hypodermic syringes and needles, ampules, medical tubing, and other medical materials, are exposed along with industrial rubbish

drainage features are present on the 1960s landfill area. A small, dry stream bed, however, parallels the northeastern landfill boundary and empties into the southern end of Bayou Grande Pond. The stream bed extends from an area approximately 100 feet northeast of permanent monitoring well GM03.

A picnic area is present in the area adjacent to monitoring well GM04. The picnic area is comprised of buildings 3487 and 3554, an outdoor pavilion, and a number of outdoor grilling areas.

The absence of surface drainage features on the landfill indicates that precipitation infiltrates rapidly enough to preclude surface runoff from the main area of the landfill; this effect is enhanced by the somewhat hummocky landfill terrain. In contrast, the presence of intermittent streams adjacent to the landfill suggest that infiltration rates are sufficiently low to enable surface runoff in these areas. Consequently, the apparently higher infiltration rates on the landfill relative to surrounding areas suggest that the landfill constitutes an area of enhanced recharge to the underlying surficial zone of the Sand-and-Gravel Aquifer relative to surrounding areas.

During the establishment of the survey grid system across the site and surrounding areas, four areas that exhibited evidence of potential contamination were identified on and adjacent to the landfill. The first area was an approximately **30-foot-long,** 15-foot-wide, and 2.5-foot deep "collapse-feature depression" located vithin the northwestern comer of the 1950s landfill area, approximately 1,400 feet west-southwest of the intersection of John E. Tower Road and Taylor Road and approximately 700 feet north of Taylor Road. Eeavily stained soil, a black tar-like substance, and severely rusted metal container remains were exposed in the southern wall and floor of this depression. In addition, organic vapor concentrations as high as 20 ppm above background were recorded within the depression.

The second area, an approximately 50-foot-long and 10-foot-wide shallow trench (the "tar pit") containing a black, tar-like material, was located in the northwestern portion of the 1970s landfill area approximately 1,580 feet west of John E. Tower Road and 420 feet south of "powerline" road. The exposed tar-like material in this trench is

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approximately 15 inches thick (determined during the collection of surface soil sample S005).

The third area, an apparently natural, nonrecreational, 6-foot-diameter, roughly circular pool containing rust-red water that exhibited a surface sheen, is located near the bed of the intermittent stream that empties into the southwestern end of Beaver Pond (see Figure 1-2), approximately 280 feet west and 160 feet north of permanent monitoring well GM38. The depth of the pool is greater than 3 feet.

The fourth area, a flowing spring (leachate seep) discharging rust-red discolored water which exhibited a surface sheen into the intermittent stream bed that empties into the southwestern end of the Beaver Pond, is located approximately 220 feet west and 300 feet north of permanent monitoring well GM38.

Three additional areas that exhibited evidence of contamination were identified during the collection of surface water and sediment samples from Bayou Grande Pond, North Pond, and Golf Course Pond.

The first area consists of the southern portion of Bayou Grande Pond, where orange discolored water that exhibited a surface sheen was present and observed flowing northward through the pond toward the tidal channel connecting the pond with Bayou Grande. The second area is a small flowing spring (leachate seep) which exhibited an orange discoloration of its sides and bed and empties into the northwestern side of North Pond opposite the landfill. The third area consists of the southwestern shoreline of Golf Course Pond opposite permanent monitoring well GM39, where shoreline vegetation and sediment exhibited an orange discoloration. Similar discoloration of water, sediment, and vegetation was also observed near the intermittent stream west of the landfill during the habitat/biota survey.

The red or orange discoloration observed in the above discussed areas is also commonly observed in landfill leachates and can be generally attributed to the presence of metal (primarily ferric) oxyhydroxides and/or iron bacteria. The surface sheen observed on the water bodies discussed above can probably be attributed to the presence of immiscible nonaqueous liquids that are less dense than water, such as petroleum hydrocarbons, halogenated hydrocarbons, or other organic contaminants. The reddish discoloration and surface sheens observed in

the above discussed areas suggest that migration of landfill leachate is probably introducing metal and/or organic contaminant into these areas.

It should be noted that the three additional potential contaminant source areas identified within the landfill during the aerial photograph analysis (see Section 3.2) were apparently covered over with soil materials while the landfill was still active and therefore could not be located during the site reconnaissance.

3.3 HABITAT/BIOTA SURVEY

Site 1 encompasses several discrete aquatic, wetland, and terrestrial habitat types (see Figure 3-[2]). A majority of the landfill area is covered by planted pines of various ages which provide habitat for many woodland birds, reptiles, amphibians, and small mammals. Slash pine (Pinus elliottii) is the dominant canopy species with common ragweed (Ambriosia artemisiifolia), camphorweed (Eeterothec subaxillaris), morning-glory (Ipomoea trichocarpa), Richardia sp., and goldenrod (Solidago sp.) comprising the groundcover. Northeastern portions of the landfill support sand pine scrub communities that are dominated by sand pine (Pinus clausa), longleaf pine (P. palustris), and turkey *oak* (Quercus laevis) in the canopy. Sand pine and turkey oak are subcanopy dominants, and horseveed (Conyza canadensis), saw palmetto (Serenoa repens), and young live *oak* (Q. virginiana) comprise the groundcover dominants. One small vetland habitat was identified on site. Located in the northeastern portion of Site 1, this wetland was mapped by the U.S. Fish and Vildlife Service as a scrub shrub/emergent wet land.

The northernmost boundary of the 1950s landfill area is demarcated by a row of old *oak* trees. The 1950s landfill area was partially cleared in 1988 in anticipation of extending a golf course fairvay. This golf course project was not completed; consequently, open areas, numerous dead branches, and SON downed trees were left in this area.

The remaining vegetative community is characterized by sand pine and turkey *oak.* This area provides a suitable habitat for gopher tortoises (Gopherus polyphemus), because the area includes well-drained sandy soils that facilitate burrow formation, abundant herbaceous

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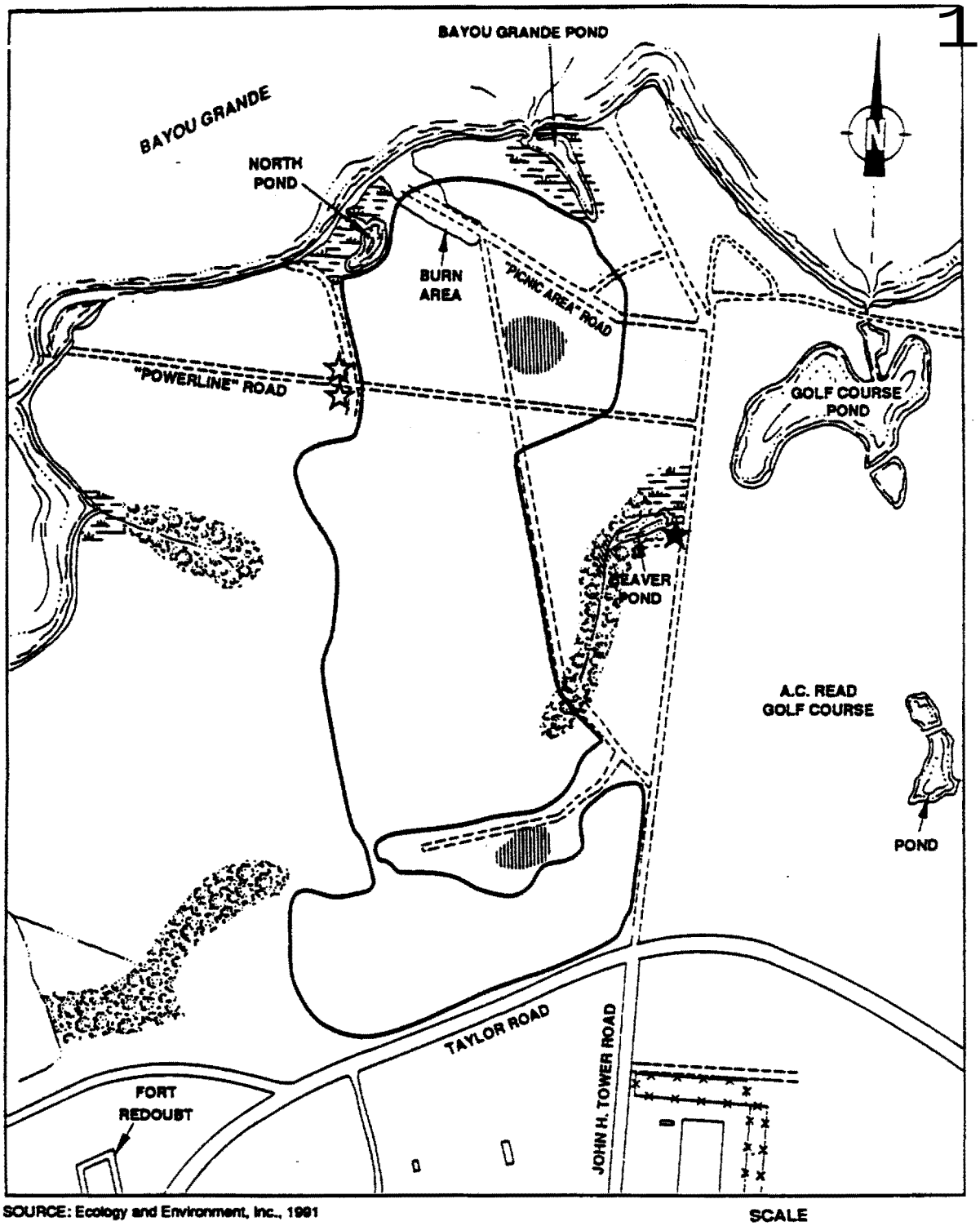

SOURCE: Ecology and Environment, Inc., 1991

SCALE
0 500 1000 FEET

KEY:
Landfill Boundary
Unpaved Road
Fence
Location Liaeopsis carolinensis
Location Polygonella macrophylla
Emergent Marsh
Forested Wetland
Scrub Shrub, Emergent Wetland

Figure 3-2 HABITAT/BIOTA MAP — NAS PENSACOLA SITE 1

groundcover, and an open canopy coupled with sparse shrub cover. One gopher tortoise vas observed in this area. The gopher tortoise is a species of special concern in Florida and is under reviev for federal protection status by the U.S. Fish and Wildlife Service.

Several sensitive areas adjacent to Site 1 vere identified and m y be affected by contaminated surface vater or groundwater discharge from the site. A natural drainagevay located east of the site (see Figure 3-[2]) has been impounded by construction of the road bordering the vest side of the golf course. An orange floc of unknown origin vas observed overlying the sediments and vegetation bases. Turtle8 vith orange-stained shells vere observed in the drainage areas. Dominant vegetation include common cattail (Typha latifolia), blue mistflover (Eupatorium coelestinum), climbing hemp-vine (Mikania scandens), and savgrass (Cladium jamaicense). Notably, approximately 30 individuals of carolina lilaeopsis (Lilaeopsis carolinensis), a federal candidate plant species, vere observed at the southern end of the pond.

Another federal candidate species, the large-leaved jointveed (Polygonella macrophylla) vas observed at tvo locations in the power line right-of-vay immediately vest of the landfill (see Figure 3-1). This species is also listed as threatened by the state of Florida.

Vater, sediment, and vegetation from a sweetbay/titi swamp vest of the landfill (see Figure 3-[2]) exhibit the saw orange discoloration as vater in the impounded drainagevay described above. Dominant vegetation include southern magnolia (Magnolia virginica), black titi (Cliftonia wnophylla), fetterbrush (Lyonia lucida), sweet gallberry (Ilex coriacea), and swamp titi (Cyrilla racemiflora).

Two brackish ponds are adjacent to the northern boundary of Site 1 (see Figure 1-2). The pond to the vest of the picnic area (North Pond) supports wetland vegetation dominated by needlerush (Juncus roemerianus) along with switchgrass (Panicum virgatum), savgrass (Cladium jamaicense), and fringe rush (Fimbrirtylis castanea). Crabs, bivalves, snails, and polychaetes comprise an active benthic community. Mollusks identified during the survey include Florida crown conch (Hclongena corona), marsh periwinkle (Littorina irrorata), olive nerite (Neretina recliva), moon snail (Polinices sp.), and Atlantic ribbed mussel (Geukensia demissa). Birds, including herons, ducks, and egrets, vere

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[Bold items enclosed in brackets denote changes to the last version of document]

found utilizing this habitat (see Appendix A). Evidence of mobile small mammals, such as raccoons, feeding in the area was observed.

Bayou Grande Pond, a brackish pond east of the picnic area, supports an emergent wetland also dominated by needlerush along with sawgrass and arrowgrass (Triglochin striata). The boundary separating the marsh from adjacent areas is well-defined by the presence of very sandy, well-drained soils supporting pine and saw palmetto. Notably, an orange discoloration is also present at the south end of the pond as a film on the water and vegetation bases. Evidence of small mammals feeding primarily on bivalves in the marsh area was observed. Mollusks identified during the survey include Florida crown conch, marsh periwinkle, olive nerite, atlantic ribbed mussel, and carolina marsh clam (Polymesoda caroliniana). A forested wetland dominated by black willow (Salix nigra) and southern magnolia (Magnolia virginiana) is located at the southwestern boundary of the emergent marsh.

A third emergent marsh is located along the margin of Bayou Grande northwest of Site 1 (see Figure 3-[2]). This marsh may also potentially receive contaminated surface water or groundwater from the site. Dominant vegetation includes needlerush, fringe rush, and switchgrass.

A wetland located southwest of the site boundary is an important adjacent habitat because of the direct exchange with Bayou Grande and also the potential to receive discharge of contaminated water from the site (see Figure 3-1). The habitat and biota survey of this area focused on the western drainage ditch flowing into Bayou Grande. Vegetation includes needlerush, marshhay cordgrass (Spartina patens), snowbush (Baccharis halimifolia), and broomsedge (Andropogon sp.). Reptiles, including cottonmouth and copperhead snakes, toads, and frogs were observed along the grassy drainageway. At the entrance to Bayou Grande, a dynamic benthic community is present as evidenced by numerous polychaete and amphipod tubes, ray feeding pits, and numerous blue crabs (Callinectes sp.). The nearshore pelagic habitat supports foraging fish species, including mullet. Birds utilizing this productive habitat include anhinga (Anhinga anhinga) and other wading and shore bird species such as ducks, teals, herons, and egrets (see Appendix A).

A scrub shrub/emergent wetland is located between the southern boundary of the landfill and the northern boundary of the 1950s

landfill area. The groundcover is dominated by blackberry (Rubus sp.), camphorweed (Pluchea rosea), flat-top goldenrod (Euthamia minor), broomsedge (Andropagon virginicus), and coinvort (Centella asiatica). The canopy consists of slash pine, and the subcanopy consists of a combination of persimmon (Diopyros virginiana), slash pine, black willow (Salix nigra), and wax myrtle (Myrica cerifera). Both the canopy and the subcanopy are sparse.

In summary, on-site habitats are primarily forested areas characterized either by slash pine or sand pine/turkey oak scrub communities. The latter provides suitable habitat for the gopher tortoise (Gophenis polyphemus), a species of special concern in Florida and under review for federal protection by the U.S. Fish and Uildlife Service. One scrub shrub/emergent wetland is located in the northeastern portion of Site 1. Adjacent sensitive features include seven wetland areas; an orange floc was observed overlying water, sediment, and vegetation bases in three of these wetlands. Two federal candidate species were observed in habitats adjacent to the site: Carolina lilaeopsis (Lilaeopsis carolinensis) in the eastern drainageway wetland and large-leaved jointweed (Polygonella macrophylla) in the poverline right-of-vay west of the site.

3.4 ASBESTOS SURVEY

[An asbestos survey was conducted at Site 1 as set forth in Section 24.) No asbestos-containing materials were identified either on Site 1 or in surrounding areas.

3s SURFACE EMISSIONS SURVEY AND PARTICULATE AIR SAMPLING

Figure 3-[3] shows the locations of elevated surface emission readings detected on site. Grid coordinates and corresponding surface emissions survey readings are presented in Appendix B. Background readings were recorded in the field logbooks.

Blevated organic vapor concentrations greater than 1.0 ppm above background were detected at five areas on the site (see Figure 3-[3]). All organic vapor concentrations observed in these areas were between 1.0 and 20 ppm above background. With the exception of the southernmost area of elevated readings observed in the 1950s landfill area, no

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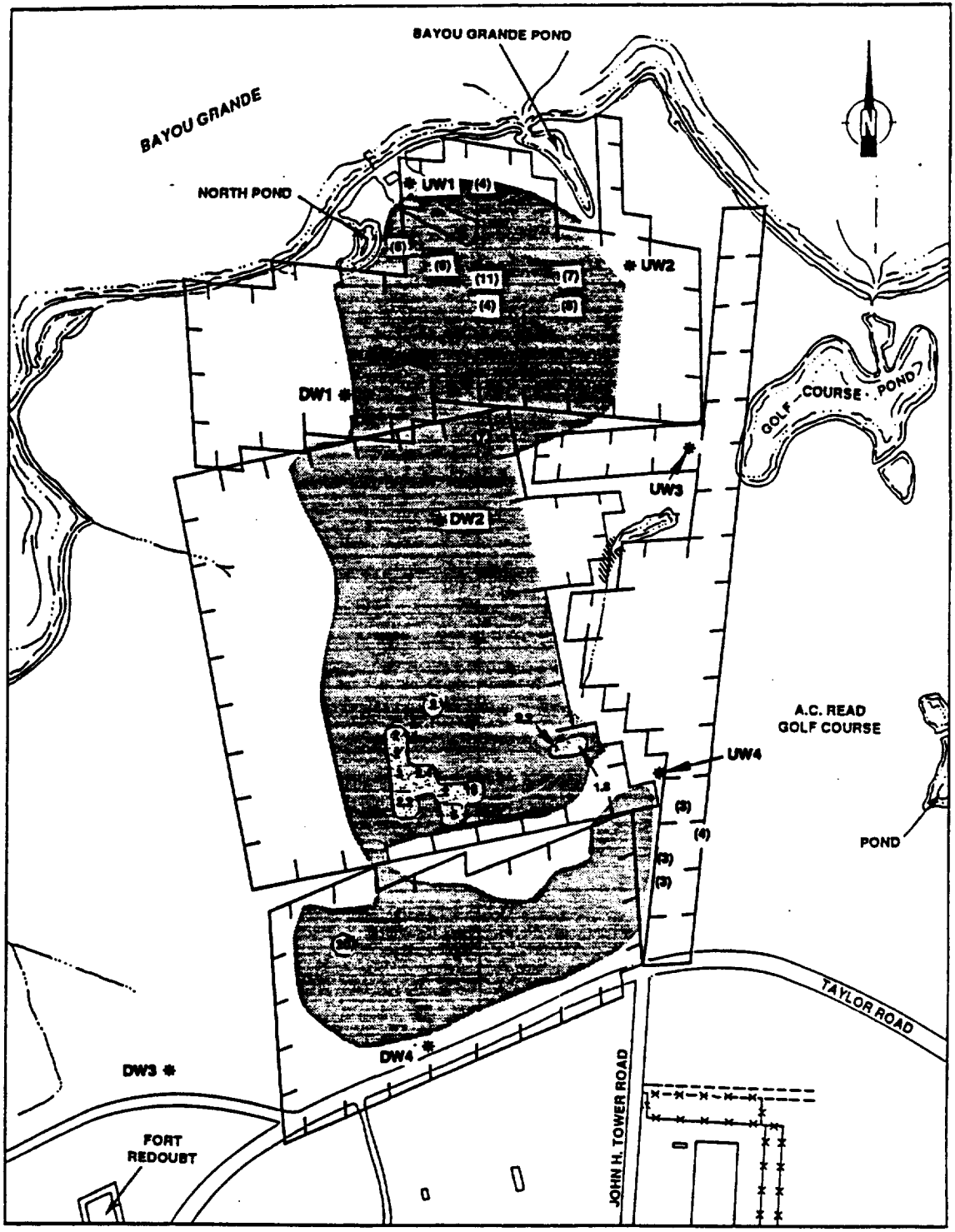

SOURCE: Ecology and Environment, Inc., 1991

KEY:

- Fence
- Geophysical Survey Grid Boundary
- Landfill Area
- (5) Gamma Radiation (uR/h) Above Background Measured at Survey Grid Points
- 3 Organic Vapor Concentration Measured at Survey Grid Points (ppm)
- Organic Vapor Emissions Greater than 1.0 ppm Above Background Observed at Survey Grid Points within Enclosed Area
- Particulate Air Sampling Location
- DW1/UW1 Particulate Air Sampling Location Number (downwind/upwind)

SCALE 0 500 1000 FEET

Figure 3-3 SURFACE EMISSIONS SURVEY, PARTICULATE AIR SAMPLING LOCATIONS, AND RADIATION SURVEY MAP — NAS PENSACOLA SITE 1

obvious, potential organic vapor sources were identified in the areas where the elevated organic vapor concentrations were measured. The remains of heavily rusted metal containers, heavily stained soils, and tar-like material are present on the surface where elevated organic vapors vere detected in the 1950s landfill area. This area is described in more detail in Section 3.7.

On November 14, 1990, a Mini-Ram particulate air monitoring device was wed to determine if Site 1 could represent a source of particulates in the air. [Figure 3-3 shows the particulate air sampling locations.] During the test, the wind was blowing-from the northeast at 2 to 5 miles per hour (aph). Airborne Particulates were measured over 15-minute intervals at eight locations in the site vicinity. Measurements were made at the following locations: 30 feet south of Bayou Grande at the picnic area located adjacent to the northeast corner of the landfill [(Urn)]; north of well GM33, at the intersection of "poverline" road and the GM33 access trail ([DW1;] see Figure 1-2); [near permanent monitoring vells GM03 and GM44, located on the northeast side of the landfill (UW2);] near permanent monitoring well GM35 [(DW2)]; near permanent monitoring well GM39 [(UW3)]; a position approximately [2,100] feet [vest-southvest] of the Taylor Road/John E. Tower Road intersection near the southvestern boundary of the landfill [(DW3)]; the vest side of John E. Tower Road 700 feet north of the Taylor Road/John E. Tover Road intersection [(UW4)]; and the north side of Taylor Road 1,000 feet west of the Taylor Road/John E. Tower Road intersection [(DW4)]. Time-veighted average (TWA) particulate concentrations measured at these eight locations vere 0.07 milligram per cubic meter (mg/m^3), 0.08 mg/m^3, 0.09 mg/m^3, 0.09 mg/m^3, 0.15 mg/m^3, 0.10 mg/m^3, 0.09 mg/m^3, and 0.08 mg/m^3, respectively. The average TWA particulate concentration measured at the [three] upvind locations was 0.[10] mg/m^3. The average TWA particulate concentrations measured at the [three] downvind locations was 0.[09] mg/m^3. Based on these measured concentrations, Site 1 does not appear to be a significant source of airborne particulates.

3.6 RADIATION SURVEY

Background [gamma] radiation levels measured at NAS Pensacola during performance of the Site 1 radiation survey were 3 to 5

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microroentgens per hour (µR/h). As shown on Figure 3-[3] (see also Appendix B), low level readings [ranging from background to 11 µR/h] were recorded across the landfill, indicating that a significant radiation problem is not present at Site 1. Slightly elevated radiation levels, ranging from 4 to 11 µR/h, were detected in the 1960s landfill area. In addition, slightly elevated radiation levels, ranging from 3 to 4 µR/h, were detected in an area adjacent to and east of the northeastern corner of the 1950s landfill area. The source of the slightly elevated radiation levels detected is unknown.

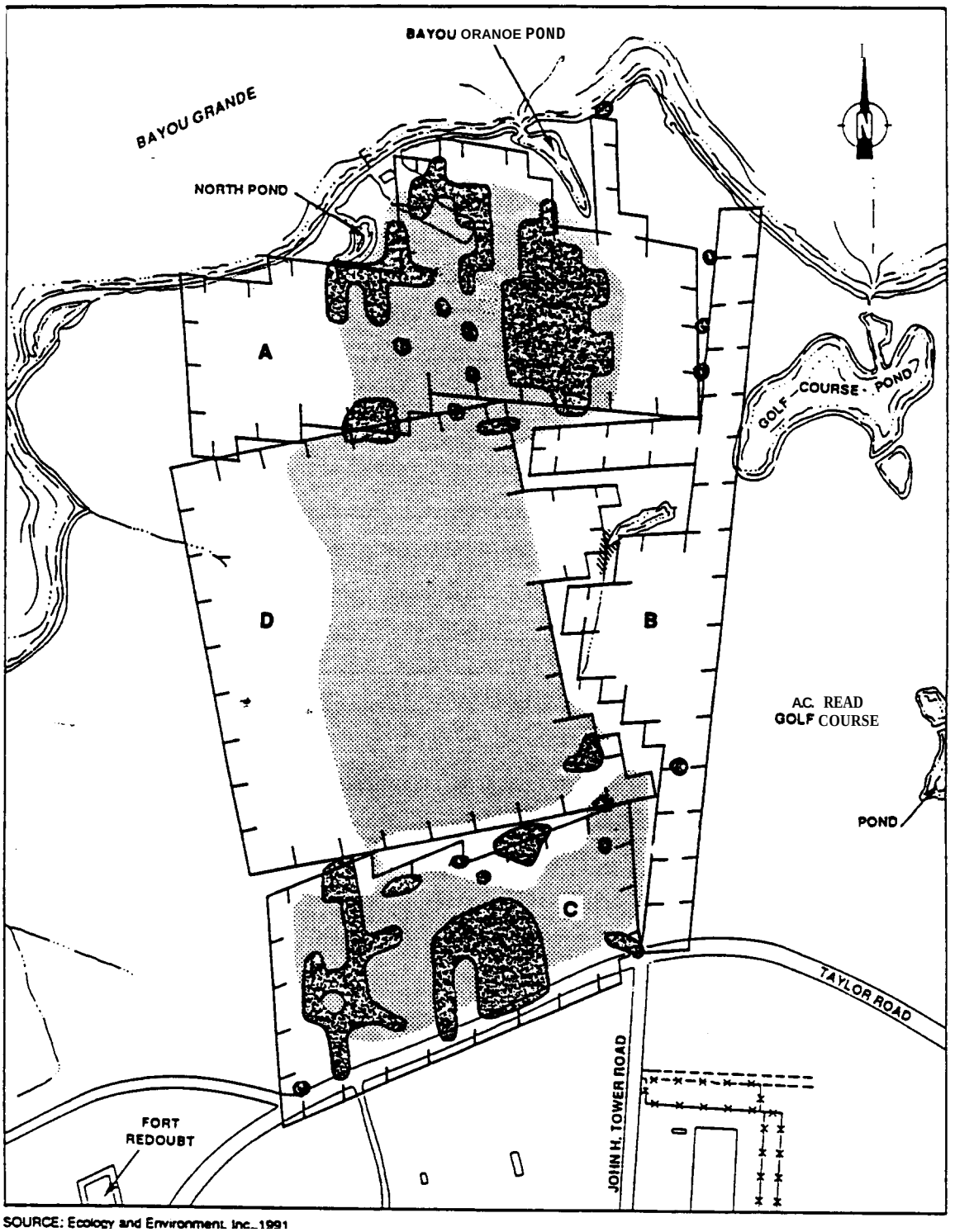
3.7 GEOPHYSICAL SURVEY

The following sections discuss the results of the metal detector, magnetometer, EH-31, and EH-34 surveys, respectively, completed across Site 1 and surrounding areas. The grid coordinates and associated readings for the metal detector survey are presented in Appendix B. The grid coordinates and associated readings for the magnetometer, EM-31, and EH-34 surveys are presented in Appendix C. The geophysical survey grid system is illustrated on Figure 2-1.

Overall, the results of the geophysical survey indicate that buried ferrometallic materials are present at shallow depths (generally less than 10 to 15 feet BLS) across most of the landfill. Primarily, anomalous readings for each of the four geophysical survey types are concentrated within the boundaries of the landfill as identified by the aerial photograph analysis and site reconaissance. However, the EH-31 and/or EM-34 surveys detected anomalously high electromagnetic conductances east, west, and north of the landfill. These anomalies could reflect leachate migration from the landfill.

3.7.1 Metal Detector Survey

Figure 3-[4] presents the results of the metal detector survey across Site 1 and surrounding areas. Large areas of buried ferrometallic materials were identified across the 1950s and 1960s landfill areas. In contrast, the metal detector survey revealed very little buried ferrometallic material in the 1970s landfill area. Eowever, based on the results of the magnetometer and EM-31 and EM-34 surveys discussed below, such buried materials are apparently also



SOURCE: Ecology and Environment, Inc., 1991

SCALE
0 500 1000 FEET

KEY:

Fence

Geophysical Survey Grid Boundary

Unpaved Road

Landfill Area

Positive Metal Detector Response Observed at Survey Grid Points Within Enclosed Area

Figure 3-4 METAL DETECTOR SURVEY MAP — NAS PENSACOLA SITE 1

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present in this area, but at depths below the effective exploration depth of the metal detector (2 to 3 feet BLS). It should be noted that metal debris was evident on the surfaces of the 1950s and 1960s landfill areas, but not on the surface of the 1970s landfill area.

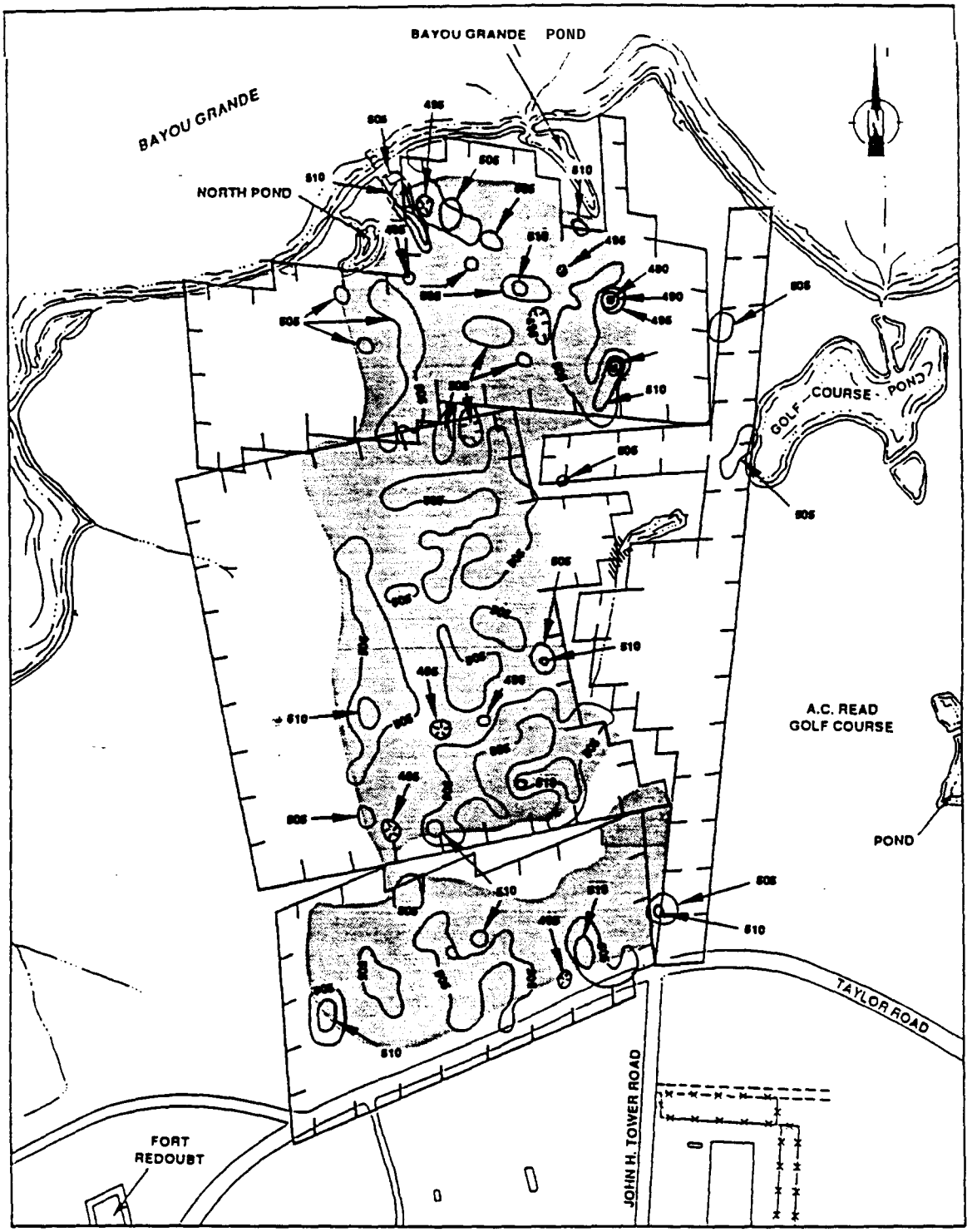
As indicated on Figure 3-[4], positive metal detector responses were recorded in the apparently unexcavated area between the 1950s and 1970s landfill areas. These positive responses most likely reflect the presence of ferrometallic materials in the debris piles located within this area. The generally isolated positive metal detector responses recorded outside the landfill boundary along Taylor Road and John E. Tower Road most likely reflect the presence of underground utilities and/or high voltage overhead powerlines (along John E. Tower Road), rather than buried debris. [One] isolated positive response [was recorded adjacent to] Bayou Grande, northeast of the landfill. [This response vas attributed to metal debris observed in the area and is not associated with the landfill.)

3.7.2 Magnetometer Survey

Figure 3-[5] shows the contoured total magnetic field values (in units of gammas x 100) observed across Site 1 and surrounding areas. Numerous moderate [(500 to 1,000 gammas)] to strong [(1,000 gammas or greater)] positive and negative magnetic anomalies (relative to the regional ambient total magnetic field strength of approximately 50,000 gammas) are generally uniformly distributed over most of the landfill, indicating that significant amounts of buried ferrometallic material are uniformly distributed within the boundaries of the site. A linear, moderately strong positive magnetic anomaly was recorded adjacent to Golf Course Pond and extending southwest toward Beaver Pond. This linear anomaly probably represents the previous location of an abandoned drainfield reported to have been present in this area. Several additional isolated positive magnetic anomalies recorded adjacent to the landfill probably represent isolated buried ferrometallic objects.

3.7.3 EM-31 Survey

Figures 3-[6] and 3-[7] summarize the results of the EM-31 survey across Site 1 and surrounding areas. [Background EM-31 readings



SOURCE: Ecology and Environment, Inc., 1991

KEY:

- Fence
- Geophysical Survey Grid Boundary
- Unpaved Road
- Landfill Area
- —500— Total Magnetic Field Isopleth (gammas x 100)
- Area of Lower Total Magnetic Field Values

Figure 3-5 MAGNETOMETER SURVEY MAP, TOTAL MAGNETIC FIELD — NAS PENSACOLA SITE 1

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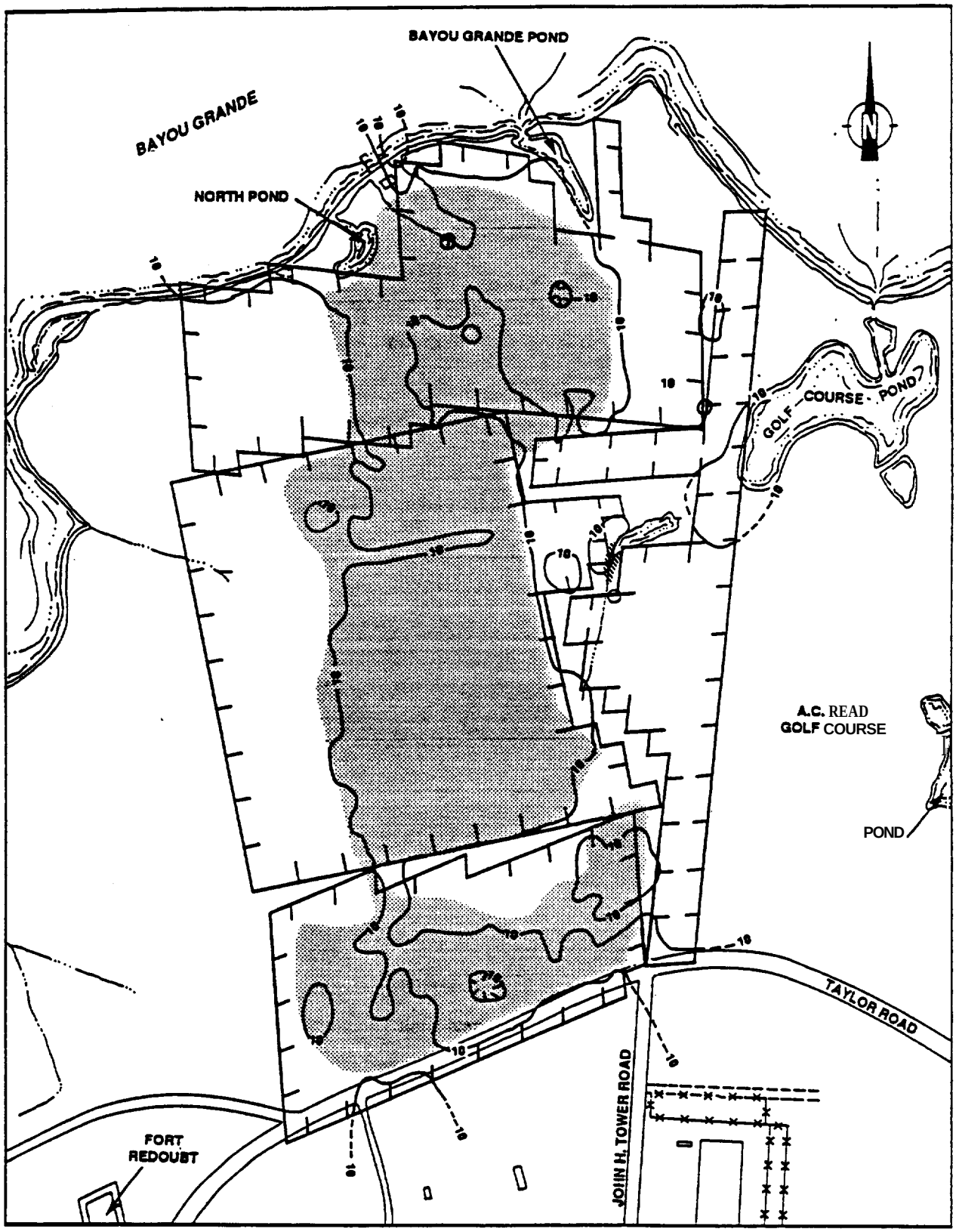


SOURCE: Ecology and Environment, Inc., 1991

KEY:

Fence

Unpaved Road

Landfill Area

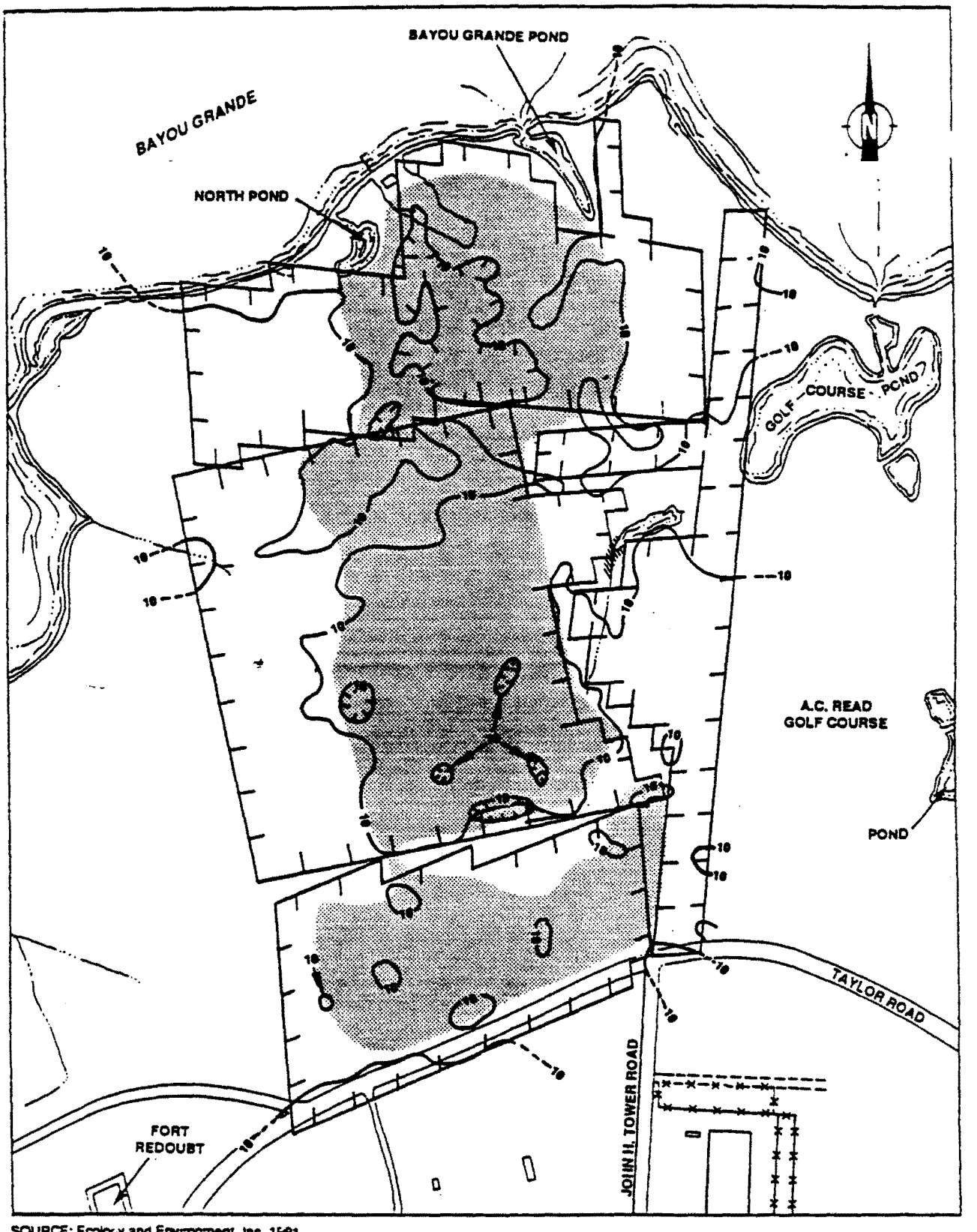
Geophysical Survey Grid Boundary

10 Electromagnetic Conductivity Isopleth (millimhos/meter)

SCALE

0 500 1000 FEET

Figure 3 6 EM-31 SURVEY MAP, HORIZONTAL COPLANAR MODE — NAS PENSACOLA **SITE 1**



SOURCE: Ecology and Environment, Inc., 1991

KEY:

- Fence
- Geophysical Survey Grid Boundary
- Unpaved Road
- Landfill Area
- 10 — Electromagnetic Conductivity Isopleth (millimhos/meter)
- Area of Lower EM-31 Values

SCALE 0 500 1000 FEET

Figure 3-7 EM-31 SURVEY MAP, VERTICAL COPLANAR MODE —NAS PENSACOLA SITE 1

recorded at the site ranged from 4 to 7 millimhos per meter (mmhos/m).] Figure 3-[7] identifies areas where anomalous (>10 mmhos/m) electromagnetic conductances were recorded in the horizontal coplanar mode (exploration depth approximately 3 meters [9.8 feet]). Figure 3-[7] identifies areas where such anomalous readings were recorded in the vertical coplanar mode (exploration depth approximately 6 meters (19.7 feet]). Detailed maps of the EM-31 survey results are presented in Appendix C.

As shown on figures 3-[6] and 3-[7], areas of anomalous electromagnetic conductance uniformly occur within the boundaries of the landfill. Within the landfill, the highest readings were generally obtained in areas where metal detector and/or magnetometer anomalies were also recorded (see appendices B and C). Consequently, the anomalous EM-31 readings within the landfill appear to be primarily associated with the presence of buried ferrometallic materials. In general, the magnitude and frequency of higher electromagnetic conductance readings within the landfill are much greater in the horizontal coplanar mode than in the vertical coplanar mode (see Appendix C). This occurrence indicates that the the depth of burial lies between the exploration depths of these two EM-31 survey modes (9.8 and 19.7 feet, respectively) and is probably between 10 and 15 feet BLS. Anomalous EM-31 readings were also recorded along the shoreline of Bayou Grande west and northeast of North Pond; between the 1970s landfill area and the southwestern end of Beaver Pond; between the northeastern end of Beaver Pond and Golf Course Pond; in three areas west of the 1970s landfill area; near the southwestern corner of the 1950s landfill area south of the landfill boundary along Taylor Road; and adjacent to and east of John E. Tower Road. The high EM-31 readings along Bayou Grande probably reflect intrusion of saline water.

The anomalies observed in the area between the 1970s landfill area and Beaver Pond and in the area between Beaver Pond and Golf Course Pond may be attributable to leachate migration eastward from the landfill. Alternatively, these anomalies may also reflect the presence of an abandoned drainfield reportedly located somewhere in the area between the landfill and Golf Course Pond. The potential presence of the abandoned drainfield is supported by the linear magnetic anomaly

detected between Beaver Pond and Golf Course Pond (see Section 3.7.2). However, the broader extent of this area of anomalous electromagnetic conductance revealed by the deeper vertical coplanar mode survey supports the probability of leachate migration.

The westernmost of the three anomalous En-31 reading areas west of the 1970s landfill area was detected only in the shallower horizontal coplanar mode survey and is coincident vith the head of an intermittent stream that extends westward to Bayou Grande. The remaining anomalous areas observed along Taylor Road and John E. Tower Road and east of John E. Tower Road generally coincide with areas where positive metal detector responses or magnetic anomalies were observed. Elevated electromagnetic conductances observed in these areas *can* probably be attributed to the presence of subsurface utilities. The remaining tvo anomalous areas extend immediately vestvard of the landfill boundary and are most clearly evidenced on the deeper vertical coplanar mode survey. These areas could reflect leachate migration from the 1970s landfill area.

3.7.4 EM-34 Survey

The effective exploration depths of the En-34 horizontal coplanar d e 10 meter and 20 meter intercoil spacing surveys are approximately 7.5 meters (24.6 feet) and 15 meters (49.2 feet), respectively. Detailed maps of the En-34 survey results are presented in Appendix C.

The results of the EM-34 10-meter and 20-meter spacing surveys generally agree vith the results of the En-31 surveys. Anomalous readings are concentrated within the boundaries of the landfill and generally exhibit a continued decrease in magnitude and frequency as the depth of exploration increases and thereby encompasses a larger column of undisturbed subsurface materials. Anomalous areas outside the landfill generally appear to reflect the influence of underground or overhead utilities or the intrusion of saline waters from Bayou Grande. However, zones of En-34 20-meter spacing elevated conductances located north and east of the landfill and, in particular, in an area trending northwest from the southern end of the 1970s landfill area (see Appendix C) may be attributable to leachate migration from the landfill toward Bayou Grande in the deeper portions of the surficial zone of the Sand-

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and-Gravel Aquifer. Alternatively, these zones could also reflect saline water intrusion (northern area) and/or the presence of more highly conductive lithologies (silts and clays) present below the base of the surficial zone in the NAS Pensacola area (eastern and western areas).

3.8 HYDROLOGIC ASSESSMENT

3.8.1 Shallow Subsurface Lithology

Based on information collected during the installation of 28 temporary monitoring wells, the shallow subsurface lithology in the vicinity of Site 1 can be characterized as an off-white to yellow, reddish-brown to brown, fine- to coarse-grained quartz sand that becomes an off-white to dark brown, fine- to coarse-grained quartz sand near the water table and decreases in grain size toward the south. During the installation of temporary monitoring well TW019 near the northwestern corner of the 1950s landfill area, a gray, clayey sand was encountered from 1 to 6 feet BLS. A black, silty, very fine- to medium-grained sand was encountered from 8.5 to 18.5 feet BLS during the installation of temporary monitoring well TW020 near the east-central edge of the 1950s landfill area. The lithologic logs for the 28 temporary monitoring wells installed at Site 1 are presented in Appendix D. [OVA readings taken in the open borehole during drilling ranged from 0 to 400 ppm. The OVA readings for the boreholes are also presented in Appendix D.]

3.8.2 Water Levels and Groundwater/Surface Water Flow

Tables 3-1, 3-2, and 3-3 list the water level elevations measured in the temporary monitoring wells, permanent monitoring wells, and surface water bodies, respectively, in the vicinity of Site 1. The depth to the water table in the site vicinity generally varies from approximately 18 feet BLS in topographically higher areas (i.e., near the southern half of the 1950s landfill area and east-northeast of the 1960s landfill area) to less than 1.0 foot BLS in topographically lower areas (i.e., in the vicinity of Bayou Grande). Water levels (potentiometric surfaces) measured in the three permanent deep monitoring wells (GM43, GM44, and GM45) completed in the upper portion of the main producing zone of the Sand-and-Gravel Aquifer range from

Table 3-1

TEMPORARY MONITORING WELL CONSTRUCTION INFORMATION
AND WATER LEVEL ELEVATIONS
NAS PENSACOLA SITE 1

Well Number	Total Depth (BLS)	Depth to Water (BLS)	Depth to Water BTOC	TOC Elevation	Water Level Elevation	Date Measured
TW001	18.5	0.39	11.30	15.37	4.07	1/19/91
m 0 2	10.5	9.60	11.59	16.00	4.41	1/17/91
TW004	10.23	6.73	11.50	13.61	2.11	1/17/91
TW005	10.26	6.66	11.40	13.00	2.40	1/17/91
TW006	6.79	2.41	5.62	0.15	2.53	1/17/91
TW007	10.68	12.30	16.62	10.03	2.21	1/16/91
m 0 0	14.55	15.06	16.31	10.06	1.75	1/20/91
TW009	--	--	16.22	--	--	1/16/91
TW010	7.93	--	5.90	7.24	1.34	1/18/91
TW011	11.08	7.03	11.75	16.61	4.06	1/18/91
TW012	10.06	7.04	11.10	22.92	11.74	1/19/91
TW013	15.95	12.05	16.10	30.17	14.07	1/19/91
TW014	15.00	12.40	12.40	26.36	13.96	1/16/91
TW015	22.07	17.63	20.56	34.29	13.73	1/16/91
TW016	19.18	15.56	16.38	29.04	13.46	1/16/91
TW017	18.83	15.00	16.17	20.56	12.39	1/17/91
TW018	0.27	4.77	6.50	10.50	12.00	1/17/91
TW019	9.50	5.01	6.31	10.70	12.39	1/17/91
m 2 0	16.22	13.42	17.20	30.52	13.32	1/20/91
TW021	11.06	7.21	11.15	21.99	10.04	1/18/91
TW022	11.04	7.49	10.65	21.92	11.27	1/18/91

14[NASP]UH6017:T0260/254/22

Key at end of table.

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changes to the last v[illegible] of document]

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Table 3-1 (Cont.)

Well Number	Total Depth (BLS)	Depth to Water (BLS)	Depth to Water BTOC	TOC Elevation	Water Level Elevation	Date Measured
TW023	**11.88**	7.73	10.85	22.64	11.79	1/18/91
TW024	12.92	9.37	11.45	**18.44**	6.99	1/20/91
TW025	11.73	8.18	11.45	20.17	0.72	1/18/91
TW026	12.91	6.92	11.01	17.34	6.33	1/20/91
TW027	11.47	0.06	11.59	19.45	7.06	1/19/91
TW028	11.99	6.24	11.25	17.50	6.33	1/16/91
TW029	11.94	0.29	11.35	21.46	**10.11**	1/16/91

14[NASP]UH6017:T0260/254/22

Note:

All dopthr are in foot.
All elevations are in foot referenced to moan sea level (MSL).
All wells were constructed of 2-inch diameter stainless stool with 5 foot of 0.01-inch screen.

Key:

Dash (--) indicates data not available.

Source: Ecology and Environment, Inc., 1991.

[Bold items enclosed in brackets denote changes to tho last version of document]

Table 3-2

PERMANENT MONITORING WELL CONSTRUCTION INFORMATION AND WATER LEVEL ELEVATIONS NAS PENSACOLA SITE 1

Well Number	Total Depth (BLS)	Depth to Water (BLS)	Depth to Water BTOC	Top of Casing Elevation	Water Level Elevation	Date Measured
GM03	19.34	14.68	16.55	20.57	4.02	2/26/91
GM04	18.25	8.47	9.98	11.71	1.73	2/26/91
GM05	12.52	5.17	6.26	8.49	2.23	2/26/91
GM31	12.78	2.76	4.51	20.85	16.34	2/26/91
am2	12.63	2.99	4.40	19.71	15.31	2/26/91
GM33	12.94	4.28	5.98	15.70	9.72	2/26/91
GM34	12.55	4.39	5.70	16.51	10.81	2/26/91
GM35	12.69	4.35	5.86	16.51	10.65	2/26/91
am8	17.69	6.76	9.52	20.86	11.34	2/26/91
GM39	17.74	1.24	3.91	8.47	4.56	2/26/91
GM40	17.75	10.07	12.95	14.68	1.73	2/26/91
GM41	17.90	0.07	4.35	5.78	1.43	2/26/91
GM42	17.82	9.02	11.08	15.56	4.48	2/26/91
GM43	69.51	3.01	5.66	9.35	3.69	2/26/91
GM44	60.42	15.81	18.68	21.37	2.69	2/26/91
GM45	107.0.	15.21	17.08	20.82	3.74	2/26/91

14[NASP]UN6017:T0260/464/16

Note:

All depths are in foot.
All elevations are in feet referenced to mean sea level (MSL).

Key:

*Value from Geraghty and Miller, 1906.

Source: Ecology and Environment, Inc., 1991.

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[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-3

SURFACE WATER LEVEL ELEVATIONS
NAS PENSACOLA SITE 1

Location	Water Level (feet)	Date
Bayou Grande	0.23	2/26/91
	--	3/12/91
Bayou Grande Pond	1.96	2/26/91
	2.00 H	3/12/91
	2.00 L	3/12/91
Beaver Pond	4.62	2/20/91
	4.53 H	3/12/91
	4.53 L	3/12/91
Golf Course Pond	0.72	2/26/91
	1.23 H	3/12/91
	0.67 L	3/12/91
north Pond	1.04	2/26/91
	1.71 H	3/12/91
	1.08 L	3/12/91

14[NASP]UH6017:T0260/463/29

Note: All elevations are in foot referenced to roan sea level (MSL).

Key:

Dash (--) indicator data not available.

H indicator measurement made at high tide.

L indicator measurement made at low tide.

Source: Ecology and Environment, Inc., 1991.

[Bold items enclosed in brackets denote changes to tho last version of document]

approximately 3 feet BLS (vell GM43; northvest comer of landfill) to 15 to 16 feet BLS (vells GM44 and GM45; northeast corner of landfill and southern end of the 1970s landfill area, respectively).

Figure 3-[8] illustrates the temporary vell vater level elevations measured January 16 through 20, 1991, and the corresponding groundvater flov directions in the upper portion of the surficial zone of the Sand-and-Gravel Aquifer at Site 1. Figure 3-(9) illustrates the permanent vell water level elevations measured February 26, 1991, and the corresponding groundvater flov directions for this zone based on both the vell vater level elevations and the surface vater elevations measured on the same date. Figure 3-(9) also shovs the vater level elevations for the three permanent deep vells in the site vicinity (GM43, GM44, and GM45).

Figures 3-(8) and 3-(9) both indicate that shallov groundvater flov within the landfill is to the north-northvest tovard North Pond, Bayou Grande Pond, and Bayou Grande, approximately parallel to the longitudinal axis of the landfill. Both figures also indicate the presence of distinct northeasterly and northwesterly shallov groundvater flov components tovard Bayou Grande avay from the longitudinal axis of the landfill. The figures also indicate the presence of an easterly shallov groundvater flov component tovard Beaver Pond and Golf Course Pond. Average horizontal hydraulic gradients are approximately 0.003 based on the temporary vell data and approximately 0.006 based on the permanent vell data. All of these results are generally consistent vith those previously reported by Geraghty and Hiller (G & M 1986).

Based on the vater level elevations in the three permanent deep vells in the site vicinity (GM43, GM44, and GM45; see Figure 3-[9] and Table 3-21, groundvater flov in the upper portion of the main producing zone of the Sand-and-Gravel Aquifer appears to be to the north-northeast tovard Bayou Grande, with a very flat (<0.001) horizontal hydraulic gradient. G & M (1986) previously reported a southerly flov direction in this zone. However, no final conclusion regarding the groundvater flov direction in the upper portion of the main producing zone is possible given the limited data base of only three vells, the large area covered by these vells, and the much deeper completion depth of vell

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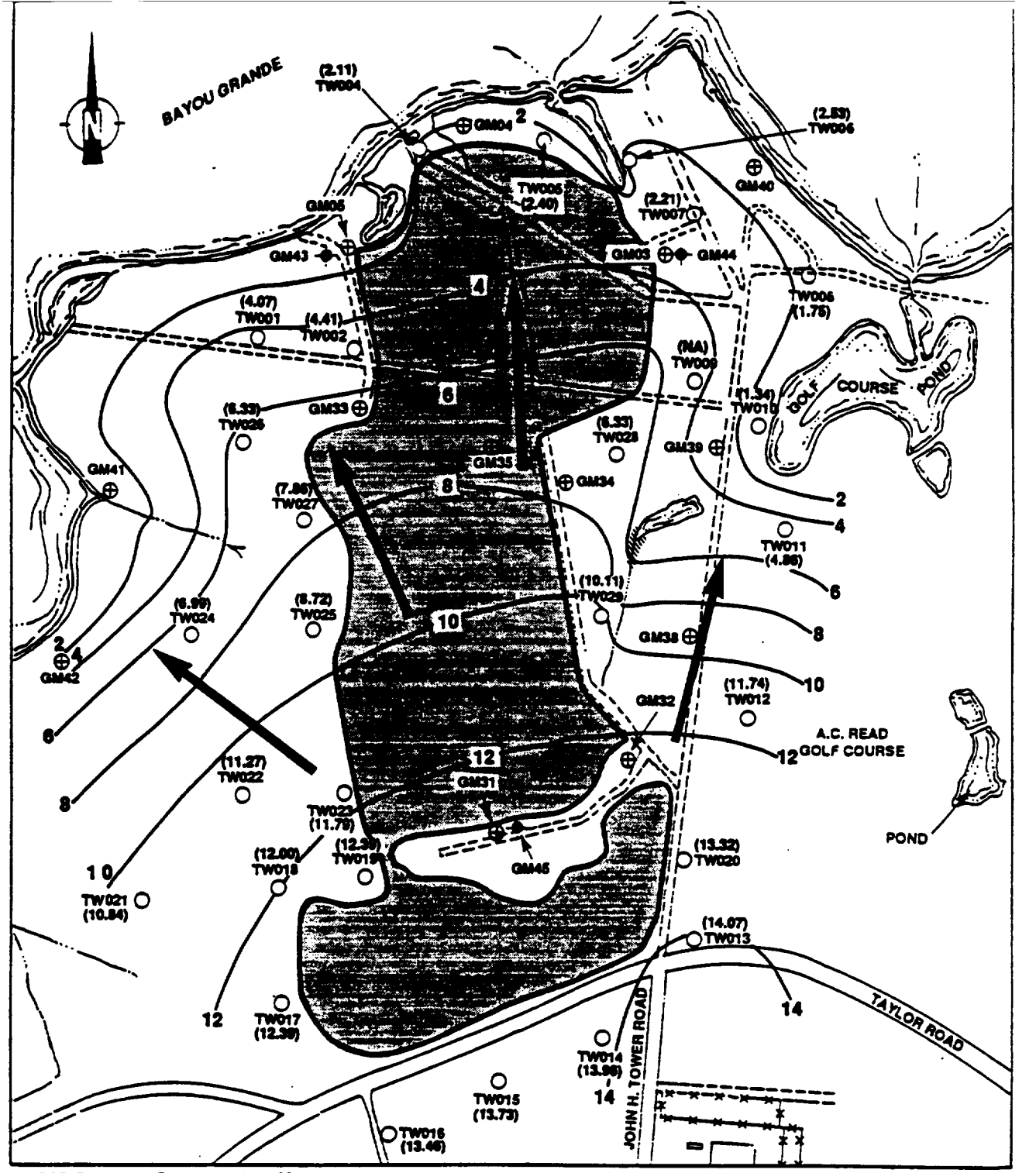


SOURCE: Ecology and Environment, Inc., 1991

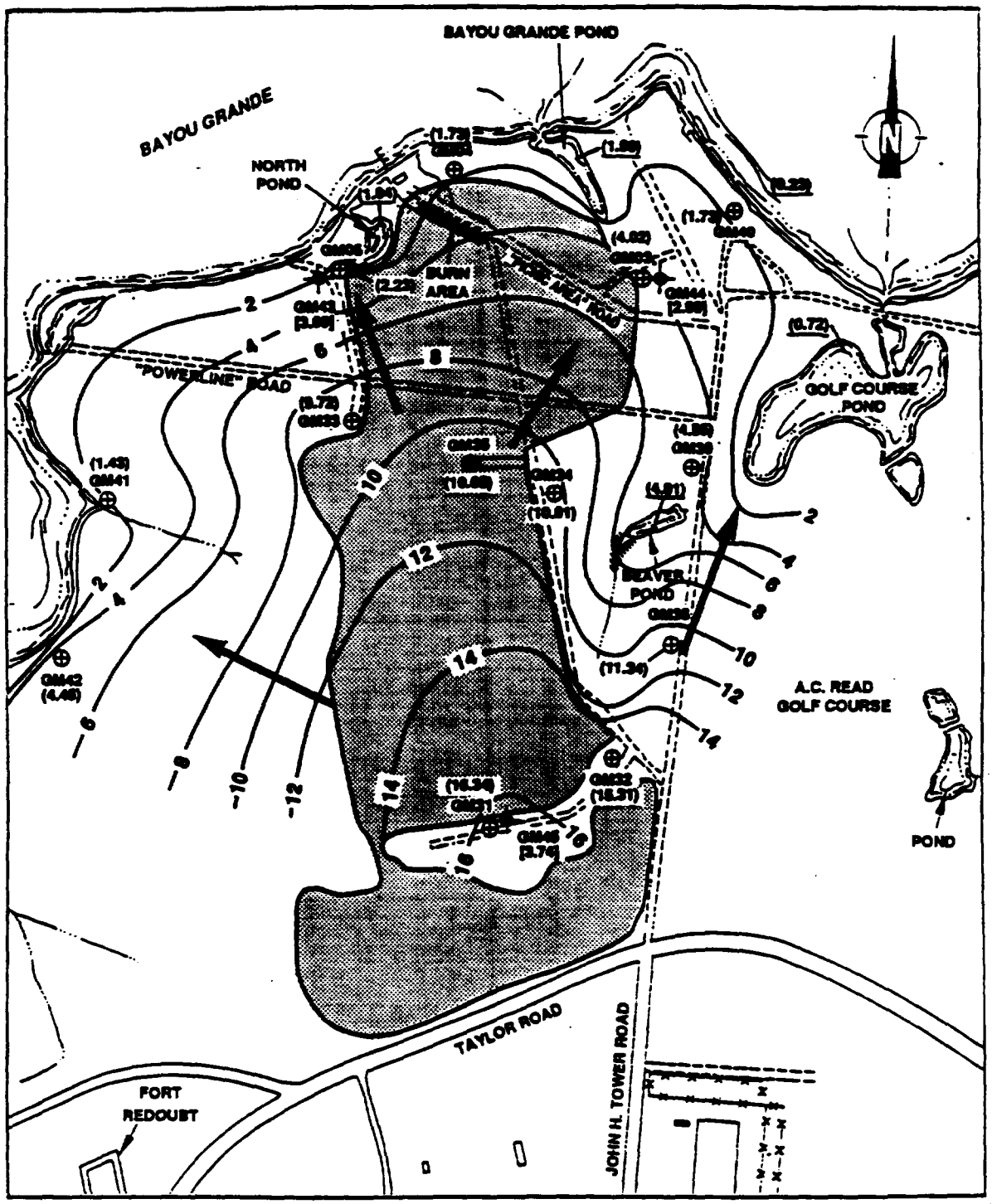
SCALE

0 500 1000 FEET

KEY:

- Landfill Boundary
- Unpaved Road
- Fence
- Permanent Shallow Monitoring Well
- Permanent Deep Monitoring Well
- Temporary Monitoring Well
- (13.73) Water Level Elevation (feet above MSL)
- (NA) Water Level Elevation Data Not Available
- 10 Water Level Elevation Isopleth (feet above MSL)
- Inferred Direction of Groundwater Flow

Figure 3-8 SURFICIAL ZONE WATER LEVEL ELEVATIONS FOR TEMPORARY MONITORING WELLS (MEASURED JANUARY 16-20, 1991) — NAS PENSACOLA SITE 1



SOURCE: Ecology and Environment, Inc., 1991

SCALE
0 500 1000 FEET

KEY:

- Landfill Area
- Unpaved Road
- Fence
- Existing Shallow Monitoring Wel
- Existing Deep Monitoring Well
- Inferred Direction of Groundwater Flow
- 10 Surficial Zone Water Level Elevation Isopleth (feet above MSL)
- (1.98) Surficial Zone Water Level Elevation (feet above MSL)
- [3.88] Main Producing Zone Water Level Elevation (feet above MSL)
- (0.72) Surface Water Body Water Level Elevation (feet above MSL)

Figure 3-9 WATER LEVEL ELEVATIONS FOR PERMANENT MONITORING WELLS AND SURFACE WATER BODIES (MEASURED FEBRUARY 26, 1991) — NAS PENSACOLA SITE 1

0000926

GH45 (107 feet BLS) compared to the depths of wells GH43 and GM44 (60 to 70 feet BLS).

As indicated on Figure 3-[9] and Table 3-2, downward vertical hydraulic gradients from the surficial zone to the main producing zone of the Sand-and-Gravel Aquifer may be present across most of the Site 1 area. Shallow and deep well clusters GM03/GM44 and GM31/GM45 both exhibit higher water level elevations in the shallow wells (1.33 above mean sea level [MSL] and 12.6 feet above MSL, respectively), although cluster GM05/GM43 exhibits a higher water level elevation in the deeper well (1.46 feet above HSL). The presence of an apparent upward hydraulic gradient at well cluster GM05/GM43 probably reflects discharge of shallow groundwater into nearby Bayou Grande. This conclusion is consistent with the steeper downward hydraulic gradient exhibited by well cluster GM31/GM45, which is located further away from Bayou Grande, although the much deeper completion depth of well GM45 (107 feet BLS) must be considered an unknown variable.

Table 3-3 presents the water level elevations measured in the five surface water bodies adjacent to Site 1 on February 26, 1991, and March 12, 1991. The high tide and the low tide water level elevations measured on March 12, 1991, indicate that Golf Course Pond and North Pond are tidally influenced, but Bayou Grande Pond and Beaver Pond are not. Eowever, given that Bayou Grande Pond contains brackish water, this pond is probably also tidally influenced at higher tide levels.

The direction of surface water flow at high tide and at low tide was observed on March 12, 1991, in tidal channels connecting Bayou Grande Pond, Golf Course Pond, and North Pond with Bayou Grande. During high tide, surface water flow from each of these ponds was observed entering Bayou Grande. During low tide, surface water was observed flowing from Bayou Grande into North Pond and Golf Course Pond, but no surface water was observed flowing from Bayou Grande into Bayou Grande Pond. Eowever, Bayou Grande water probably also flows into Bayou Grande Pond at higher tide levels. North Pond, Golf Course Pond, and Bayou Grande Pond contain brackish waters representing a mixture of saline Bayou Grande water and discharged surficial zone groundwater. Beaver Pond appears to contain only discharged surficial zone groundwater.

3.9 CHEMICAL ANALYSES

[The following section presents the results of the laboratory analyses of the surface vater, sediment, soil, and groundvater samples. The specific analytical parameters and parameter groups are listed or referenced in Table 2-2.]

3.9.1 Surface Water

Table 3-4 summarizes the analytical screening results for surface water samples collected at Site 1. Figure 3-(10) shovs the locations of the surface water samples collected at the site. The complete analytical screening results for surface water samples are presented in Appendix B.

In general, only low concentrations of tw metals (chromium and zinc) and one volatile organic compound (VOC; chlorobenzene) vere detected in any of the surface water samples collected at Site 1. Eovever, based on the analytical results for groundvater samples collected from the on-site permanent monitoring wells (see Section 3.9.4.3) and the orange discoloration observed in the site vicinity surface water bodies (see sections 3.2 and 3.3), elevated concentrations of two other metals (iron and manganese) may also be present in the surface vaters near Site 1. Chlorobenzene was detected only in the samples from North Pond. Total recoverable petroleum hydrocarbons (TRPHs), phenols, pesticides, and polychlorinated biphenyls (PCBs) were not detected in any of the surface vater samples.

3.9.1.1 Metals

As shown on Figure 3-(lo], low levels of zinc (≤ 100 micrograms per liter [µg/L]) vere detected in all surface vater samples with the exception of samples SW003 and SW005, collected from Bayou Grande, and samples SW014 and SW015, collected from Golf Course Pond. All of the samples collected from Bayou Grande, North Pond, Bayou Grande Pond, and Golf Course Pond exhibited zinc concentrations well belov the Florida Department of Environmental Regulation (FDER) Class III Surface Uater Quality Standard (Marine) of 1,000 µg/L (Chapter 17-302, Florida Administrative Code [FAC]). Bovever, the tvo surface vater samples collected in and upstream of Beaver Pond (SW009 and SW010, respectively)

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Table 3-4

SUMMARY ANALYTICAL SCREENING RESULTS FOR SURFACE WATER SAMPLES
NAS PENSACOLA SITE 1
(All results in µg/L)

Parameter	[Detection Limit	Sample Number (Location)							
		P01SW001 (SW001)	P01SW003 (SW003)	P01SW005 (SW005)	P01SW006 (SW006)	P01SW007 (SW007)	P01SW008 (SW008)	P01SW009 (SW009)	[FSWS
Chromium	**10**	--	--	--	13	34	--	**18**	**50**
Zinc	**20**	**20**	--	--	100	34	38	**43**	**30]**
Chlorobenzene	**5]**	--	--	--	--	--	--	--	

14[NASP]UH6017:T0260/248/0

Key at end of table.

[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-4 (Cont.)

Parameter	[Detection Limit	Sample Number (Location)							
		P01SW010 (SW010)	P01SW011 (SW011)	P01SW012 (SW012)	P01SW012D[a] (SW012)	P01SW013 (SW013)	P01SW014 (SW014)	P01SW015 (SW015)	[FSWS
Chrorium	10	23	--	--	21	--	--	--	50
Zinc	20	35	48	21	21	22	--	--	30]
Chlorobenzene	5]	--	14	26	22	--	--	--	

14[NASP]UM6017:T0260/240/0

Key :

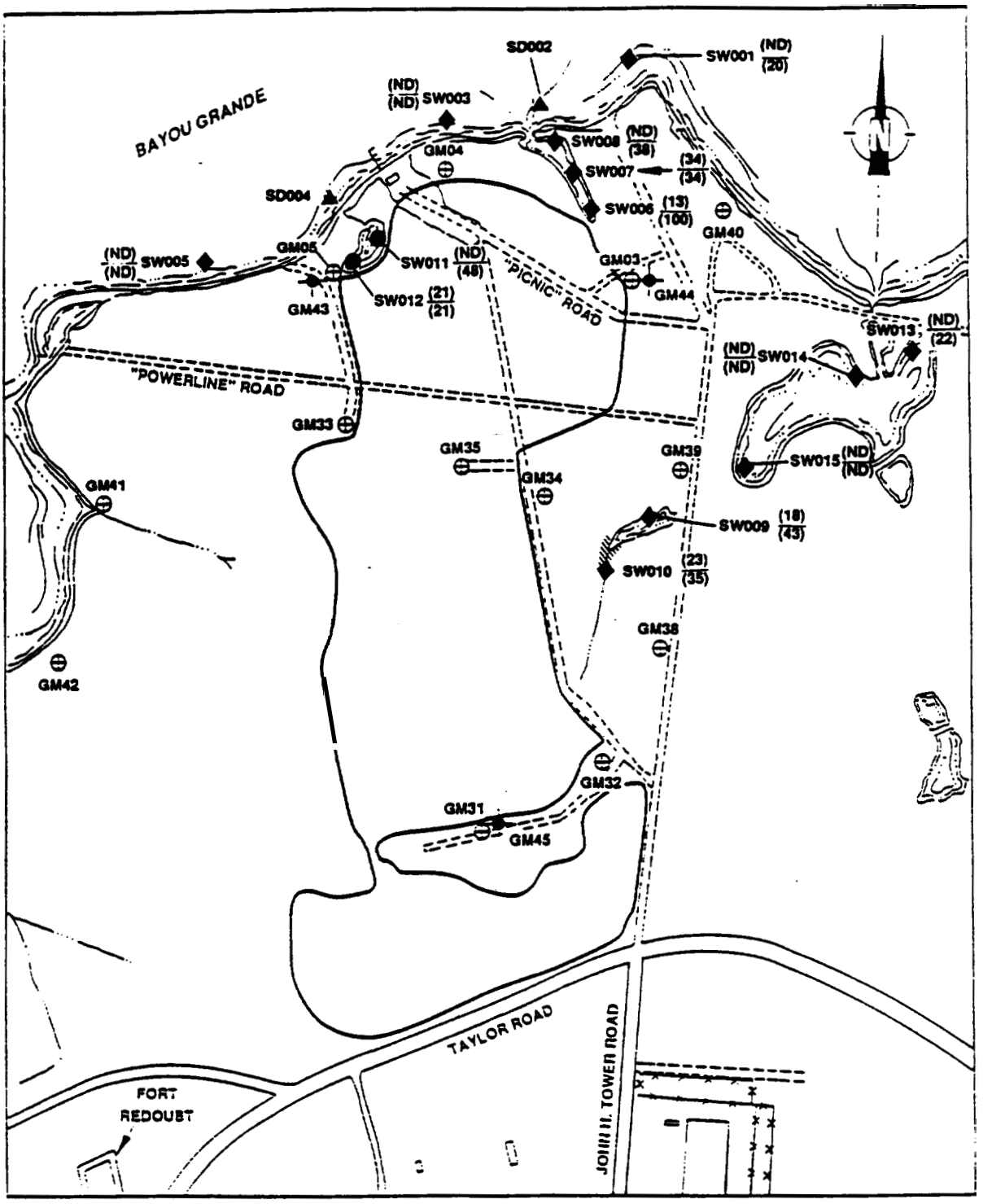
[a]Duplicate of sample P01SW012.

[FSWS = Florida Class III Fresh Surface Water Standard.]

Dash (--) indicates compound not detected.

Source: Ecology and Environment, Inc., 1991.

[Bold items enclosed [illegible] rackets denote changes to the last [illegible] of document]



SOURCE: Ecology and Environment, Inc., 1991

SCALE
0 500 1000 FEET

KEY:

- Landfill Boundary
- Unpaved Road
- ▲ Sediment Sample
- ◆ Sediment and Surface Water Sample
- ⊕ Permanent Shallow Monitoring Well
- ✦ Permanent Deep Monitoring Well
- (23) Chromium Concentration (ug/L)
- (35) Zinc Concentration (ug/L)
- ● Surface Water Sample Where Chlorobenzene Detected
- (ND) Not Detected

Figure 3-10 CHROMIUM AND ZINC CONCENTRATIONS IN SURFACE WATER SAMPLES AND SAMPLE LOCATIONS WHERE CHLOROBENZENE WAS DETECTED — NAS PENSACOLA SITE 1

both exhibited zinc concentrations slightly above the FDER Class III Surface Water Quality Standard (Prcshvater) of 30 µg/L (Chapter 17-302, FAC; see Figure 3-[10]).

As shown on Figure 3-[lo], lov levels of chromium vere detected in only five of the surface vater samples. In all five samples, the detected chromium concentrations vere well belov the FDER Class III Surface Water Quality Standard (Marine and Freshwater) of 50 µg/L (Chapter 17-302, PAC).

As noted above, iron and manganese may also be present at elevated concentrations in the surface water bodies near Site 1. Neither of these metals vas included in the metals analytical screening group, but the presence of these compounds in the surface vater samples is likely given that: 1) shallow groundwater discharges into these surface vater bodies (see Section 3.8.2.1); 2) elevated iron and manganese concentrations vere detected in the total and dissolved metals samples collected from the on-site permanent monitoring wells (see Section 3.9.4.3); 3) and the observed orange discoloration of surface vaters, sediments, and vegetation (see sections 3.2 and 3.3) are characteristic of iron-staining. No FDER Class III Surface Water Quality Standard (Marine and Freshvater) exists for manganese (Chapter 17-302, PAC). However, base on the detected groundvater concentrations, the FDER Class III Surface Water Quality Standards for iron (1,000 µg/L in freshvaters and 300 µg/L in marine waters) could be exceeded in the surface vaters near Site 1 (Chapter 17-302, PAC).

3.9.1.2 VOCs

Chlorobenzene was the only VOC detected in the surface vater samples collected at Site 1 and vas detected only in the samples from North Pond (see Figure 3-[lo]) at concentrations ranging from 14 to 26 µg/L. No FDER Class III Surface Water Quality Standard exists for this compound (Chapter 17-302, PAC).

3.9.2 Sediment

Table 3-5 summarizes the analytical screening results for sediment samples collected in the vicinity of Site 1. Figures 3-11, [3-12, and 3-13] show the locations of the sediment samples collected in the

0000929

Table 3-5

SUMMARY ANALYTICAL SCREENING RESULTS FOR SEDIMENT SAMPLES
NAS PENSACOLA SITE 1
(All results in mg/kg, unless noted)

Parameter	[Detection Limit	Sample Number (Location)							
		P01SD001 (SD001)	P01SD002 (SD002)	P01SD003 (SD003)	P01SD004 (SD004)	P01SD005 (SD005)	P01SD006 (SD006)	P01SD007 (SD007)	P01SD008 (SD008)
Chcomium	1	1.9	11	—	1.2	1.7	7.9	3.4	6.2
Zinc	2	3.0	3.0	2.5	2.3	—	34	26	8.9
Load	4	5.1	10	—	—	—	92	35	—
Cidmiun	0.5	—	—	—	—	—	7.5	11	—
Coppec	2.5	—	—	—	—	—	6.2	2.7	—
TRPHs	5	230	—	6.7	—	—	5.2	—	14
Methylene Chloride (µg/kg)	1,000	—	—	—	—	—	4,000(B)	4,400(B)	3,700(B)
Total PAHs as Benzo-a-pyrene (µg/kg)	1,000	1,400	1,600	1,200	(L)	1,200	6,100	1,600	—
Phenols as Trichloro-phenol (µg/kg)	2,000]	—	—	—	—	—	5.800	5,100	—

14[NASP]UH6017:T0260/247/2

Key at end of table.

[Bold items enclosed in brackets denote changes to tho last version of document]

Table 3-5 (Cont.)

Parameter	[Detection Limit	Sample Number (Location)							
		P01SD009 (SD009)	P01SD010 (SD010)	P01SD011 (SD011)	P01SD012 (SD012)	P01SD012D[a] (SD012)	P01SD013 (SD013)	P01SD014 (SD014)	P01SD015 (SD015)
Chromium	1	6.7	4.9	6.1	19	21	2.7	2.0	18
Zinc	1	7.0	6.0	140	37	41	3.7	3.2	26
Lead	4		—	64	—	—	—	—	28
Cadmium	0.5	—	—	0.63	—	—	—	—	—
Copper	2.5	—	—	4.8	4.6	4.8	—	—	6.4
TRPHs	5	—	22	33	28	22	21	19	27
Methylene Chloride (µg/kg)	1,000	3,700(B)	3,600(B)	3,900(B)	4,200(B)	4,300(B)	3,400(B)	4,200(B)	3,800(B)
Total PAHs as Benzo-a-pyrene (µg/kg)	1,000	(L)	(L)	(L)	—	(L)	(L)	(L)	(L)
Phenols as Trichlorophenol (µg/kg)	2,000]	5,900	—	—	—	—	—	(L)	9,600

14[NASP]UH6017:T0260/247/2

Note: These results were reported on a wet-weight basis.

Key:

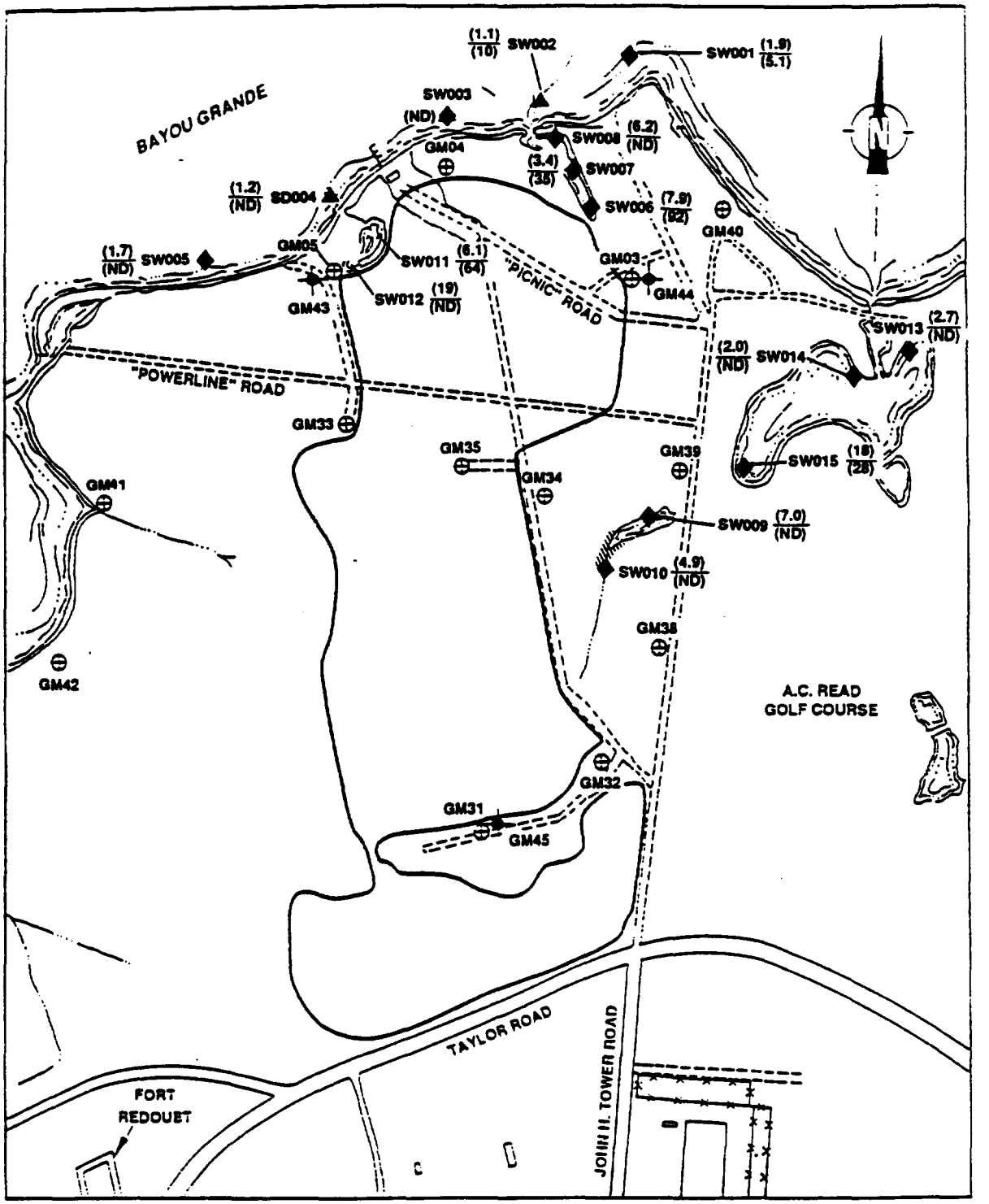
[a]Duplicate of sample P01SD012.

Dash (—) indicator compound not detected.

Qualifiers:

(B) = Compound also present in method blank.
(L) = Present below stated detection limit.

Source: Ecology and Environment, Inc., 1991.



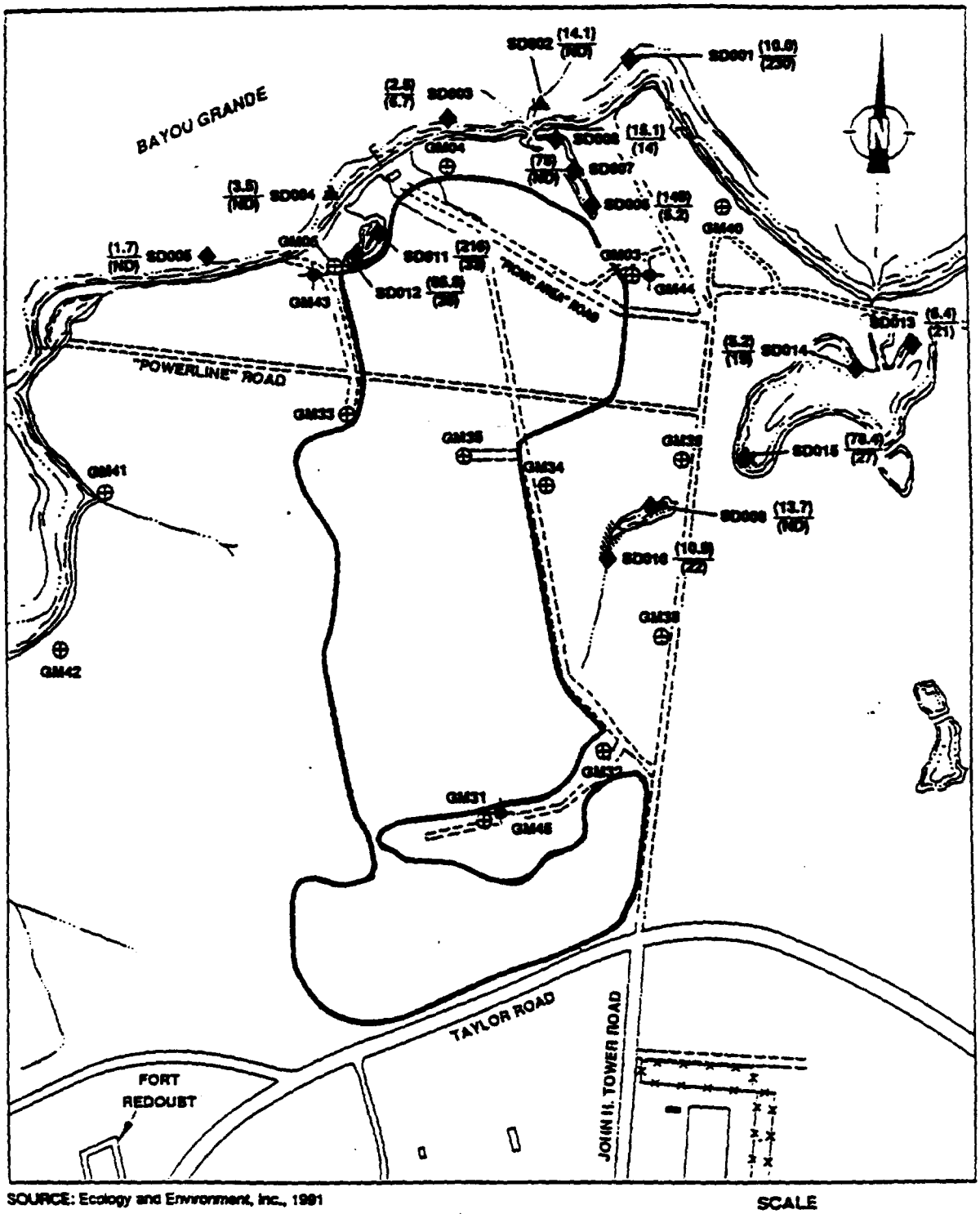
SOURCE: Ecology and Environment, Inc., 1991

SCALE
0 500 1000 FEET

KEY:

- Landfill Boundary
- Unpaved Road
- Permanent Shallow Monitoring Well
- Permanent Deep Monitoring Well
- Sediment and Surface Water Sample
- Sediment Sample
- (7.9) Chromium Concentration (mg/kg)
- (92) Lead Concentration (mg/kg)
- (ND) Not Detected

Figure 3-11 CHROMIUM AND LEAD CONCENTRATIONS IN SEDIMENT SAMPLES — NAS PENSACOLA SITE 1



SOURCE: Ecology and Environment, Inc., 1991

KEY:

- Landfill Boundary
- Unpaved Road
- Sediment Sample
- Sediment and Surface Water Sample
- Permanent Shallow Monitoring Well
- Permanent Deep Monitoring Well
- (10.9) / (22) Total Metals Concentration (mg/kg) / TRPH Concentration (mg/kg)
- (ND) Not Detected

Figure 3-12 TOTAL METALS AND TRPH CONCENTRATIONS IN SEDIMENT SAMPLES — NAS PENSACOLA SITE 1

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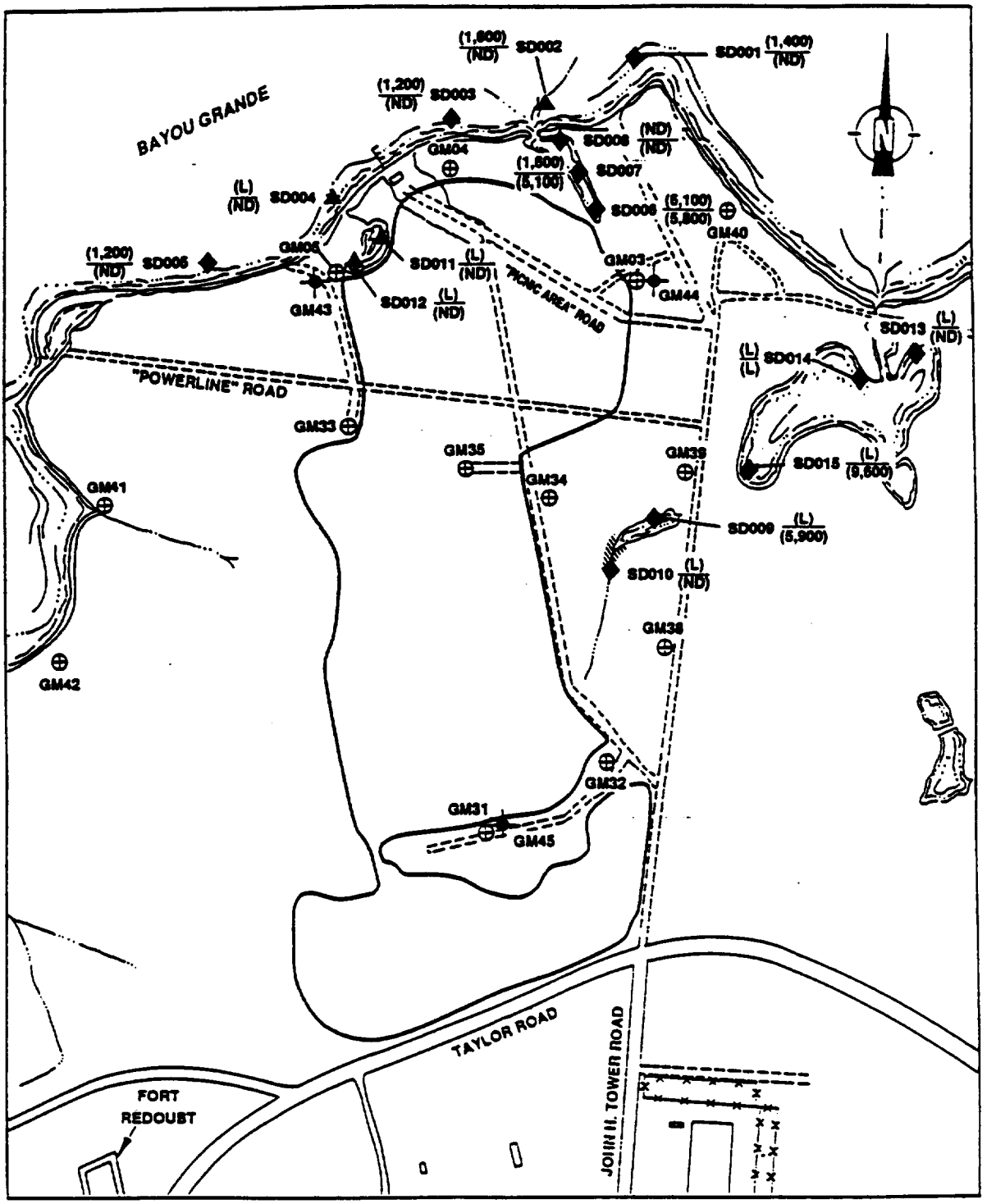

Figure 3-13 PAH AND PHENOL CONCENTRATIONS IN SEDIMENT SAMPLES — NAS PENSACOLA SITE 1

vicinity of the site. The complete analytical screening results for sediment samples are presented in Appendix F.

In general, one or more sediment samples collected in the vicinity of Site 1 exhibited elevated concentrations of metals, TRPHs, PAHs, and/or phenols. Methylene chloride vas the only VOC detected, but the presence of this cogon laboratory solvent in the sediment samples can be attributed to laboratory-derived contamination because it vas detected at similar levels in the associated laboratory method blanks (see Section 3.11.2). Pesticides and PCBs were not detected in any of the samples.

3.9.2.1 Metals

Figure 3-(12) shows the distribution of total metals concentrations in the Site 1 sediment samples. Most of the samples exhibited fairly low total metals concentrations (≤ 15.1 micrograms per kilogram [µg/kg]). However, both samples from North Pond, the two southernmost samples from Bayou Grande Pond, and the southernmost sample from Golf Course Pond exhibited much higher total metals concentrations (>65 µg/kg). The highest total metals concentration (216 µg/kg) was detected in sample SD011 from the northeastern end of North Pond.

[Figure 3-11 illustrates the distribution of the chromium and lead concentrations detected in Site 1 sediment samples.] Chromium, zinc, and lead are the predominant metal contaminants present (see Table 3-5). Vith a fev minor exceptions, the highest concentrations of these three metals and of the other metals detected vere associated vith the five high total metals concentration samples identified above. Also, as discussed above with respect to surface waters, the sediment samples may also contain elevated levels of iron and manganese.

3.9.2.2 TRPHs

Figure 3-(12) shovs the distribution of TRPE concentrations in the Site 1 sediment samples. The highest TRPH concentration (230 milligrams per kilogram [mg/kg]) was detected in the easternmost Bayou Grande sample, SD001. Hoderately elevated TRPE concentrations (14 to 33 mg/kg) were detected in both samples from North Pond, the northernmost sample from Bayou Grande Pond, all three samples from Golf Course Pond, and the

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[Bold items enclosed in brackets denote changes to the last version of document)

sample collected upstream from Beaver Pond. In the remaining six samples, TRPHs were present at low levels or were not detected.

3.9.2.3 PAHs

Figure 3-[13] shows the distribution of PAE concentrations in the Site 1 sediment samples. At least trace levels of PAHs were present in all but one of the samples. The highest PAR concentration (6,100 µg/kg) was detected in the southernmost sample from Bayou Grande Pond, SD006. Quanitifiable levels of PAHs (1,200 to 1,600 µg/kg) were present only in five other samples (four from Bayou Grande and one from Bayou Grandc Pond). PAHs were detected in all of the remaining samples except the southernmost Bayou Grande Pond sample, SD008, but at concentrations below the detection limit of 1,000 µg/kg. It should be noted that PAHs were reported as benzo-a-pyrene for laboratory reporting purposes; however, PAHs other than benzo-a-pyrene may be present in the samples.

3.9.2.4 Phenols

Figure 3-[13] shows the distribution of phenol concentrations in the Site 1 sediment samples. Elevated phenol concentrations (5,100 to 9,600 µg/kg) were detected in the southernmost sample from Golf Course Pond, the sample from Beaver Pond, and the two southernmost samples from Bayou Grande Pond. The highest phenol concentration (9,600 µg/kg) was detected in the Golf Course Pond sample, SD015. Trace levels of phenols (<1,000 µg/kg) were also detected in Golf Course Pond sample, SD014. It should be noted that phenols were reported as trichlorophenol for laboratory reporting purposes; however, phenols other than trichlorophenol may be present in the sediment samples.

3.9.3 Surface Soil

Table 3-6 summarizes the analytical screening results for surface soil samples collected at Site 1. Figure [3-14] shows the locations of the surface soil samples collected at the site. The complete analytical screening result's for surface soil samples are presented in Appendix G.

In general, low metal concentrations and elevated TRPH, VOC, PAH, and/or phenol concentrations were detected in one or more of the surface

000033

Table 3-6

SUMMARY ANALYTICAL SCREENING RESULTS FOR SURFACE SOIL SAMPLES
NAS PENSACOLA SITE 1
(All results in mg/kg, unless noted)

Parameter	[Detection Limit	Sample Number (Location)							
		P01S001 (S001)	P01S002 (S002)	P01S003 (S003)	P01S004 (S004)	P01S005 (S005)	P01S006 (S006)	P01S007 (S007)	P01S008 (S008)
Chromium	1	4.2	3.4	3.8	2.6	1.2	1.2	—	3.1
Zinc	2	9.2	3.7	12	5.2	14	5.8	—	—
Lead	4	9.4	—	—	—	24	—	—	—
Cadmium	0.5	1.8	0.59	0.72	—	—	0.67	0.52	0.92
Copper	2.5	—		—	—	4.8	—	—	—
TRPHs	5	12	11	14	38	330,000	13	—	5.8
Toluene (μg/kg)	1,000	—	—	—	—	1,400	—	—	—
Ethylbenzene (μg/kg)	1,000	—			—	6,200	—	—	—
Total Xylenes (μg/kg)	1,000	—		—	—	39,000		—	—
Methylene Chloride (μg/kg)	1,000	2,300(B)	2,600(B)	2,500(B)	2,200(B)	2,700(B)	2,300(B)	2,500(B)	3,000(B)
Total PAHs as Benzo-a-pyrene (μg/kg)	1,000	(L)	—	—	—	26,000	—	—	—
Phenols as Trichlorophenol (μg/kg)	2,000]	—	—	—	—	2,500,000	—	—	—

14[NASP]UH6017:T0260/249/2

Key at end of table.

[Bold items enclosed i[illegible]ckets denote changes to the last v[illegible] of document]

Table 3-6 (Cont.)

Parameter	[Detection Limit	Sample Number (Location)						
		P01S009 (S009)	P01S010 (S010)	P01S010D[a] (S010)	P01S011 (S011)	P01S012 (S012)	P01S013 (S013)	P01S014 (S014)
Chromium	1	1.5	--	1.6	5.4	6.7	3.7	3.4
Zinc	2	2.4	3.4	--	2.7	3.6	5.8	5.1
Load	4	20	8.6	--	0.2	--	14	--
Cadmium	0.5	--	--	--	--	1.4	--	--
Copper	2.5	--	--	--	--		--	--
TRPHs	5	8.2	5.8	6.4	12	16,000	35	15
Toluene (µg/kg)	1,000	--	--	--	--	1,400	--	--
Ethylbenzene (µg/kg)	1,000	--	--	--	--	--	--	--
Total Xylenes (µg/kg)	1,000	--	--	--	--	--	--	--
Methylene Chloride (µg/kg)	1,000	2,000(B)	3,300(B)	3,600(B)	3,600(B)	19,000(B)	6,000 B)	3,900(B)
Total PAHs as Benzo-a-pyrene (µg/kg)	1,000	--	(L)	(L)	--	--	--	--
Phenols as Trichloro-phenol (µg/kg)	2,0001	--	--	--	--	22,000	--	--

14[NASP]UH6017:T0260/249/2

Note: These results were reported on a wet-weight basis.

Key:

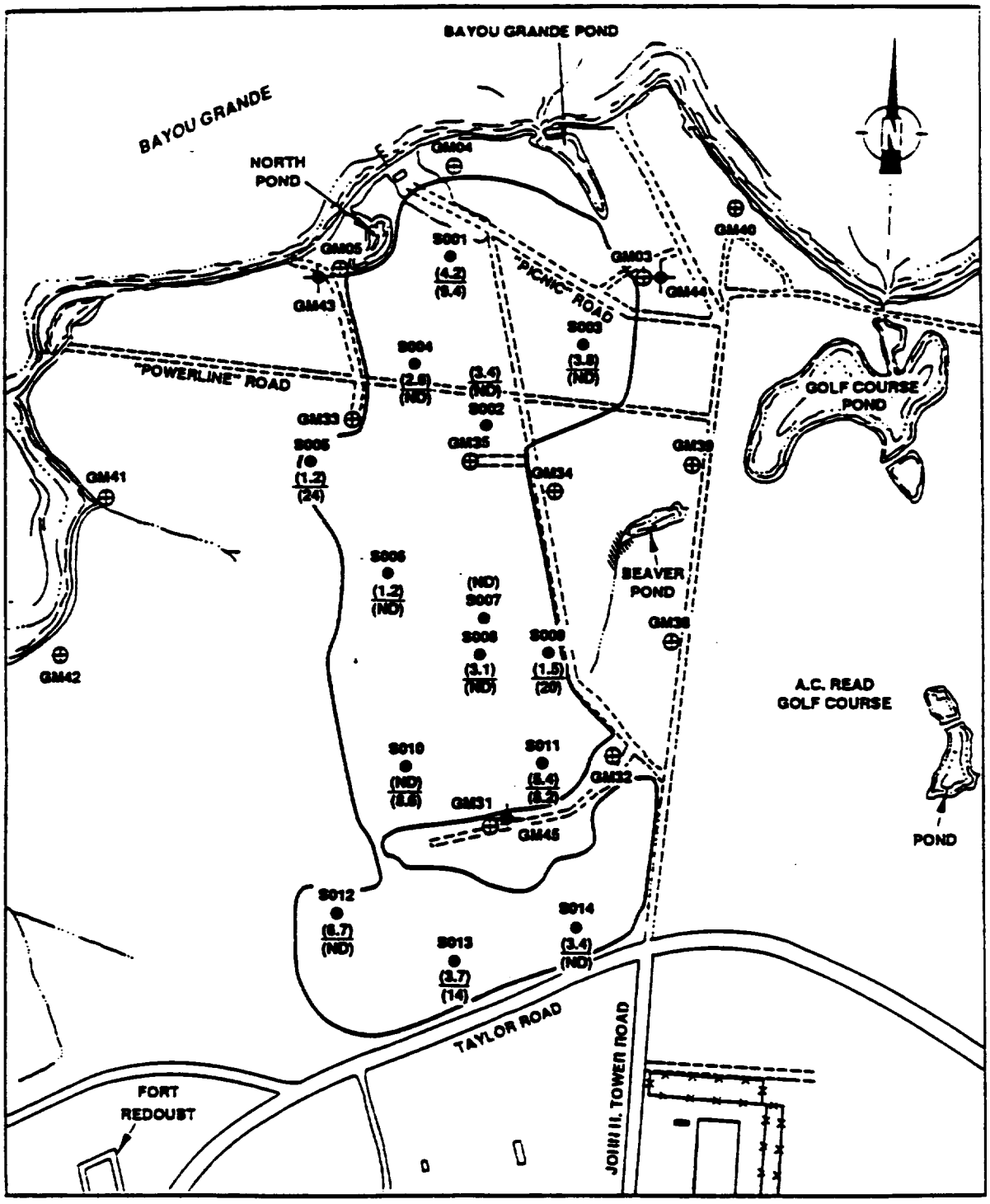
[a]Duplicate of sample P01S010.

Dash (--) indicates compound not detected.

Qualifiers:
(B) = Compound also present in method blank.
(L) = Present below stated detection limit.

Source: Ecology and Environment, Inc., 1991.

[Bold items enclosed in brackets denote changes to tho last version of document]



SOURCE: Ecology and Environment, Inc., 1991

Figure 3-14 CHROMIUM AND LEAD CONCENTRATIONS IN SOIL SAMPLES — NAS PENSACOLA SITE 1

0000934

soil samples collected at Site 1. Pesticides and PCBs were not detected in any of the Site 1 surface soil samples.

3.9.3.1 Metals

All of the surface soil samples exhibited fairly low total metal concentrations (≤ 44 mg/kg). The highest concentration (44 mg/kg) was detected in sample S005, collected from the "tar pit" located near the northvest corner of the 1970s landfill area. [Figures 3-14 and 3-15 illustrate the distribution of the chromium and lead concentrations and the cadmium and zinc concentrations, respectively, detected in Site 1 surface soil samples.] Figure 3-[16] shows the distribution of total metals concentrations in the Site 1 surface soil samples.

Chromium and zinc were present in most of the samples; lead and cadmium were present in some of the samples; and copper was present in one of the samples (see Table 3-6). Of the detected metals, lead was present at the highest concentrations: 24 mg/kg in sample S005 and 20 mg/kg in sample S009, which was collected within an area of stressed vegetation near the east-central edge of the 1970s landfill area.

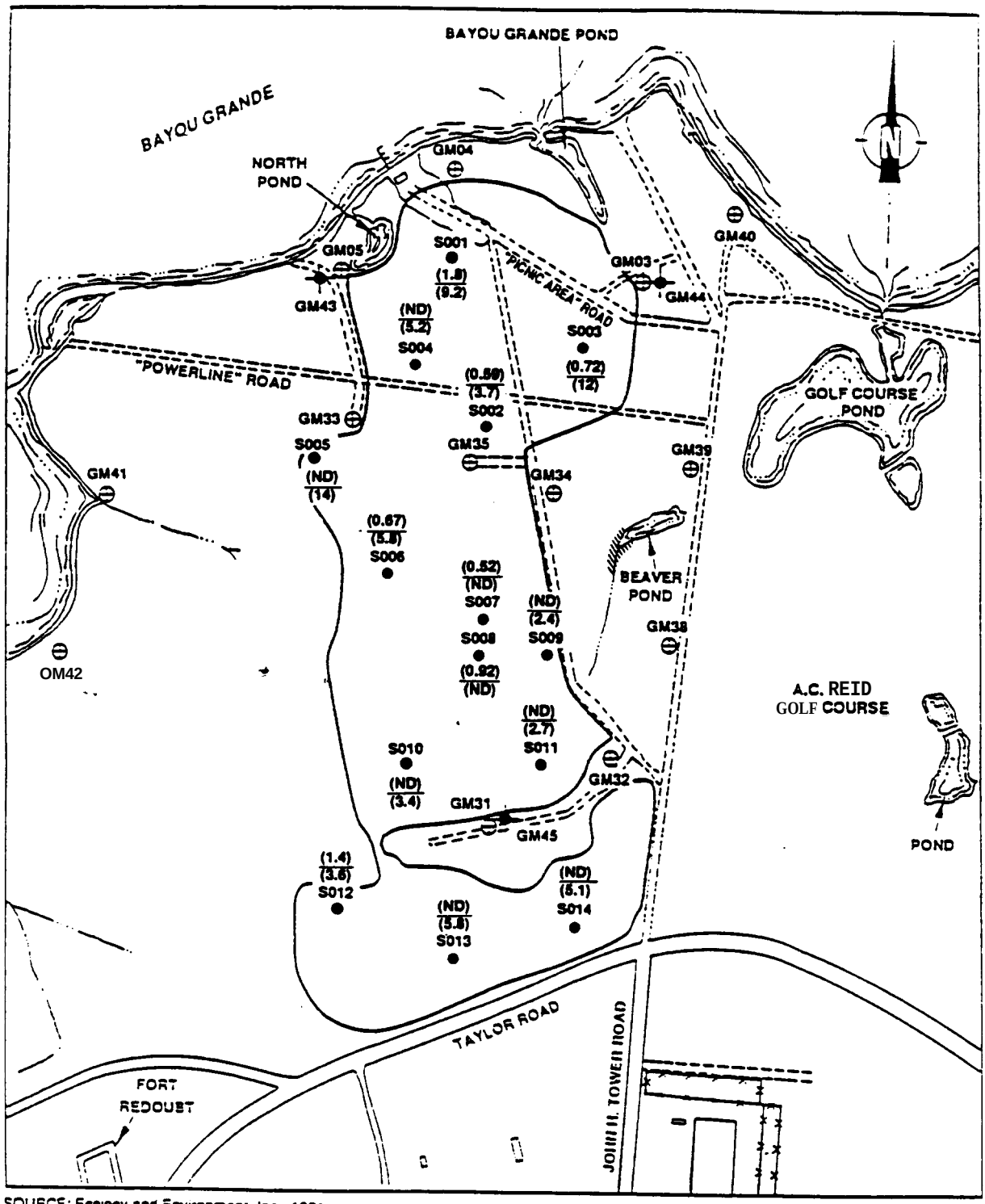
3.9.3.2 TRPHs

Figure 3-[16] shows the distribution of TRPH concentrations in the Site 1 surface soil samples. The highest TRPH concentrations were detected in sample S005 (330,000 mg/kg) and sample S012 (16,000 mg/kg), collected from the "collapse-feature depression" in the northwest corner of the 1950s landfill area. All except one of the remaining surface soil samples exhibited low to moderately elevated TRPH concentrations, randomly distributed across the site.

3.9.3.3 VOCs

As shown on Figure 3-[17], VOCs were detected in surface soil samples S005 and S012. Sample S005 exhibited a high concentration of xylenes (39,000 µg/kg) and lower levels of ethylbenzene (6,200 µg/kg) and toluene (1,400 µg/kg). Sample S012 exhibited toluene only (1,400 µg/kg). Methylene chloride was the only other VOC detected in the surface soil samples.

[Bold items enclosed in brackets denote changes to the last version of document]



SOURCE: Ecology and Environment, Inc., 1991

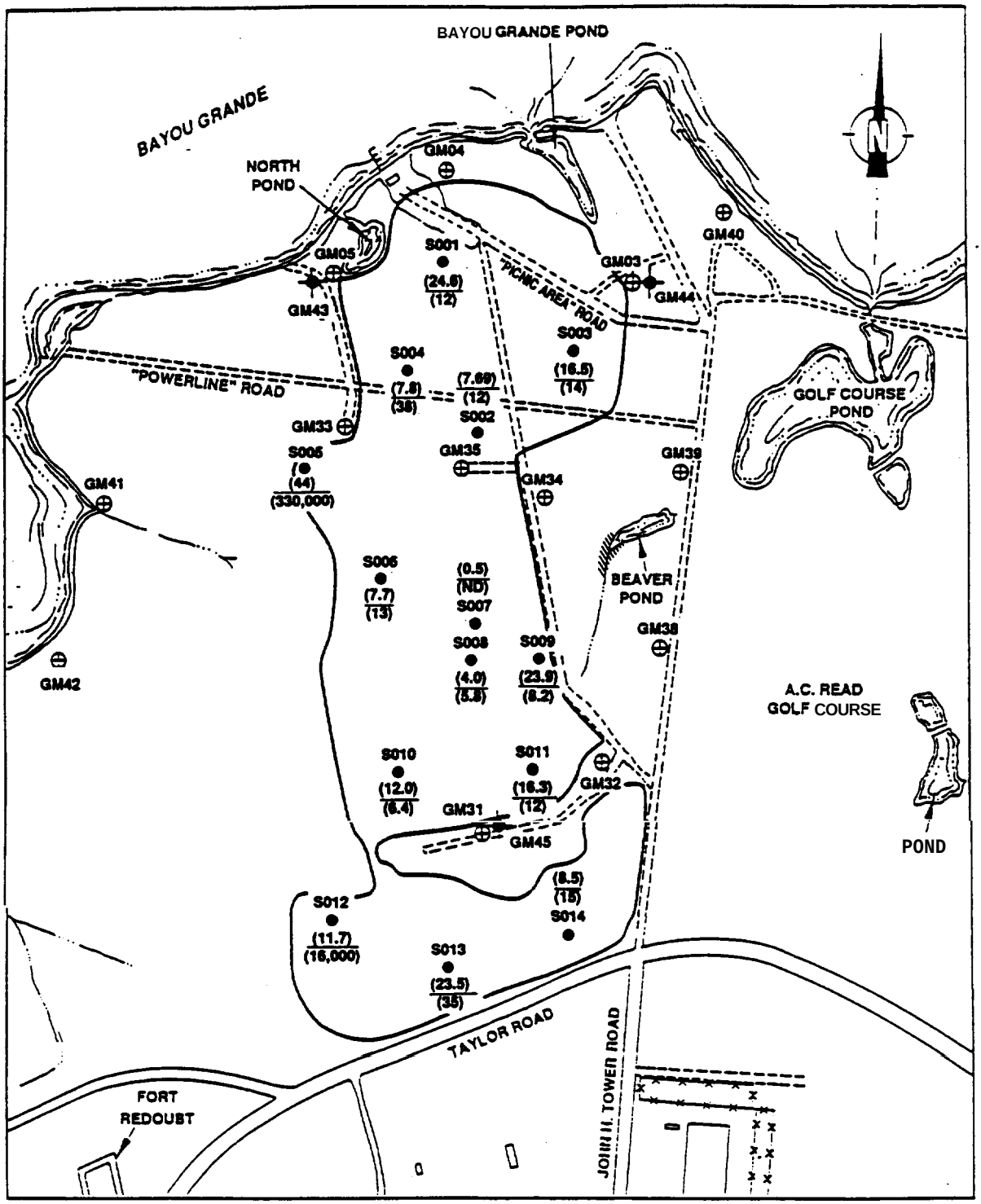
SCALE
0 500 1000 FEET

KEY:

- Landfill Boundary
- Unpaved Road
- Surface Soil Sample
- Permanent Shallow Monitoring Well
- Permanent Deep Monitoring Well
- (1.8) Cadmium Concentration (ug/L)
- (9.2) Zinc Concentration (ug/L)
- (ND) Not Detected

Figure 3-15 CADMIUM AND ZINC CONCENTRATIONS IN SOIL SAMPLES — NAS PENSACOLA SITE 1

0006935



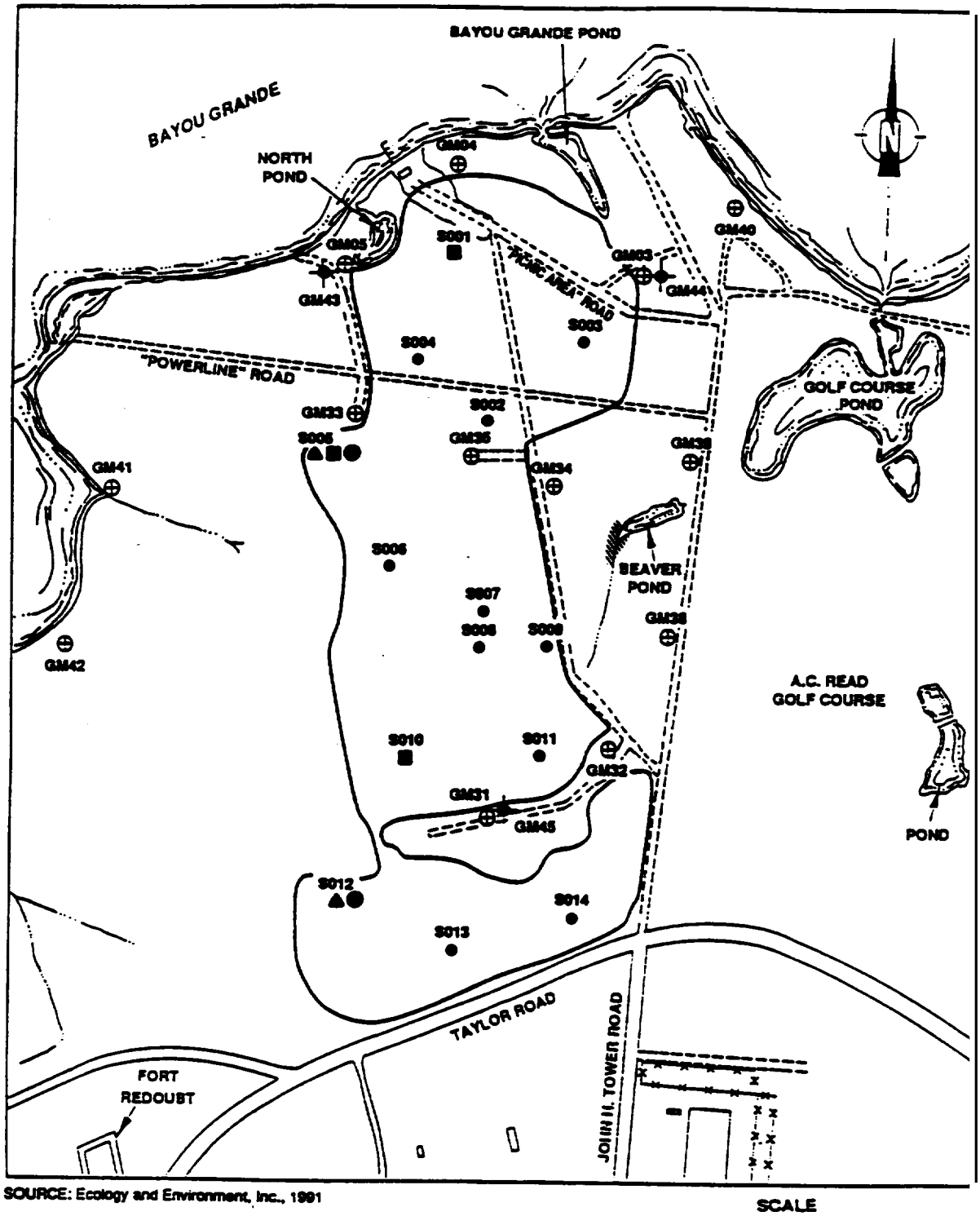
SOURCE: Ecology and Environment, Inc., 1991

SCALE
0 500 1000 FEET

KEY:

Landfill Boundary
Unpaved Road
Surface Soil Sample
Permanent Shallow Monitoring Well
Permanent Deep Monitoring Well
(16.3) / (12) Total Metals Concentration (mg/Kg) / TRPH Concentration (mg/kg)
(ND) Not Detected

Figure 3-16 TOTAL METALS AND TRPH CONCENTRATIONS IN SOIL SAMPLES — NAS PENSACOLA SITE 1



SOURCE: Ecology and Environment, Inc., 1991

SCALE
0 500 1000 FEET

KEY:

- Landfill Boundary
- Unpaved Road
- Surface Soil Sample
- Permanent Shallow Monitoring Well
- Permanent Deep Monitoring Well
- Soil Sample Where Volatile Aromatic Compounds Detected
- Soil Sample Where PAHs Detected
- Soil Sample Where Phenols Detected

Figure 3-17 SOIL SAMPLES WHEREVOLATILE AROMATIC COMPOUNDS, PAHs, AND/OR PHENOLS WERE DETECTED — NAS PENSACOLA SITE 1

0000936

Methylene chloride was detected in all of the samples, usually at concentrations less than 6,800 µg/kg. In all but one of the samples, this common laboratory solvent was also detected at similar concentrations in the associated laboratory method blanks (see Section 3.11.2); therefore, the presence of this compound in all but one of the surface soil samples can be attributed to laboratory-derived contamination. In contrast, sample S012 from the "collapse-feature depression" in the 1950s landfill area exhibited a methylene chloride concentration of 19,000 µg/kg, significantly above the level detected in the associated laboratory method blank. Although this occurrence probably still represents laboratory-derived contamination, the presence of an on-site source of methylene chloride surface soil contamination in this area cannot be entirely discounted, especially given that the second highest methylene chloride concentration (6,800 µg/kg) was detected in nearby surface soil sample S013 (see Table 3-6 and Figure 3-[17]).

3.9.3.4 PAHs

As shown on Figure 3-[17], PAHs were detected in three Site 1 surface soil samples: sample S005, collected from the "tar pit" located near the northwest corner of the 1970s landfill area; sample S001, collected in the 1960s landfill area; and sample S010, collected at the southern end of the 1970s landfill area. Elowever, PAHs were present at only trace levels (<1,000 µg/kg) in samples S001 and S010, but sample S005 exhibited a clearly elevated PAH concentration of 26,000 µg/kg (see Table 3-6).

3.9.3.5 Phenols

As shown on Figure 3-[17] and in Table 3-6, phenols were detected at very high concentrations in only two of the Site 1 surface soil samples: sample S005 (2,500,000 µg/kg) and sample S012 (22,000 µg/kg). Both of these samples also exhibited elevated concentrations of other organic contaminants, as discussed above.

3.9.4 Groundwater

3.9.4.1 Field Parameters

Table 3-7 lists the groundwater pH, temperature, and specific conductance values measured in groundvater samples from the Site 1 temporary and permanent monitoring wells. The field parameter measurements for these vell samples (including the lov pH values) are vithin the reported range of values for ambient groundvater in Escambia County (Clemens et al. 1989) vith one exception. Well TW014 exhibited a pH value (1.86) vell klov the range of Escambia County ambient groundvater pH values (Clemens et al. 1989). The cause of the lov groundvater pH observed in well TW014 is unknovn. [pH values observed rt the site ranged from 1.86 to 7.44.] No floating [and/]or [sinking] immiscible hydrocarbons were observed in any of the vells. The temporary monitoring vell information, including field parameter and groundwater elevation data, are presented in Appendix D.

3.9.4.2 Analytical Screening Parameters

Table 3-8 summarizes the analytical screening results for the groundwater samples collected from the 28 temporary monitoring vells installed in the vicinity of Site 1. Figures [3-18 and 3-19] shov the locations of the temporary monitoring vells. The complete analytical screening results for the groundwater samples are presented in Appendix E.

In general, one or more of the temporary well groundvater samples collected at Site 1 exhibited elevated concentrations of metals, VOCs, PAHs, and phenols. However, the elevated metals concentrations probably reflect leaching or dissolution of aquifer matrix sediments entrained in these unfiltered samples by the acid preservative rather than actual groundvater contamination (see Section 3.10). TRPHs were detected in only four samples at generally lov concentrations. Pesticides and PCBs were not detected in any of the temporary monitoring vell samples.

Metals

[Figures 3-18 urd 3-19 illustrate the distribution of the chromium and lead concentrations and the cadmium urd zinc concentrations, respectively, detected in Site 1 groundvater samples.] Chromium (all

0000937

[Bold items enclosed in brackets denote changes to the last version of document]

fable 3–7

GROUNDWATER FIELD PARAMETERS
NAS PENSACOLA SITE 1

Well Number	Temperature (°C)	pH (units)	Specific Conductance (umhos/cm)	Date Measured
TW001	19	4.1	60	1/19/91
Tm02	23	6.9	300	1/17/91
TWO04	23.5	6.2	835	1/17/91
TW005	21.5	5.9	300	1/17/91
TW006	21	6.6	40	1/17/91
Two07	20.7	7.44	194	1/16/91
TW008	20	4.6	46	1/20/91
TW009	20.2	6.56	599	1/16/91
TW010	25.1	6.2	580	1/18/91
TW011	25.2	6.2	280	1/18/91
Two12	18	5.0	75	1/19/91
Two13	21	6.0	180	1/19/91
TW014	22.5	1.86	88	1/16/91
TW015	21	5.68	45	1/16/91
Two16	23.3	6.6	269	1/16/91
TW017	24.5	4.65	70	1/17/91
TWO18	23.1	6.0	180	1/17/91
TW019	25	—	70	1/17/91
TW020	20.5	5.6	140	1/20/91
Two21	—	4.8	52	1/18/91
TWO22	—	4.6	62	1/18/91
TWO23	—	4.6	70	1/18/91
Two24	22	4.2	52	1/20/91
TWO25	—	5.2	720	1/18/91
TW026	21	3.9	45	1/20/91
TW027	21	4.8	100	1/19/91
Two28	22.8	6.65	380	1/16/91
TWO29	19.9	6.52	558	1/16/91

14[NASP]UH6017:T0260/252/26

Key at end of table.

[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-7 (Cont.)

Well Number	Temperature (°C)	pH (units)	Specific Conductance (umhos/cm)	Date Measured
GM04	22.5	6.63	434	10/18/90
GM05	21.1	3.01	59	10/31/90
GM31	21.0	5.66	87	11/1/90
GM32	22.3	6.09	103	10/23/90
GM33	20.6	6.36	399	11/1/90
GM34	23.0	6.3	580	10/28/90
GM35	23.5	5.76	460	10/23/90
GM38	22.7	5.21	134	10/23/90
GM39	21.1	6.1	270	10/23/90
GM40	23.6	6.02	142	10/18/90
GM41	21.0	4.60	79	11/1/90
GM42	21.0	5.96	201	11/1/90
GM43	21.0	6.4	143	10/23/90
GM44	21.3	6.95	268	10/23/90
GM45	21.2	5.42	140	11/1/90

14[NASP]UK6017:T0260/252/26

Key:

Dash (—) indicates data not available.

Source: Ecology and Environment, Inc., 1991.

[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-8

SUMMARY ANALYTICAL SCREENING RESULTS FOR GROUNDWATER SAMPLES
(FROM TEMPORARY MONITORING WELLS)
NAS PENSACOLA SITE 1
(All results in µg/L, unless noted)

Parameter	[Detection Limit	Sample Number (Location) P01GW001 (TW001)	P01GW001D[a] (TW001)	P01GW002 (TW002)	P01GW004 (TW004)	P01GW005 (TW005)	P01GW006 (TW006)	P01GW007 (TW007)	P01GW008 (TW008)	[FPDWS/ FSDWS
Arsonic	69	—	—	—	—	—	—	—	—	50
Chromium	10	370	350	250	410	420	87	350	110	50
Zinc	20	140	120	98	700	220	100	180	100	5,000
Lead	40	270	180		240	—	—	240	—	50
Cadmium	5	24	18	21	37	48	5.6	26	10	10
Nickel	40	72	69	81	82	120	45	120	—	
Copper	25	140	140	210	200	100	—	110	38	1,000
TRPHs (mg/L)	1	—	—	—	7.8	—	—	—	—	
Benzene	10	—	—	—	—	—	—	—	—	1
Total Xylenes	10	—	—	—	—	—	—	—	—	
1,4-Dichlorobenzene	10	—	—	—	—	—	—	—	—	75
Tetrachloroethene	10	—	—	—	—	—	—	—	—	3]
Chlorobenzene	5	—	—	15	—	—	—	—	—	
Total PAHs as Benzo-a-pyrene	100	—	—	—	250	(L)	—	—	—	
Phenols AS Trichlorophenol	100]	—	—	—	—	—	—	—	—	

14[NASP]UH6017:T0260/251/0

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[Bold items enclosed in brackets demote changes to the last version of document]

Table 3-8 (Cont.)

Parameter	[Detection Limit	Sample Number (Location) P01GW009 (TW009)	P01GW010 (TW010)	P01GW011 (TW011)	P01GW012 (TW012)	P01GW013 (TW013)	P01GW014 (TW014)	P01GW015 (TW015)	P01GW016 (TW016)	[FPDMS/ PSDMS
Arsenic	69	—	—	310	—	—	—	—	—	50
Chromium	10	150	93	700	1,000	290	300	200	110	50
Zinc	20	60	410	280	370	77	91	66	50	5,000
Lead	40	160	1,400	460	740	200	330	160	67	50
Cadmium	5	15	54	120	98	12	—	—	—	10
Nickel	40	—	—	170	280	53	48	—	—	
Copper	as	46	110	110	370	130	120	76	32	1,000
TRPHs (mg/L)	1	—	—	—	—	—	—	—	—	
Benzene	10	—	—	—	—	—	—	—	—	1
Total Xylenes	10	—	—	—	—	—	—	—	—	
1,4-Dichlorobenzene	10	—	—	—	—	—	—	—	—	75
Tetrachloroethene	10	—	—	—	—	—	—	—	—	3]
Chlorobenzene	5	17	—	—	—	—	—	—	—	
Total PAHs as Benzo-a-pyrene	100	—	—	—	—	—	—	—	—	
Phenols as Trichlorophenol	100]	170	—	—	—	—	—	—	(L)	

14[NASP]UH6017:T0260/251/2

Key at end of table.

Table 3-8 (Cont.)

Parameter	[Detection Limit	Sample Number (Location) P01GW017 (TW017)	P01GW018 (TW018)	P01GW019 (TW019)	P01GW020 (TW020)	P01GW020D[b] (TW020)	P01GW021 (TW021)	P01GW022 (TW022)	P01GW023 (TW023)	[FPDWS/ FSDWS
Arsonic	**69**	--	--	--	--	--	--	110	--	SO
Chromium	*10*	**280**	**100**	**210**	**500**	410	**260**	540	440	*50*
Zinc	**20**	**78**	**98**	**96**	**140**	130	**60**	140	120	*5,000*
Lead	40	--	--	--	**250**	400	**75**	340	210	*50*
Cadmium	**5**	--	--	--	**82**	75	**5.5**	10	14	10
Nickel	4	--	--	**56**	**100**	100	**60**	95	120	
Copper	**25**	--	--	**140**	**200**	180	**210**	500	290	1,000
TRPHs (mg/L)	1	--	--	--	**1.4**	--	--	--	--	
Benzene	10	--	--	--	--	--	--	--	--	**1**
Total Xylenes	**10**	--	--	--	--	--	--	--	--	
1,4-Dichlorobenzene	10	--	--	--	--	--	--	--	--	**75**
Tetrachloroethene	*10*	--	**19**	--	--	--	--	--	--	**3]**
Chlorobenzene	**5**	--	--	--	--	--	--	--	--	
Total PAHs as Benzo-a-pyrene	100	--	--	--	--	--	--	--	--	
Phonols as Trichlorophenol	100]	--	--	--	--	150	--	--	--	

14[NASP]UH6017:T0260/251/2

Key at ond of table.

[**Bold** items enclosed in brackets denote **changes** to tho last **version of** document]

Table 3-8 (cart.)

Parameter	[Detection Limit	Sample Number (Location) P01GW024 (TW024)	P01GW025 (TW025)	P01GW026 (TW026)	P01GW027 (TW027)	P01GW028 (TW028)	P01GW029 (TW029)	[FPDWS/ FSDWS
Arsonic	69	—	—	—	—	—	—	50
Chromium	10	420	61	360	360	1,000	440	SO
Zinc	20	150	40	60	110	250	170	5,000
Lead	40	100	—	110	180	600	300	50
Cadmium	5	57	2a	5.0	19	SO	30	10
Nickel	40	94	—	52	93	100	140	
Copper	2s	120	30	200	220	200	260	1,000
TRPHs (mg/L)	1	2.6	—	1.5	—	—	—	
Benzene	10	—	00	—	—	—	20[c]	1
Total Xylenes	10	—	18	—	—	—	—[c]	
1,4-Dichlorobenzene	10	—	22	—	—	—	29[c]	75
Tetrachloroethene	10	—	—	—	—	—	—[c]	3]
Chlorobenzene	5	—	160	—	19	—	91[c]	
Total PAHs am								
Benzo-a-pyrene	100	—	(L)	—	—	—	—	
Phenols as								
Trichlorophenol	100]	—	320	—	—	—	180	

14[NASP]UH6017:T0260/251/0

Key:

[a]Duplicate of sample P01GW001.
[b]Duplicate of sample P01GW020.
[[c]Detection limit for specified parameters increased by a factor of 2 in this sample.]

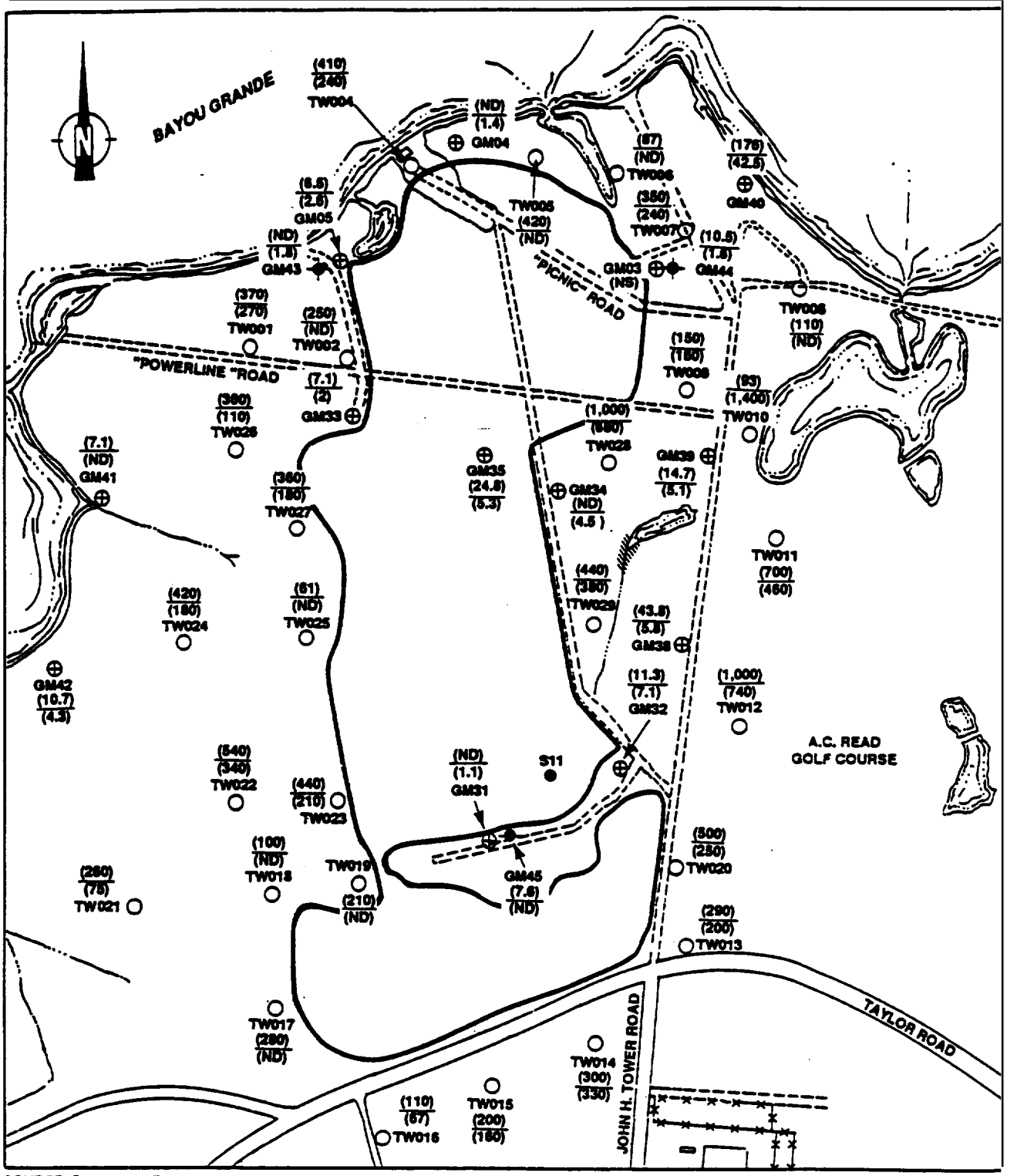
[FPDWS = Florida Primary Drinking Water Standard.
FSDWS = Florida Secondary Drinking Water Standard.]

Dash (—) indicates compound not detected.

Qualifiers:

(B) = Compound also present in method blank.
(L) = Present below stated detection limit.

Source: Ecology and Environment, Inc., 1991.



SOURCE: Ecology and Environment, Inc., 1991

SCALE

0 500 1000 FEET

KEY:

Landfill Boundary

Unpaved Road

Temporary Monitoring Well

Permanent Shallow Monitoring Well

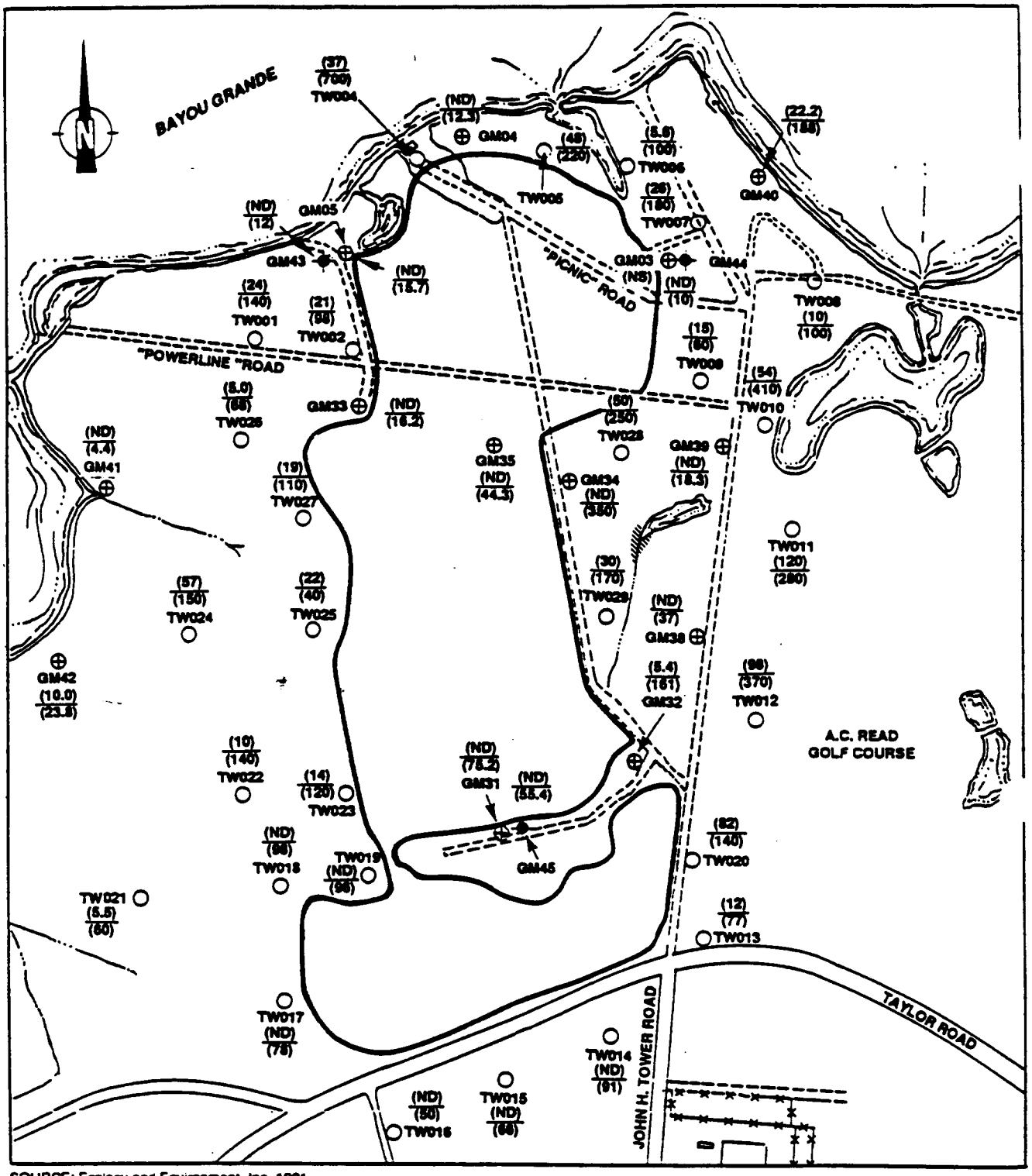
Permanent Deep Monitoring Well

(370) Chromium Concentration (ug/L)
(270) Lead Concentration (ug/L)

(NS) Not Sampled

(ND) Not Detected

Figure 3-18 CHROMIUM AND LEAD CONCENTRATIONS IN GROUNDWATER SAMPLES — NAS PENSACOLA SITE 1



SOURCE: Ecology and Environment, Inc., 1991

SCALE

0 500 1000 FEET

KEY:

- Landfill Boundary
- Unpaved Road
- Temporary Monitoring Well
- Permanent Shallow Monitoring Well
- Permanent Deep Monitoring Well

(24) Cadmium Concentration (ug/L)
(140) Zinc Concentration (ug/L)

(NS) Not Sampled

(ND) Not Detected

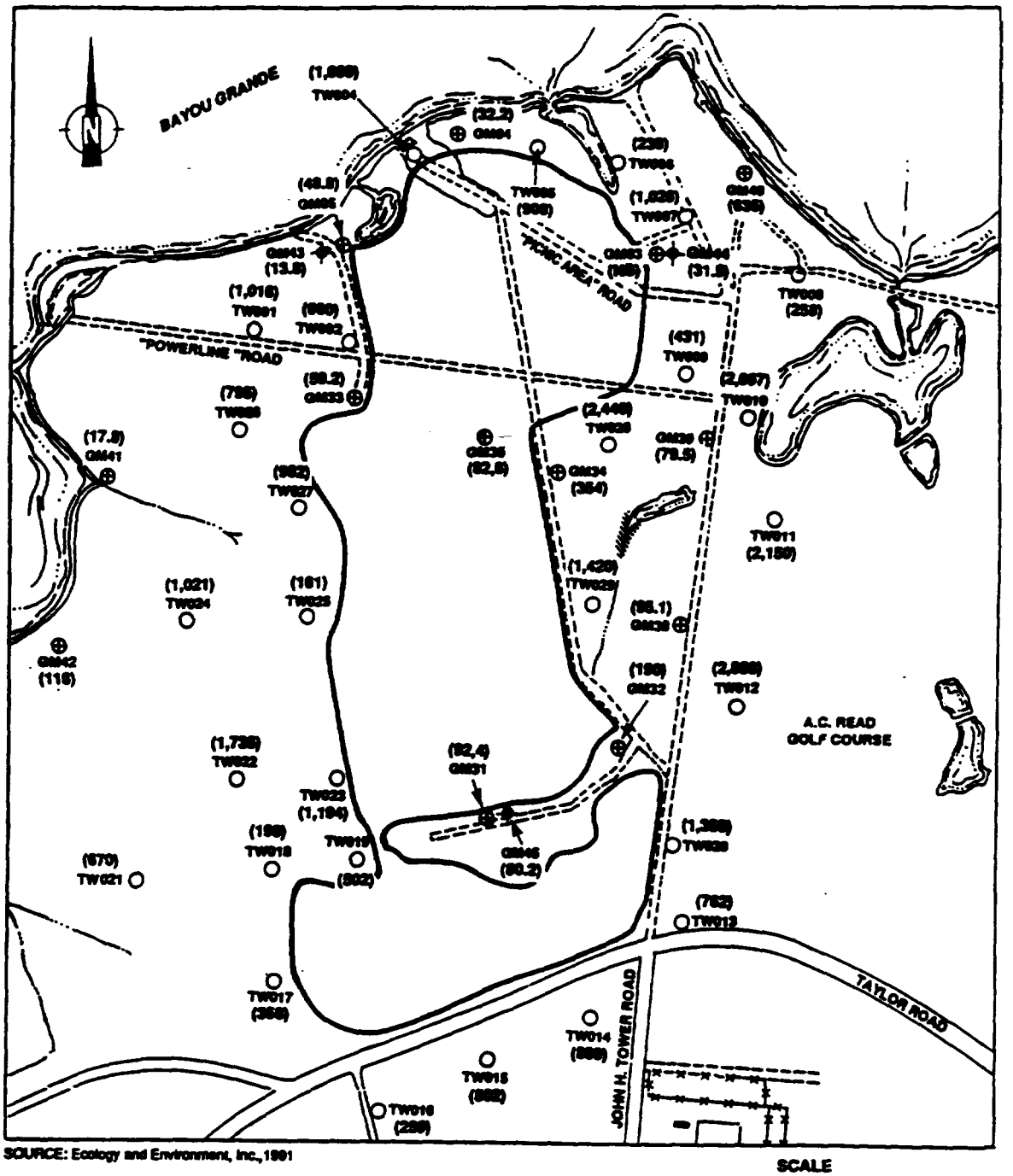
Figure 3-19 CADMIUM AND ZINC CONCENTRATIONS IN GROUNDWATER SAMPLES — NASPENSACOLA SITE 1

0000941

samples), lead (20 samples), and cadmium (17 samples) were detected at concentrations that exceed the Florida Primary Drinking Water Standards (FPDWSs) of 50 µg/L, 50 µg/L, and 10 µg/L, respectively (Chapter 17-550, FAC; see Table 3-8). Arsenic was detected in only two samples at concentrations that exceed the FPDWS of 50 µg/L (Chapter 17-550, FAC). Zinc was detected in all samples, and copper was detected in all but three samples. The zinc and copper concentrations are well below the Florida Secondary Drinking Water Standards (FSDWSs) of 5,000 µg/L and 1,000 µg/L, respectively (Chapter 17-550, FAC). Nickel was detected in 22 samples, but the measured concentrations in only three samples exceed the Florida Groundwater Guidance Concentration (FGGC) of 150 µg/L (FDER 1989).

In general, the highest concentrations of any individual metal occurred in temporary well samples exhibiting the highest total metals concentrations. Consequently, the occurrence of metals in the Site 1 temporary well groundwater samples can be discussed from the perspective of total metals concentrations. However, it should be noted that individual samples did exhibit extremely elevated levels of one or more of the detected metals (e.g., lead as high as 1,400 µg/L and chromium as high as 1,000 µg/L; see Table 3-8).

Figure 3-[20] shows the distribution of total metals concentrations in the temporary well groundwater samples. For comparison, the figure also shows the total metals concentrations (unfiltered samples, screening group metals only) in the permanent well samples. Figure 3-[20] illustrates that no clear pattern of the distribution of elevated total metals concentrations in the temporary well groundwater samples exists and that the permanent well samples exhibit much lower total metal concentrations. As will be discussed further in Section 3.10, these results, in combination with the permanent well sample dissolved metals analytical results, strongly suggest that the detected elevated total metals concentrations in the temporary well groundwater samples probably reflect acid preservative leaching or dissolution of aquifer matrix sediments entrained in these unfiltered samples rather than actual groundwater contamination. However, even if such leaching or dissolution is occurring, the magnitude and widespread distribution of the elevated total metals concentrations detected in the temporary well



SOURCE: Ecology and Environment, Inc., 1991

KEY:

- Landfill Boundary
- Unpaved Road
- Permanent Shallow Monitoring Well
- Permanent Deep Monitoring Well
- Temporary Monitoring Well
- (2,555) Total Metals Concentration (screening group metals only, mg/kg)
- (NS) Not Sampled

Figure 3-20 TOTAL METALS CONCENTRATIONS IN GROUNDWATER SAMPLES FROM TEMPORARY MONITORING WELLS AND (SCREENING GROUP METALS ONLY) EXISTING PERMANENT MONITORING WELLS — NAS PENSACOLA SITE 1

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groundwater samples at least suggest that the aquifer matrix sediments might have been adversely impacted by migration of metal-contaminated leachate from the landfill.

TRPHs

Low levels of TRPHs were detected in only four samples (GW004, GW020, GW024, and GW026; see Table 3-8). Only the detected TRPH concentration (7.8 mg/L) in sample GW004, collected from the northern end of the landfill, exceeds the Florida Groundwater Cleanup Standard of 5 mg/L (Chapter 17-770, FAC).

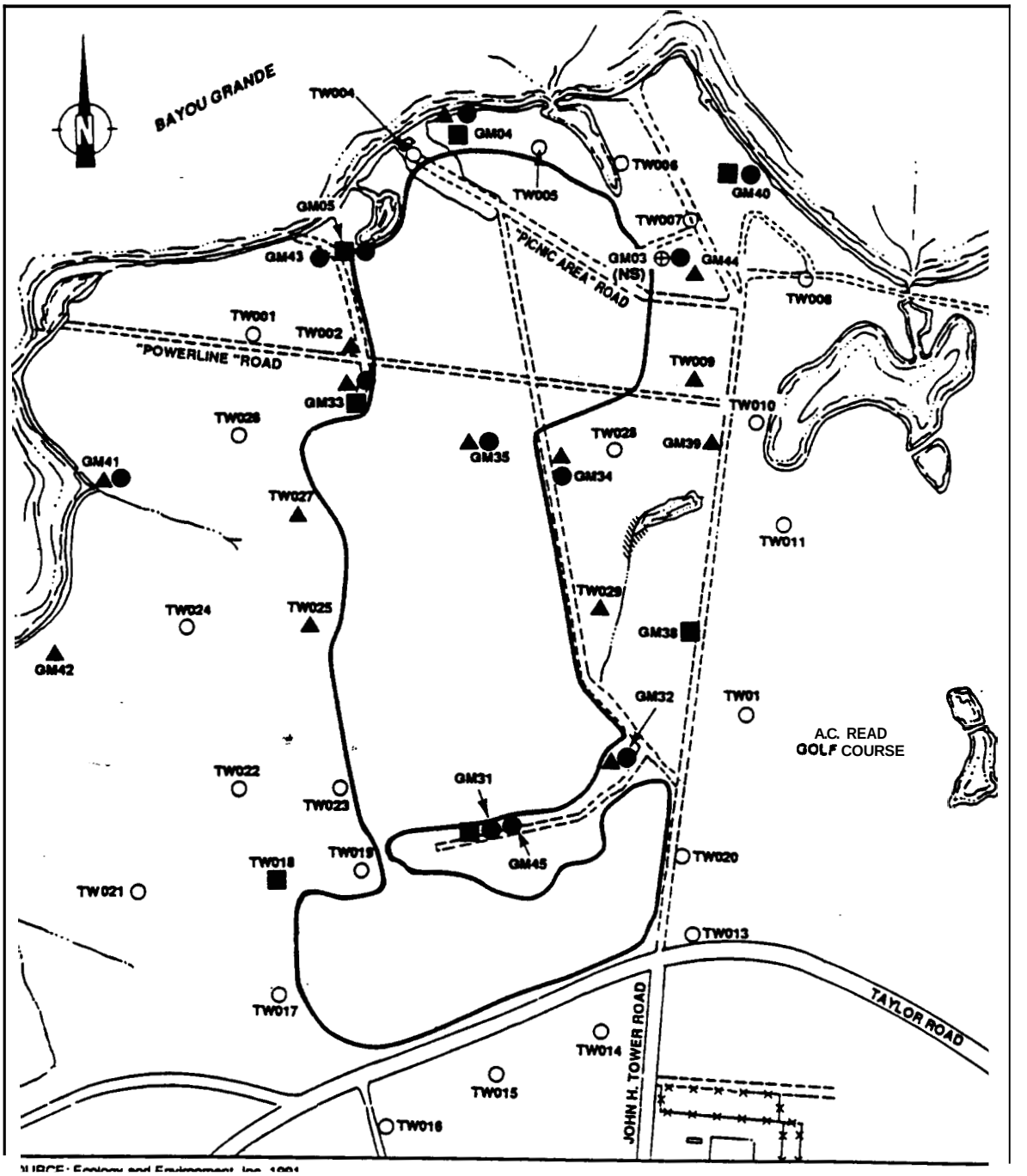
VOCs

Figure 3-[21] shows the temporary well sampling locations where VOCs were detected. VOCs (benzene, xylenes, chlorobenzene, and/or 1,4-dichlorobenzene) were detected in five samples (GW002, GW009, GW025, GW027, and GW029), collected adjacent to the east and west landfill boundaries. Two of these samples (GW025 and GW029) exhibited benzene concentrations (80 µg/L and 20 µg/L, respectively) significantly above the PPDWS of 1 µg/L (Chapter 17-550, FAC). All five samples exhibited chlorobenzene concentrations (15 to 160 µg/L) that exceed the FGGC of 10 µg/L (FDER 1989); the highest concentrations were detected in benzene-contaminated samples GW025 and GW029 (160 µg/L and 91 µg/L, respectively). Samples GW025 and GW029 also exhibited 1,4-dichlorobenzene concentrations of 22 µg/L and 29 µg/L, respectively, well below the PPDWS of 75 µg/L (Chapter 17-550, FAC). Xylenes were detected only in sample GW025, but at a concentration (18 µg/L) well below the PGGC of 50 µg/L (FDER 1989).

Tetrachlorethene was the only volatile halocarbon compound detected and was present only in sample GW018, collected near the northwestern corner of the 1960s landfill area. However, the detected concentration (19 µg/L) was significantly above the FPDWS of 3 µg/L (Chapter 17-550, FAC).

PAHs

PAHs were detected in only three of the temporary monitoring well groundwater samples (GW004, GW005, and GW025; see Figure 3-[22]).



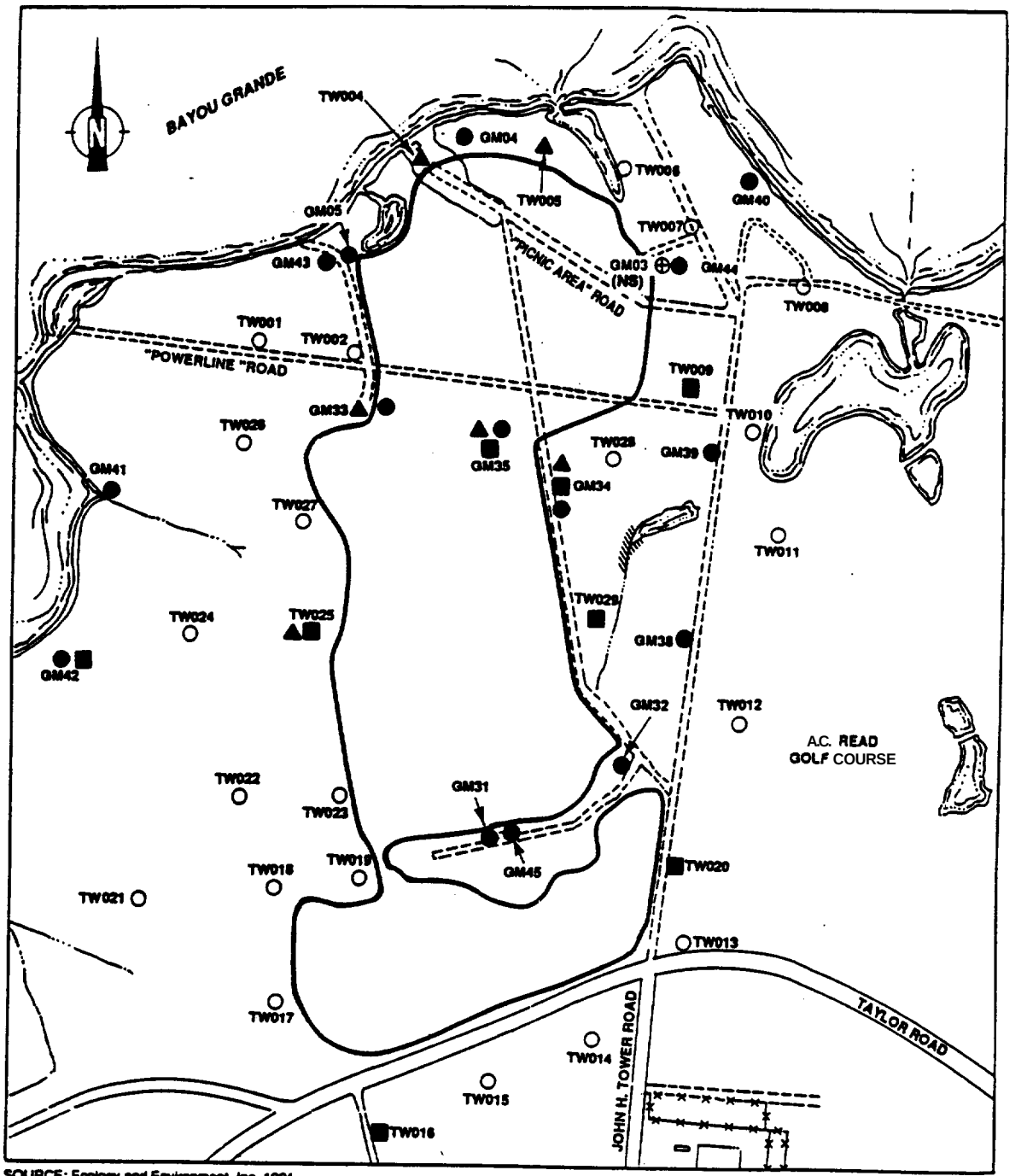
SCALE

0 500 1000 FEET

KEY

- Landfill Boundary
- Unpaved Road
- ○ Temporary Monitoring Well
- ⊕ Permanent Shallow Monitoring Well
- ▲ Groundwater Sample Where Volatile Aromatic Compounds (including chlorobenzene compounds) Detected
- ■ Groundwater Sample Where Volatile Halocarbon Compounds (excluding chlorobenzene compounds and methylene chloride) Detected
- ● Groundwater Sample Where Volatile Tentatively Identified Compounds (excluding hexane and freon 113) Detected
- (NS) Not Sampled

Figure 3-21 GROUNDWATER SAMPLES WHERE VOLATILE AROMATIC COMPOUNDS, VOLATILE HALOCARBON COMPOUNDS, AND/OR VOLATILE TENTATIVELY IDENTIFIED COMPOUNDS WERE DETECTED — NAS PENSACOLA SITE 1



SOURCE: Ecology and Environment, Inc., 1991

SCALE

0 500 1000 FEET

KEY:

- Landfill Boundary
- Unpaved Road
- ○ Temporary Monitoring Well
- ⊕ Permanent Shallow Monitoring Well
- ▲ Groundwater Sample Where PAHs (temporary wells) or Base/Neutral Extractables (excluding dichlorobenzenes and phthalates; permanent wells) Detected
- ■ Groundwater Sample Where Phenols (temporary wells) or Acid Extractables (permanent wells) Detected
- ● Groundwater Sample Where BNA Extractable Tentatively Identified Compounds (excluding 2,2'-oxybis-ethanol) Detected
- (NS) Not Sampled

Figure 3-22 GROUNDWATER SAMPLES WHERE PAHs — BASE/NEUTRAL EXTRACTABLES, PHENOLS — ACID EXTRACTABLES, AND/OR BNA EXTRACTABLE TENTATIVELY IDENTIFIED COMPOUNDS WERE DETECTED — NAS PENSACOLA SITE 1

Samples GW005 and GW025 exhibited PAH concentrations below the detection limit of 100 µg/L. In contrast, sample GW004 exhibited a clearly elevated PAR concentration of 250 µg/L. This concentration exceeds the potentially applicable FDER Groundwater Cleanup Standards for naphthalene (100 µg/L) and total PAHs excluding naphthalene (10 µg/L; Chapter 17-770, FAC).

Phenols

Elevated phenol concentrations were detected in four of the temporary monitoring well samples: GW009 (170 µg/L), GW020D (150 µg/L), GW025 (320 µg/L), and GW029 (180 µg/L; see Figure 3-[22] and Table 3-8). These concentrations could exceed FGGCs for specific phenol species (e.g., FGGC for phenol is 20 µg/L; FDER 1989). In addition, phenols were detected in sample GW016 at a concentration lower than the analytical method detection limit of 100 µg/L (see Table 3-8).

3.9.4.3 [TAL and] TCL Parameters

Tables 3-9 and 3-10 summarize the analytical results for the groundwater samples collected from the existing permanent monitoring wells in the vicinity of Site 1. These samples were analyzed for the [TAL and] TCL parameter group[s], TRPHs, total alkalinity, total hardness, total organic carbon, and gross alpha radioactivity. Figures [3-20, 3-21, and 3-22] show the locations of the existing permanent monitoring wells on Site 1. The complete [TAL and] TCL analytical results for the groundvater samples are presented in Appendix I.

In general, one or more of the samples exhibited elevated levels of metals, VOCs, and base/neutral acid extractable organic compounds (BNAs). A greater variety and higher concentrations of metals were detected in the unfiltered (total metals) samples than in the filtered (dissolved metals) samples. TRPHs were detected in only one sample. Cyanide, pesticides, and PCBs were not detected in any of the samples. Analytical results were generally consistent vith those of G & M (1986), except for G 6 M's detection of benzene contamination in deeper well samples and the magnitude and distribution of vinyl chloride contamination. High levels of contamination were not detected in deeper well

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Table 3-9

SUMMARY TAL METALS ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES
(FROM PERMANENT MONITORING WELLS)
NAS PENSACOLA SITE 1
(All results in µg/L, unless noted)

Parameter	[Detection Limit	Sample Number (Location) P01W004 (GM04]	P01W005 (GM05)	P01W031 (OH31)	[FPDWS/ FSDWS
Total Metals					
Aluminum	62	259	1,060(E)	466(E)	
Arsenic	1	2(W)	1.1(M)	--	50
Barium	**10**	59.2	16.8	--	1,000
Beryllium	**1**	--	2.8	1.1	
cadmium	1	--	--	--	10
Calcium	**500**	87,900	1,280	9,170	
Chromium	10	--	6.5*	--	SO
Cobalt	12	--	9.5	--	
Copper	15	16.5	7.5	4.5	1,000
Iron	19	13,200	1,220	2,130	*300*
Load	1	1.4	2.6	1.1(M)	SO
Magnesium	**500**	2,030.	1,400	2,150	
Manganese	2	221	108	44.9	SO
Nickel	10	--	15.4	11.6	
Potassium	**500**	1,030	1,030	983	
Selenium	1	--	1.2(M)	--	10
Silver	7	--		--	SO
Sodium	**500**	5,990	7,140	6,450	160,000
Vanadium	10	--	--	--	
Zinc	4	12.3	15.7	75.2.	**5,***000*
Dissolved Metals					
Aluminum	62	178	192(E)	76.9(E)	
Arsenic	1	2.1(W)	--	--	**50**
Barium	10	55.9	10.3	--	1.000
Cadmium	1	--	--	--	10
Calcium	**500**	87,900	1,320	7,840	
Chromium	10	--	6.2*	13.4*	SO
Cobalt	12	--	--		
Copper	**15**		5.1	2.8	1,000
Iron	19	9,900	463	1,320	300
Lead	1	--	--		50
Magnesium	**500**	2,030	1,440	2,180	
Manganese	**2**	213	107	34	*50*
Nickel	10	--	10.4	--	
POtassium	**500**	961	1,180	960	
Selenium	1	--	--	--	10
Sodium	**500**	5,410	7,120	6,440	160,000
Vanadium	10	--	--	--	
Zinc	**4]**	7.8	13.8*	7.74	**5,000]**

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Key at end of table.

[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-9 (Cont.)

Parameter	[Detection Limit	Sample Number (Location) P01W032 (GM32)	P01W033 (GM33)	P01W034 (GM34)	[PPDWS/ PSDWS
Total Metals					
Aluminum	62	1,290	572(E)	390	
Arsenic	1	5.3	20.3	—	50
Barium	10	131	20.3	202	1,000
Beryllium	1				
Cadmium	1	5.4	—	—	10
Calcium	500	21,300	59,300	58,600	
Chromium	10	11.3	7.1*		50
Cobalt	12		—	—	
Copper	15		5.6	—	1,000
Icon	19	19,300,	36,300	41,000	300
Lead	1	7.1	2(M)	4.5	50
Magnesium	500	2,470	3,640	3,160	
Manganese	2	271	267	241	50
Nickel	10	—		—	
Potassium	500	002	3,010	1,050	
Selenium	1	1.1(M)		—	10
Silver	7		—	—	50
Sodium	500	0,100	6,370	5,520	160,000
Vanadium	10		24.6	11.2	
zinc	4	161	162'	3S0	5,000
Dissolved Metals					
Aluminum	62	103	12(E)	—	
Arsenic	1	—	10.0	—	50
Barium	10	113	15.9	262	1,000
Cadmium	1	—	—	5.5	10
Calcium	500	20,700	60,000	71,000	
Chromium	10	—	6.5*	—	50
Cobalt	12	—	—	—	
Copper	15	—	2.3		1,000
Icon	19	6,530	20,200	47,100	300
Lead	1	—	—	2.2(W)	50
Magnesium	500	2,390	3,750	3.970	
Manganese	2	272	270	279	50
Nickel	10	—	9.1	—	
Potassium	500	790	3,230	2,440	
Selenium	1	—	—	—	10
Sodium	500	0,330	5,520	6,650	160,000
Vanadium	10	—	19.9	14.2	
Zinc	4]	59.4	11.5'	20.1	5,000]

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[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-9 (Cont.)

Parameter	[Detection Limit	Sample Number (Location) P01W035 (GM35)	P01W038 (GM38)	P01W039 (GM39)	IFPDWS/ IS —
Total Metals					
Aluminum	62	801	21,400	4,300	
Arsonic	1	8.2	8.5	41.4	SO
Barium	10	53.7	46.5	15	1,000
D. rylliium	1	--	--	--	
Cadmium	1	--	--	--	10
Calcium	500	37,300	14,700	15,500	
Chromium	10	24.8	43.8	14.7	SO
Cobalt	12	--	--	--	
Copper	15		--	--	1,000
Icon	19	48,800	29,800	43,800	300
Lead	1	5.3	5.8	5.1	SO
Magnesium	500	4,110	3,060	3,100	
Manganese	2	401	40	317	SO
Nickel	10	--	--	--	
Potassium	500	4,710	2,600	3,580	
Selenium	1	--	--	--	10
Silver	7	--	--	--	SO
Sodium	500	6,660	6,570	7,760	160,000
Vanadium	10	14.4	101	13.7	
Zinc	4	44.3	37	18.3	5,000
Dissolved Metals					
Aluminum	62	--	--	68.5	
Arsonic	1	6.3	--	14	50
Barium	10	48.1	--	10.1	1,000
Cadmium	1	6.7	--	--	10
Calcium	500	38,600	14,100	16,200	
Chromium	10	--	--	--	SO
Cobalt	12	--	--	--	
Copper	15	--	--	--	1,000
Iron	19	45,300	43	25,600	300
Load	1		--	--	SO
Magnesium	500	4,250	2,360	3,220	
Manganese	2	412	12.1	326	50
Nickel	10	--	--	--	
Potassium	500	5,100	2,130	3,730	
Selenium	1	--	1.1(W)	--	10
Sodium	500	7,010	6,400	8,270	160,000
Vanadium	10	13.7	--	--	
Zinc	41	24.4	--	60.8	5,000]

14[NASP]UH6017:T0260/348/19

Key at end of table.

[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-9 (Cont.)

Parameter	[Detection Limit	Sample Number (Location) P01W040 (GM40)	P01W041 (GM41)	P01W042 (GM42)	[PPDWS/ PSDWS
Total Metals					
Aluminum	62	210,000	2,500(E)	5,740(E)	
Arsenic	1	7.4	1.2(M)	59.8	W
Barium	10	271	24.2	27.0	1,000
Beryllium	1	—	—	1.0	
Cadmium	1	22.2	—	10.0	10
Calcium	500	653	904	907	
Chromium	10	176	7.1*	10.7.	50
Cobalt	12	26.0	—	—	
Copper	15	9Y.3	5.1	9.0	1,000
Iron	19	140,000	1,140	57,500	300
Lead	1	42.5		4.3	50
Magnesium	500	5,630	1,470	1,040	
Manganese	2	1,340	S16	160	W
Nickel	10	99.9		—	
Potassium	n 0	3,670	1,110	2,700	
Selenium	1	—		—	10
Silver	7	—	3.5	—	W
Sodium	500	37,900	10,900	10,600	160,000
Vanadium	10	236		41.3	
Zinc	4	188	4.4*	23.0.	5,000
Dissolved Metals					
Aluminum	62	6Y7	227(E)	104(E)	
Arsenic	1	—		59.8	50
Barium	10	—	18	15.9	1,000
Cadmium	1	—	—	—	10
Calcium	500	—	805	732	
Chromium	10	—	7.6*	6*	50
Cobalt	12	—	s.7	5.9	
Copper	15	—	6.2	3.2	1,000
Iron	19	512	93.3	45,700	300
Lead	1	—	—	—	50
Magnesium	500	—	1,320	935	
Manganese	2	1.9	4Y1	150	50
Nickel	10		13.1	—	
Potassium	500	—	1,300	3,040	
Selenium	1	—		—	10
Sodium	500	35,500	10,500	13,200	160,000
Vanadium	10	—	—	33.5	
Zinc	4]	—	8.6*	13.3*	5,000]

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Key at end of table.

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[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-9 (Cont.)

Parameter	[Detection Limit	Sample Number (Location) P01W043 (GM43)	P01W044 (GM44)	P01W045 (GM45)	[FPDWS/ FSDWS
Total Metals					
Aluminum	62	295	147	115(E)	
Arsenic	1	--	--	--	SO
Barium	10	11.6	13.3	12.6	1,000
Beryllium	1	--		--	
Cadmium	1		--	--	10
Calcium	**500**	25,600	49,900	13,900	
Chromium	10	--	10.5	7.6*	SO
Cobalt	12	--	--		
Copper	**15**	--	--	5.1	1,000
Iron	19	3,590	2,800	3,450	300
k 8 d	1	1.8	1.6	--	SO
Magnesium	**500**	1,660	2,010	1,700	
Manganese	2	96.9	89.9	50.6	SO
Nickel	10	--	9.4	12.1	
Potassium	**500**	707	1,420	**808**	
Selenium	1	--	--	--	10
Silver	7	--	--	--	SO
Sodium	**500**	5,590	7,760	10,300	160,000
Vanadium	10	--	--	7.1	
Zinc	4	12	10	55.4.	**5,000**
Dissolved Metals					
Aluminum	62	473	72.4	36.9(E)	
Arsonic	1	--	--	1.8(M)	SO
Barium	10		12.3	10.3	1,000
Cadmium	1	--	--	--	10
Calcium	**500**	23,100	50,500	13,700	
Chromium	10	--		--	SO
Cobalt	12	--	--	--	
Copper	15	--	--	3	1,001
Iron	19	2,540	134	3 140	300
k 8 d	1	--	1.3(M)	--	SO
Magnesium	**500**	1,620	2,110	1 630	
Manganese	2	*88.8*	71.3	8.6	SO
Nickel	10	--	--	--	
Potassium	**500**	751	1,300	819	
Selenium	1	--	--	--	10
Sodium	**500**	5,780	7,210	11 100	160,*000*
Vanadium	**10**	--	--	--	
Zinc	**4]**	7	12.4	9.44	5,0001

14[NASP]UH6017:T0260/348/19

Key :

[FPDWS = Florida Primary Drinking **Water Standard.**
FSDWS = Florida Secondary Drinking **Water Standard.]**

Dash (--) indicates compound not detected.
*Duplicate analysis not within control limits.
+Correlation coefficient for tho MSA is loss than 0.995.

Qualifiers:
(E) = Reported value is estimated because of tho presence of interference.
(M) = Duplicate injection precision not mot.
(W) = Post digestion spike for furnace AA analysis is out of control limits (85-115%), while sample absorbance is loss than 502 of spike absorbenco.

Source: Ecology and Environment, fnc., 1991.

[Bold items enclosed *io* brackets denote **changes** to the last version of document]

Table 3-10

SUMMARY TCL ORGANIC AND INORGANIC ANALYTICAL RESULTS
FOR GROUNDWATER SAMPLES
(FROM PERMANENT MONITORING WELLS)
NAS PENSACOLA SITE 1
(All results in µg/L, unless noted)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W004 (GM04)	P01W005 (GM05)	P01W031 (GM31)	[FPDWS/ PSDWS
TRPHS (mg/L)	1	—	—	—	
Vinyl Chloride	10	—	10	16	1
Methylene Chloride	10	20(B[a])	30(B[a])	14(B[a])	
Acetone	10	22(B[a])	—	33(B[a])	
Carbon Disulfide	5	—	—	—	
1,1-Dichloroethene	5	—	—	—	7
1,2-Dichloroethene (Total)	5	9	7	—	
Chloroform	5	—	—	—	
Bromodichloromethane	5	—	—	—	
Trichloroethene	5	4(J)	—	—	3
Benzene	5	—	—	—	1
Toluene	5	—	—	—	
Chlorobenzene	5	23	—	—	
Ethylbenzene	5	—	—	—	
Total Xylenes	5	—	—	—	
Phenol	10	—	—	—	
1,4-Dichlorobenzene	10	6(J)	—	—	**75]**
1,2-Dichlorobenzene	10	—	—	—	
Bis(2-Chloroisopropyl)Ether	10	—	—	—	
4-Methylphenol	10	—	—	—	
2,4-Dimethylphenol	10	—	—	—	
Naphthalene	10	—	—	—	
2-Methylnaphthalene	10	—	—	—	
N-Nitrosodiphenylamine	10	—	—	—	
Phenanthrene	10	—	—	—	
Di-N-Butyl-Phthalate	10	—	—	—	
Bis(2-Ethylhexyl)Phthalate	10	6(B[a],J)	3(B[a],J)	2(B[a],J)	
Di-N-Octyl Phthalate	**10]**	—	—	1(J)	
Tentatively Identified Compounds[1]					
Freon 113		9(B[a],J)	—	—	
2-Butoxy-Ethanol-Phosphate		—	—	—	
Hexane		13(B[a],J)	18(B[a],J)	12(B[a],J)	
2,2'-Oxybis-Ethanol		—	—	—	
N,N-Dimethyl-Benzenamine		—	—	—	
2-Propenyl-Benzene		—	—	—	
Alkyl **Benzene**		—	—	—	
Butyl **Phenol** Isomer		—	—	—	
Diethyl Benzene Isomer		10(J)	—	—	
Dihydro Methyl Indene Isowr		—	—	—	
Dimethyl Naphthalene Isomer		—	—	—	
Ethyl Methyl Benzene Isomer		—	—	—	
Methyl Indene Isowr		—	—	—	
Methyl Methyl Ethyl Benzene		—	—	—	
Methyl Naphthalene Isomer		—	—	—	
Methyl Propyl Benzene **Isomer**		—	—	—	
N-Ethyl-Methyl **Benzene** Sulfanamide		—	—	—	
Tetramethyl Benzene Isowr		—	—	—	
Trimethyl Benzene Isowr		—	—	—	

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Key at end of table.

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[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-10 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W004 (GM04)	P01W005 (GM05)	P01W031 (GM31)	[FPDWS/ FSDWS]
Unknown Alkyl Benzene		--	--	--	
Unknown Naphthalene		--	--	--	
Unknown Acid		--	--	--	
Unknown Alcohol		13(B[a],J)	--	--	
Unknown Amide		--	--	--	
Unknown Aromatic		--	--	--	
Unknown Hydrocarbon		(3) 71(J)	(4) 63(J)	14(J)	
Unknown Hydrocarbon		--	--	--	
Unknown Ketone		--	--	--	
Unknown Oxy-Hydrocarbon		--	--	--	
Unknown Phenol		--	--	--	
Unknown Siloxane		--	--	32(J)	
Unknown Compound		10(J)	(2) 57(J)	(4) 207(J)	
Unknown Compound		--	(2) 59(B[a],J)	(2) 87(B[a],J)	
Total Alkalinity (mg/L as $CaCo_3$)	1	230	--	13	
Total Hardness (mg/L as $CaCo_3$)	1	240	14	28	
Total Organic Carbon (mg/L)	1]	24	9.8	12	
Gross Alpha Radioactivity (pCi/L)		3±2	<2	<2	

14[NASP]UH6017:T0260/349/9

Key at end of table.

[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-10 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W032 (GM32)	P01W033 (GM33)	P01W034 (GM34)	[FPDWS/ PSDWS
TRPHs (mg/L)	1	—	—	1.4	
Vinyl Chloride	10	—	—	—	1
Methylene Chloride	10	6(B[a])	14(B[a])	18(B[a])	
Acetone	10	12(B[a])	2(B[a])	26(B[a])	
Carbon Disulfide	5	2(J)	—	1(J)	
1,1-Dichloroethene	5	—	3(J)	—	7
1,2-Dichloroethene (Total)	5	—	—	—	
Chloroform	5	—	—	—	
Bromodichloromethane	5	—	—	—	
Trichloroethene	5	—	3(J)	—	3
Benzene	5	—	5	54	1
Toluene	5	—	5	—	
Chlorobenzene	5	3(J)	16	16	
Ethylbenzene	5	—	86	8	
Total Xylenes	5	—	63(B[a])	1(B[a],J)	
Phenol	10	—	—	2(J)	
1,4-Dichlorobenzene	10	—	2(J)	8(J)	75]
1,2-Dichlorobenzene	10	—	—	—	
Bis(2-Chloroisopropyl)Ether	10	—	—	—	
4-Methylphenol	10	—	—	—	
2,4-Dimethylphenol	10	—	—	—	
Naphthalene	10	—	26	3(J)	
2-Methylnaphthalene	10	—	5(J)	5(J)	
N-Nitrosodiphenylamine	10	—	—	2(J)	
Phenanthrene	10	—	—	1(J)	
Di-N-Butyl-Phthalate	10	—	1(B[a],J)	—	
Bis(2-Ethylhexyl)Phthalate	10	10(B[a])	3(B[a],J)	6(B[a],J)	
Di-N-Octyl Phthalate	10]	—	—	—	
Tentatively Identified Compounds*					
Freon 113		7(B[a],J)	—	—	
2-Butoxy-Ethanol-Phosphate		—	—	—	
Hexane		11(B[a],J)	—	9(B[a],J)	
2,2'-Oxybis-Ethanol		53(B[a],J)	—	—	
N,N-Dimethyl-Benzenamine		—	—	—	
2-Propenyl-Benzene		—	—	—	
Alkyl Benzene		—	(2) 165(J)	—	
Butyl Phenol Isomer		—	—	—	
Diethyl Benzene Isomer		—	13(J)	—	
Dihydro Methyl Indene Isomer		—	(3) 170(J)	—	
Dimethyl Naphthalene Isomer		—	—	(2) 20(J)	
Ethyl Methyl Benzene Isomer		—	(2) 27(J)	—	
Methyl Indene Isomer		—	—	—	
Methyl Methyl Ethyl Benzene		—	88(J)	—	
Methyl Naphthalene Isomer		—	—	11(J)	
Methyl Propyl Benzene Isomer		—	—	—	
N-Ethyl-Methyl Benzene Sulfanamide		—	—	—	
Tetramethyl Benzene Isomer		—	(3) 133(J)	—	
Trimethyl Benzene Isomer		—	32(J)	—	

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Key at end of table.

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Table 3-10 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W032 (GM32)	P01W033 (GM33)	P01W034 (GM34)	[FPDWS/ FSDWS]
Unknown Alkyl Benzene		--	(3) 53(J)	--	
Unknown Naphthalene		--	9(J)	--	
Unknown Acid		(3) 210(J)	--	--	
Unknown Alcohol		--	--	--	
Unknown Amide		--	--	--	
Unknown Aromatic		--	(4) 94(J)	--	
Unknown Hydrocarbon		(3) 30(J)	(2) 36(J)	(11) 235(J)	
Unknown Hydrocarbon		140(B[a],J)	--	--	
Unknown Ketone		--	--	11(B[a],J)	
Unknown Oxy-Hydrocarbon		--	--	--	
Unknown Phenol		14(J)	--	--	
Unknown Siloxane		--	--	--	
Unknown Compound		(3) 64(J)	(6) 201(J)	(7) 310(J)	
Unknown Compound		--	79(B[a],J)	31(B[a],J)	
Total Alkalinity (mg/L as $CaCo_3$)	1	50	180	250	
Total Hardness (mg/L as $CaCo_3$)	1	59	160	180	
Total Organic Carbon (mg/L)	11	9.9	19	20	
Gross Alpha Radioactivity (pCi/L)		3±2	<2	<2	

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Table 3-10 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W035 (GM35)	P01W038 (GM38)	P01W039 (GM39)	[FPDWS/ PSDWS
TRPHs (mg/L)	1	—	—	—	
Vinyl Chloride	10	—	—	—	1
Methylene Chloride	10	7(B[a])	8(B[a])	6(B[a])	
Acetone	10	25(B[a])	15(B[a])	14(B[a])	
Carbon Disulfide	5	—	5(B[a])	6(B[a])	
1,1-Dichloroethene	5	—	—	—	7
1,2-Dichloroethene (Total)	5	—	—	—	
Chloroform	5	—	—	—	
Bromodichloromethane	5	—	—	—	
Trichloroethene	5	—	3(J)	—	3
Benzene	5	7	—	2(J)	1
Toluene	5	—	—	—	
Chlorobenzene	5	18	—	4(J)	
Ethylbenzene	5	2(J)	—	—	
Total Xylenes	5	2(J)	—	—	
Phenol	10	—	—	—	
1,4-Dichlorobenzene	10	9(J)	—	1(J)	75]
1,2-Dichlorobenzene	10	5(J)	—	—	
Bis(2-Chloroisopropyl)Ether	10	5(J)	—	—	
4-Methylphenol	10	—	—	—	
2,4-Dimethylphenol	10	5(J)	—	—	
Naphthalene	10	14	—	—	
2-Methylnaphthalene	10	3(J)	—	—	
Hexachlorodiphenylamine	10	—	—	—	
Phenanthrene	10	—	—	—	
Di-N-Butyl-Phthalate	10	—	—	—	
Bis(2-Ethylhexyl)Phthalate	10	13(B[a])	13(B[a])	9(B[a],J)	
Di-N-Octyl Phthalate	101	—	—	—	
Tentatively Identified Compounds*					
Freon 113		7.6(B[a],J)	8.2(B[a],J)	6.3(B[a],J)	
2-Butoxy-Ethanol-Phosphate		28(J)	—	—	
Hexane		10(B[a],J)	12(B[a],J)	11(B[a],J)	
2,2'-Oxybis-Ethanol		96(B[a],J)	38(B[a],J)	46(B[a],J)	
N,N-Dimethyl-Benzenamine		—	—	—	
2-Propenyl-Benzene		19(J)	—	—	
Alkyl Benzene		—	—	—	
Butyl Phenol Isomer		(2) 52(J)	—	—	
Diethyl Benzene Isomer		—	—	—	
Dihydro Methyl Indene Isomer		—	—	—	
Dimethyl Naphthalene Isomer		—	—	—	
Ethyl Methyl Benzene Isomer		—	—	—	
Methyl Indene Isomer		7(J)	—	—	
Methyl Methyl Ethyl Benzene		—	—	—	
Methyl Naphthalene Isomer		—	—	—	
Methyl Propyl Benzene Isomer		15(J)	—	—	
N-Ethyl-Methyl Benzene Sulfonamide		(2) 96(J)	—	—	
Tetramethyl Benzene Isomer		13(J)	—	—	
Trimethyl Benzene Isomer		6(J)	—	—	

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Table 3-10 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W035 (GM35)	P01W038 (GM38)	P01W039 (GM39)	[FPDWS/ FSDWS]
Unknown Alkyl Benzene		--	--	--	
Unknown Naphthalene		--	--	--	
Unknown Acid	(2)	110(J)	14(J)	--	
Unknown Alcohol		--	--	--	
Unknown Amide		--	--	--	
Unknown Aromatic		--	--	--	
Unknown Rydrocatbon		9(J)	--	--	
Unknown Rydrocatbon		220(B[a],J)	140(B[a],J)	47(B[a],J)	
Unknown Ketone		--	--	--	
Unknown Oxy-Rydrocarbon		15(J)	--	--	
Unknown Phenol		--	--	--	
Unknown Siloxane		--	--	--	
Unknown Compound	(4)	91(J)	16(J)	14(J)	
Unknown Compound		--	--	--	
Total Alkalinity (mg/L as $CaCo_3$)	1	190	18	90	
Total Hardness (mg/L as $CaCo_3$)	1	100	34	42	
Total Organic Carbon (mg/L)	1]	16	19	17	
Gross Alpha Radioactivity (pCi/L)		3±2	4±2	3±2	

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[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-10 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W040 (GM40)	P01W041 (GM41)	P01W042 (GM42)	[FPDWS/ FSDWS
TRPHs (mg/L)	1	—	—	—	
Vinyl Chloride	10	—	—	—	1
Methylene Chloride	10	18(B[a])	14(B[a])	6(B[a])	
Acetone	10	21(B[a])	18(B[a])	15(B[a])	
Carbon Disulfide	[illegible]	—	—	—	
1,1-Dichloroethene	5	—	—	—	7
1,2-Dichloroethene (Total)	[illegible]	—	—	8	
Chloroform	5	13	—	—	
Bromodichloromethane	5	3(J)	—	—	
Trichloroethene	5	—	—	—	3
Benzene	5	—	2(J)	—	1]
Toluene	[illegible]	—	—	—	
Chlorobenzene	[illegible]	—	15	—	
Ethylbenzene	5	—	—	3(J)	
Total **Xylenes**	[illegible]	—	—	—	
Phenol	10	—	—	—	
1,4-Dichlorobenzene	10	—	2(J)	—	75
1,2-Dichlorobenzene	10	—	1(J)	—	
Bis(2-Chloroisopropyl)Ether	10	—	—	—	
4-Methylphenol	10	—	—	1(J)	
2,4-Dimethylphenol	10	—	—	—	
Naphthalene	10	—	—	—	
2-Methylnaphthalene	10	—	—	—	
N-Nitrosodiphenylamine	10	—	—	—	
Phenanthrene	10	—	—	—	
Di-N-Butyl-Phthalate	10	—	1(B[a],J)	1(B[a],J)	
Bis(2-Ethylhexyl)Phthalate	10	5(B[a],J)	3(B[a],J)	3(B[a],J)	
Di-N-Octyl Phthalate	**10]**	—	—	2(J)	
Tentatively Identified Compounds*					
Freon 113		5(B[a],J)	—	—	
2-Butoxy-Ethanol-Phosphate		—	—	—	
Hexane		12(B[a],J)	11(B[a],J)	10(B[a],J)	
2,2'-Oxybis-Ethanol		—	—	—	
N,N-Dimethyl-Benzenamine		—	—	—	
2-Propenyl-Benzene		—	—	—	
Alkyl **Benzene**		—	—	—	
Butyl Phenol Isowr		—	—	—	
Diethyl **Benzene** Isowr		—	—	—	
Dihydro Methyl Indene Isomer		—	—	—	
Dimethyl Naphthalene Isorr		—	—	—	
Ethyl Methyl **Benzene** Isorr		—	—	—	
Methyl Indene Isorr		—	—	—	
Hothyl Methyl Ethyl Benzene		—	—	—	
Methyl Naphthalene Isorr		—	—	—	
Methyl **Propyl Benzene** Isomer		—	—	—	
N-Ethyl-Methyl Benzene Sulfonamide		—	—	—	
Tetramethyl **Benzene** Isomer		—	—	—	
Trimethyl **Benzene** Isomer		—	—	—	

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[Bold items enclosed in brackets denote changes to the last version of document]

Table 3-10 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W040 (GM40)	P01W041 (GM41)	P01W042 (GM42)	[FPDMS/ FSDMS]
Unknown Alkyl Benzene		--	--	--	
Unknown Naphthalene		--	--	--	
Unknown Acid		--	--	--	
Unknown Alcohol		9(B[a],J)	--	--	
Unknown Amide		10(J)	--	--	
Unknown Aromatic		--	--	--	
Unknown Hydrocarbon		(6) 72(J)	--	(8) 107(B[a],J)	
Unknown Hydrocarbon		250(B[a],J)	--	--	
Unknown Ketone		--	--	--	
Unknown Oxy-Hydrocarbon		--	--	--	
Unknown Phenol		--	--	--	
Unknown Siloxone		--	--	--	
Unknown Compound		(3) 123(J)	(5) 164(J)	(8) 213(J)	
Unknown Compound		(2) 260(B[a],J)	(2) 58(B[a],J)	27(B[a],J)	
Total Alkalinity (mg/L as $CaCo_3$)	1	44	--	58	
Total Hardness (mg/L as $CaCo_3$)	1	43	--	16	
total Organic Carbon (mg/L)	1]	78	5.4	26	
Gross Alpha Radioactivity (pCi/L)		9i3	<2	<2	

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[Bold items enclosed in brackets denote changes to tho last version of document]

Table 3-10 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W043 (GM43)	P01W044 (GM44)	P01W045 (GM45)	[FPDWS/ FSDWS
TRPHs (mg/L)	1	—	—	—	
Vinyl Chloride	10	—	—	—	1
Methylene Chloride	10	50(B[a])	5(B[a])	11(B[a])	
Acetone	10	16(B[a])	22(B[a])	10(B[a])	
Carbon Disulfide	5	5(B[a])	—	—	
1,1-Dichloroethene	5	—	—	—	7
1,2-Dichloroethene (Total)	5	—	—	—	
Chloroform	5	—	—	—	
Bromodichloromethane	5	—	—	—	
Trichloroethene	5	—	—	—	3
Benzene	5	—	—	—	1
Toluene	5	—	—	—	
Chlorobenzene	5	—	—	—	
Ethylbenzene	5	—	—	—	
Total Xylenes	5	—	2(J)	—	
Phenol	10	—	—	—	
1,4-Dichlorobenzene	10	—	—	—	75]
1,2-Dichlorobenzene	10	—	—	—	
Bis(2-Chloroisopropyl)Ether	10	—	—	—	
4-Methylphenol	10	—	—	—	
2,4-Dimethylphenol	10	—	—	—	
Naphthalene	10	—	—	—	
2-Methylnaphthalene	10	—	—	—	
N-Nitrosodiphenylamine	10	—	—	—	
Phenanthrene	10	—	—	—	
Di-N-Butyl-Phthalate	10	—	4(B[a],J)	4(B[a],J)	
Bis(2-Ethylhexyl)Phthalate	10	12(B[a])	9(B[a],J)	3(B[a],J)	
Di-N-Octyl Phthalate	10]	—	—	—	
Tentatively Identified Compounds*					
Freon 113		7.2(B[a],J)	—	—	
2-Butoxy-Ethanol-Phosphate		—	—	—	
Hexane		10(B[a],J)	5(B[a],J)	10(B[a],J)	
2,2'-Oxybis-Ethanol		40(B[a],J)	78(B[a],J)	—	
N,N-Dimethyl-Benzenamine		—	9(B[a],J)	—	
2-Propenyl-Benzene		—	—	—	
Alkyl Benzene		—	—	—	
Butyl Phenol Isomer		—	—	—	
Diethyl Benzene Isomer		—	—	—	
Dihydro Methyl Indene Isomer		—	—	—	
Dimethyl Naphthalene Isomer		—	—	—	
Ethyl Methyl Benzene Isomer		—	—	—	
Methyl Indene Isomer		—	—	—	
Methyl Methyl Ethyl Benzene		—	—	—	
Methyl Naphthalene Isomer		—	—	—	
Methyl Propyl Benzene Isomer		—	—	—	
N-Ethyl-Methyl Benzene Sulfonamide		—	—	—	
Tetramethyl Benzene Isomer		—	—	—	
Trimethyl Benzene Isomer		—	—	—	

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Table 3-10 (Coat.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W043 (GM43)	P01W044 (GM44)	P01W045 (GM45)	[FPDWS/ FSDWS]
Unknown Alkyl Benzene		--	--	--	
Unknown Naphthalene		--	--	--	
Unknown Acid		--	22(J)	--	
Unknown Alcohol		--	--	--	
Unknown Amide		--	--	--	
Unknown Aromatic		--	--	--	
Unknown Hydrocarbon		--	--	--	
Unknown Hydrocarbon		150(B[a],J)	130(B[a],J)	--	
Unknown Ketone		--	--	--	
Unknown oxy-Hydrocarbon		--	--	--	
Unknown Phenol		--	--	--	
Unknown Siloxane		--	--	10(J)	
Unknown Compound		(3) 33(J)	(2) 15(J)	(2) 145(J)	
unknown Compound		--	(2) 15(B[a],J)	--	
Total Alkalinity (mg/L as $CaCo_3$)	1	75	150	26	
Total Hardness (mg/L as $CaCo_3$)	1	61	120	26	
Total Organic Carbon (mg/L)	1]	--	1.8	3.3	
Gross Alpha Radioactivity (pCi/L)		3±2	3±2	<2	

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Note: The number within parentheses preceding tho concontration is tho number of tentatively identified compounds (TICs) in this parameter group. Tho listed concontration represents tho sum of tho individual group-member concentrations.

Key:

[FPDWS = Florida Primary Drinking Water Standard.
FSDWS = Florida Secondary Drinking Water Standard.]

Dash (--) indicates compound not detected.

[*Values for TICs are estimated. No detection limits were established for TICs.]

Qualifiers:

(B[a]) = Present in method blank.
(J) = [For non-TICs,] estimated value; compound present [but] below detection limit. [Also indicates that TIC concentrations are estimated because no detection limits were established.]

Source: Ecology and Environment, Inc., 1991.

[Bold items enclosed in brackets denote changes to tho last version of document]

samples, but potential groundvater contamination belov the surficial zone of the Sand-and-Gravel Aquifer was suggested by the analytical results.

Metals

As shown in Table 3-10, only five metals (calcium, magnesium, manganese, potassium, and sodium) were commonly detected at similar levels in both the total and dissolved metal samples. Of these five metals, only manganese and sodium are subject to a Florida Groundwater standard or guidance concentration. Manganese was detected in all but two of the total metals samples (W031 and W038) and all but four of the dissolved metals samples (W031, W038, W040, and W045) at Concentrations that exceed the FSDVS of 50 µg/L (Chapter 17-550, PAC). The highest total manganese concentration (1,340 µg/L) was detected in the sample (W040) that also exhibited the lowest dissolved manganese concentration (9.9 µg/L). All three deep well total metal samples (W043, W044, and W045) and two of the deep well dissolved metal samples (W043 and W044) exhibited levels of manganese that exceed the above-noted FSDWS. All the samples exhibited sodium concentrations well below the FPDWS of 160,000 µg/L (Chapter 17-550, PAC).

Vith respect to the remaining metals, total concentrations were usually much higher than the dissolved concentrations, but much lover than the temporary well sample concentrations, as discussed previously (see Section 3.9.4.2), and the deep well sample concentrations vere generally lower than the shallow well sample concentrations. Arsenic was detected in both the total and dissolved metals samples from the westernmost well (GM42; see Figure 3-[20]) at a concentration (59.8 µg/L in both samples) that exceeds the FPDWS of 50 µg/L (Chapter 17-550, PAC). Cadmium and chromium were both detected in total metals sample W040 at concentrations (22.2 µg/L and 176 µg/L, respectively) above the FPDWSs of 10 µg/L and 50 µg/L, respectively. Iron was detected in all the total metals samples and all but three of the dissolved metals samples (shallow wells TW038 and TW041 and deep well TW044) at concentrations that usually greatly exceed the PSDVS of 300 µg/L (Chapter 17-550, PAC).

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Based on the above data, manganese and iron appear to be the only significant (in terms of magnitude and frequency of occurrence) potential groundwater metal contaminants present in the vicinity of Site 1. As noted in Section 3.9.4.2 and as will be discussed further in Section 3.10, the high screening group metals (e.g., chromium, lead, and cadmium) concentrations detected in the temporary well unfiltered groundwater samples appear more likely to reflect aquifer matrix sediment contamination rather than actual groundwater contamination. The occurrences of elevated manganese and iron concentrations in the permanent well samples do not exhibit any distinct distribution pattern across Site 1.

TRPHs

TRPHs were detected only in the sample from permanent shallow well GM34. The detected concentration (1.4 mg/L) was well below the Florida Groundwater Cleanup Standard of 5 mg/L (Chapter 17-770, FAC).

VOCs

Figure 3-**[21]** shows the permanent well sampling locations where VOCs were detected. VOCs (benzene, toluene, ethylbenzene, xylenes, chlorobenzene, 1,2-dichlorobenzene, and/or 1,4-dichlorobenzene; see Table 3-10) were detected in eight of the shallow well samples (W004, U032 through W035, and U039 through W041) and in one of the deep well samples (W044). In particular, benzene was detected in four samples (W033, W034, W035, and W039) at concentrations (2 to 54 µg/L) that exceed the FPDWS of 1 µg/L (Chapter 17-550, FAC). Chlorobenzene was detected in all eight shallow well samples, and in six of the samples (excluding W032 and W039) the detected concentrations (15 to 23 µg/L) exceed the FGGC of 10 µg/L (FDER 1989). 1,4-Dichlorobenzene was detected in the same six samples, but at concentrations well below the FPDWS of 75 µg/L (Chapter 17-550, FAC). Only a low level of xylenes (2 µg/L) was detected in deep well sample W044.

In general, the above results are consistent with the G & M (1986) analytical results. However, during the G & M 1985 sampling event, elevated concentrations of benzene (76 µg/L and 67 µg/L) were detected in samples from deep wells GM44 and GM45, respectively.

Excluding methylene chloride, vhich represents a laboratory-derived contaminant (see Section 3.11.2), volatile halocarbon compounds (vinyl chloride, 1,1-dichloroethene, 1,2-dichloroethene, trichloroethene, chloroform, and/or bromodichloromethane; see Table 3-10) vere detected in seven of the permanent shallov vell samples (W004, W005, W031, W033, W038, W040, and W042), but in none of the deep vell samples (see Figure 3-[21]). In particular, vinyl chloride vas detected in two samples (W005 and W031) at concentrations (10 µg/L and 16 µg/L, respectively) that exceed the FPDWS of 1 µg/L (Chapter 17-550, PAC). Trichloroethene was detected in three samples (W004, W0[33], and W038) at concentrations equal to or just slightly above the FPDWS of 3 µg/L (Chapter 17-550, FAC). 1,1-Dichloroethene vas detected in sample W033 at a concentration (3 µg/L) below the FPDWS of 7 µg/L (Chapter 17-30, PAC). 1,2-Dichloroethane was detected in samples W004, W005, and W042 at concentrations (7 to 9 µg/L) slightly above the FGGC of 4.2 µg/L (FDER 1989).

In general, the above results are consistent vith the G 6 M (1986) analytical results. However, during the G 6 M 1985 sampling event, vinyl chloride vas detected in nine shallov vell samples at higher Concentrations. Samples from wells GM05, GM34, and GM39 exhibited vinyl concentrations of 56 µg/L, 250 µg/L, and 30 µg/L, respectively. In contrast, a greater variety of volatile halocarbon compounds, albeit at lov concentrations, were detected during E 6 E's more recent sampling event.

In addition to the TCL VOCs discussed above, acetone and a variety of volatile tentatively identified compounds (TICs) vere detected in most of the permanent vell groundwater samples. The detected acetone can be readily attributed to laboratory-derived contamination (see Section 3.11.2). Figure 3-[21] identifies the locations where volatile TICs were detected. Table 3-10 lists all TICs detected in the VOC and BNA analyses. Appendix I identifies specific TICs associated vith the VOC analyses. In general, higher concentrations of volatile TICs vere detected in samples vith higher TCL VOC levels. The highest total volatile TIC concentration, excluding the laboratory-derived contaminants hexane and Freon 113 (see Section 3.11.2), vas detected in shallov well sample W033 (638 µg/L). Overall, these data indicate

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potentially widespread VOC contamination below and adjacent to the landfill, as well as potential groundwater VOC contamination below the surficial zone of the Sand-and-Gravel Aquifer.

BNAs

Figure 3-[22] shows the permanent well sampling locations where BNAs were detected. A variety of BNAs were detected in one or more samples, but usually at low concetrations well below Florida standards or guidance concentrations (see Table 3-10). Various phthalate species were commonly detected, but the presence of these compounds is attributable to laboratory-derived contamination (see Section 3.11.2).

BNA TICs were detected in most of the permanent well groundwater samples at total concentrations exceeding 100 µg/L and potentially as high as 700 µg/L (exact concentrations cannot be specified because at least some of the BNA TICs reflect laboratory-derived contamination; see Section 3.11.2). Figure 3-[22] identifies the locations where BNA TICs were detected. Table 3-10 lists all TICs detected in the VOC and BNA analyses. Appendix I identifies specific TICs associated with the BNA analyses. Similarly to the VOC TIC data, these data overall indicate potentially widespread groundwater BNA contamination in the Site 1 area and below the surficial zone of the Sand-and-Gravel Aquifer.

Gross Alpha Radioactivity

The groundwater samples from the existing permanent monitoring wells were analyzed for gross alpha radioactivity (see Table 3-10). The measured gross alpha activities in all groundwater samples were below the FPDWS of 15 picocuries per liter (pCi/L; Chapter 17-550, FAC). The highest observed gross alpha activity, 9 ± 3 pCi/L, was detected in shallow well sample W040.

Remediation Parameters

The existing permanent well groundwater samples were also analyzed for total alkalinity, total hardness, and total organic carbon to support subsequent groundwater remediation design activities at Site 1, if required. Table 3-10 presents the analytical results for these remediation parameters. In general, concentrations of the above-listed

remediation parameters exhibited a moderate degree of variability vithin the permanent well groundvater samples. Total alkalinity concentrations vere as high as 250 milligrams per liter (mg/L; sample W034); total hardness concentrations vere as high as *240* mg/L (sample W040); total organic carbon concentrations vere as high as 78 mg/L (sample W040).

[For comparative purposes, regional (i.e., vithin southern Escambia County) values of these same parameters in the Sand-and-Gravel Aquifer are as follows: alkalinity (as mg/L of $CaCO^3$) values range from <1.00 mg/L to 129.97 mg/L (Clemens et al. 1989); total hardness values range from 1.00 mg/L to 326.00 mg/L, vith the majority being less than 50 mg/L (Johnson 1991); and total organic carbon values range from 2.88 mg/L to 24.41 mg/L (Clemens et al. 1989). The majority of Site 1 groundvater samples exhibited values of alkalinity, hardness, and total organic carbon well vithin the reported ranges of regional values.]

3.10 CONTAMINATION DISTRIBUTION/SOURCE DISCUSSION

All four media (surface water, sediment, surface soil, and groundvater) sampled on and in the vicinity of Site 1 exhibit at least trace levels of one or more of six of the contaminant groups (metals, TRPHs, VOCs, PAHs-base/neutral extractables, phenols-acid extractablcs, and gross alpha radioactivity) included in the Phase I investigation. In most cases, the detected contamination appears clearly associated vith disposal activities on or leachate migration from the landfill. However, the Phase I results do not preclude the possible presence of additional, perhaps ambient, sources of contamination in the site vicinity. Overall, the results of E & E's Phase I investigation and those of previous site investigations (NEESA 1983; G 6 M 1984; and G & M 1986) do not clearly indicate that extensive off-site migration of significant levels of contamination from the landfill has occurred. However, sediments in adjacent surfce water bodies (including Bayou Grande) appear to have been impacted by leachate migration, and significant levels of soil and shallov groundwater contamination are clearly present, at least locally, vithin and immediately adjacent to the landfill boundaries. The Phase I investigation results also suggest that more extensive off-site migration of groundvater contaminants may

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be occurring in the deeper portions of the surficial zone of the Sand-and-Gravel Aquifer. In the following sections, each of the sampled media will be discussed separately regarding the nature, distribution, and potential source(s) of contamination.

3.10.1 Surface Water

Chromium, zinc, and the VOC chlorobenzene were the only contaminants detected in the surface water samples. The detected metal concentrations were generally low, and only the detected zinc concentrations in the samples collected in and upstream of Beaver Pond even slightly exceeded the FDER Class III Surface Water Quality Standard. Chlorobenzene, which was also commonly detected in the groundwater samples, was detected at low levels only in the North Pond surface water samples. No FDER surface water quality standard exists for this contaminant. Orange discoloration of surface waters, sediments, and vegetation was observed at several surface water body locations; this staining probably reflects discharge of iron- and manganese-contaminated groundwaters into these surface water bodies at levels possibly exceeding the FDER Class III Surface Water Quality Standards for iron (no such standard exists for manganese). Overall, with the possible exception of iron-contamination, surface water contamination does not appear to be a problem at Site 1. However, the low levels of contamination detected can be attributed to leachate migration from the landfill via discharge of groundwater into these surface water bodies.

3.10.2 Sediment

Elevated levels of metals, TRPHs, PAHs, and/or phenols were detected in one or more of the sediment samples. Chromium, zinc, and lead were the primary sediment metal contaminants, and the highest levels of metals contamination were detected in samples from North Pond, Bayou Grande Pond, and Golf Course Pond. Low to moderately elevated levels of TRPHs were detected in most of the pond sediment samples, but by far the highest TRPH concentration was detected in the easternmost sample from Bayou Grande. PAHs were detected at trace to low levels in all but one of the sediment samples, with the highest concentration

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being detected in the southernmost sample from Bayou Grande Pond. Trace to moderately elevated levels of phenols were detected in samples from Bayou Grande Pond, Beaver Pond, and Golf Course Pond, with the highest concentration being detected in the southernmost sample from Golf Course Pond.

Overall, sediment contamination may be a problem at Site 1. Host of the detected contamination, especially in the pond sediments, can be attributed to leachate migration from the landfill via discharge of contaminated groundwater. However, the widespread PAH contamination in the Bayou Grande sediments and, in particular, the elevated TRPE level detected in the easternmost Bayou Grande sediment sample could reflect the presence of other, perhaps ambient, sources in the site vicinity.

3.10.3 Surface Soil

Significant levels of surface soil contamination (VOCs, TRPHs, PAHs, and/or phenols) were only detected at two locations: the "tar pit" located near the northwest comer of the 1970s landfill area and the "collapse-feature depression" located in the northwest corner of the 1950s landfill area. Low to moderately elevated TRPH concentrations were detected in all but one of the other surface soil samples and appear to reflect a potential ambient source of contamination in the site vicinity. Trace level PAHs were detected in only two of the remaining samples. Metals concentrations were generally low in all of the surface soil samples.

The very high contaminant concentrations detected in the "tar pit" and "collapse-feature depression" samples suggest that significant levels of subsurface soil contamination may be present not only in these areas, but also in other areas within the landfill where "concentrated" disposal of wastes might have occurred. Based on the aerial photograph analysis, three such additional areas may be present: two other "tar pits" along the western landfill boundary, immediately south of the identified "tar pit," and a large "stained" area in the north-central part of the 1970s landfill area. All three of these areas have apparently been covered over and therefore could not be identified during the site reconnaissance or surface soil sampling program.

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Subsurface metals and organic contamination of aquifer matrix sediments below the water table may also be present. This possibility is suggested by the elevated total metals concentrations detected in the temporary well groundwater samples and the potential evidence of leachate migration beyond the landfill boundaries provided by the EM-31 and EH-34 surveys. To a limited extent, the areas of elevated groundwater total metals concentrations appeared to generally coincide with areas of elevated electromagnetic conductance.

3.10.4 Groundwater

Various VOC, PAH-base/neutral extractable, and phenol-acid extractable species constitute the primary groundwater contaminants at Site 1. Elevated metal concentrations above Florida standards were detected in a number of samples, but, as will be discussed below, are not believed to represent actual groundwater contamination, except in the cases of manganese, iron, and a single occurrence of arsenic. TRPHs were detected in only a few samples, and only in one sample was the detected concentration even slightly above the Florida standard. Although present, detected gross alpha radioactivity levels did not exceed Florida standards.

All of the unfiltered (total metals) groundwater samples from the temporary wells exhibited elevated concentrations of several metals. Eowever, the samples collected from existing permanent monitoring wells in the same areas exhibited much lower total metals concentrations and still lower dissolved (millipore-filtered) metals concentrations. Consequently, the Phase I temporary well sample data are not believed to reflect actual groundwater contamination, but rather leaching or dissolution of aquifer matrix sediments entrained in these samples by the acid preservative. This conclusion is supported by the fact that the permanent well samples were much less turbid than the temporary well samples. However, as noted in Section 3.10.3, the elevated temporary well metal concentrations may indicate that the aquifer matrix sediments have been impacted by the off-site migration of metal-contaminated leachate from the landfill.

Groundwater metals contamination is present at Site 1. Manganese and iron in particular were detected at concentrations exceeding Florida

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secondary standards in most of the total and dissolved metals samples from the permanent monitoring wells. The occurrences of these metals is probably attributable to landfill sources. In contrast, the single occurrence of total and dissolved arsenic at a level above the Florida primary standard in the sample from the westernmost permanent well GM42 cannot be attributed to a landfill source.

Shallow groundwater contamination by a variety of organic species was detected in a number of temporary and permanent well samples. In particular, several VOCs (benzene, chlorobenzene, vinyl chloride, trichloroethene, and tetrachloroethene) and phenols were present in one or more samples at concentrations exceeding Florida standards or guidance concentrations. For the most part, shallow groundwater organic contamination was restricted to areas immediately adjacent to the landfill boundary (in particular, near the 1970s landfill area). This distribution indicates limited off-site migration, and the potential for greater levels of contamination, at least locally, within the landfill. However, the distribution of volatile halocarbon occurrences in the shallow groundwater samples was more sporadic and more likely to be associated with wells located further from the landfill boundaries. Given that these contaminant species have higher specific gravities than water, the somewhat anomalous distribution identified could indicate off-site migration within deeper zones of the Sand-and-Gravel Aquifer.

It is not clear whether contaminants have migrated below the surficial zone of the Sand-and-Gravel Aquifer into at least the upper part of the main producing zone. A downward hydraulic gradient appears to exist between these zones across most of the site, and G & M (1986) detected high levels of benzene in two on-site deep well samples. In contrast, only low levels of mostly volatile and BNA TICs appear to have been present in E & E's Phase I samples from the on-site deep vells. However, the presence of even lov levels of these TICs, in combination vith the G & M 1986 data, the somewhat anomalous distribution of volatile halocarbons in E & E's Phase I groundwater samples, and the presence of elevated electromagnetic conductances revealed by the deeper EM-31 and *BH-34* surveys in areas adjacent to the landfill, all suggest the potential presence of deeper groundvater contamination below and adjacent to the landfill.

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3.11 QA/QC

3.11.1 Field QA/QC Samples

3.11.1.1 Analytical Screening Parameters

One surface water field duplicate sample, one sediment field duplicate sample, one surface soil field duplicate sample, and two groundwater field duplicate samples were collected for the Site 1 screening samples. The analytical results for the duplicate samples are presented in the summary analytical tables for the surface water, sediment, surface soil, and groundwater samples (see tables 3-4, 3-5, 3-6, and 3-8). The results for the surface water duplicate sample (SW012D), sediment duplicate sample (SD012D), surface soil duplicate sample (S010D), and groundwater duplicate sample (GW001D) were all in agreement, within acceptable limits, with the results for the original samples. In contrast, groundwater duplicate sample GW020D exhibited a reported phenols value of 150 µg/L, but sample GW020 exhibited no detectable phenols. However, given that the detection limit for the phenols analyses is 100 µg/L, the results for these samples can still be considered in good agreement.

3.11.1.2 [TAL and] TCL Samples

Two field duplicate samples, two trip bottle blanks, two sampling equipment rinsate blanks, one field blank, and one preservative blank were collected for the 15 Site 1 [TAL and] TCL groundwater samples. The analytical results for these QA/QC samples are presented in tables 3-11 and 3-12. The results for groundwater duplicate samples W005D and W032D were in agreement, within acceptable limits, with the results for the respective original groundwater samples. Methylene chloride and hexane were detected in trip blanks TB04 and TB06 (analyzed only for VOCs), rinsate blanks RB03 and RB04, field blank FB03, and preservative blank PB03. Acetone was detected in all of the above-listed blanks except RB04. Aluminum, iron, lead, and sodium were detected in most or all of the blanks. Zinc was detected in two blanks. Calcium, copper, and manganese were also detected in rinsate blank RB04. In addition, one or more TICs were also detected in each of the blanks. The detected contaminants in the various blanks are of little significance given that these contaminants also occurred in the laboratory analytical method

Table 3-11

SUMMARY TAL METALS ANALYTICAL RESULTS
FOR GROUNDWATER AND FIELD QA/QC SAMPLES
(FROM PERMANENT MONITORING WELLS)
NAS PENSACOLA SITE 1
(All results in µg/L, unless noted)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W005 (GM05)	P01W005D[a] (GM05)	P01W032 (GM32)	[FPDWS/ FSDWS
Total Metals					
Aluminum	62	**1,060(E)**	1,100(E)	1,290	
Arsenic	1	**1.1(M)**	—	5.3	W
Barium	10	16.8	17.3	131	1,000
Beryllium	1	2.8	1.4	—	
Cadmium	1	—	—	5.4	10
Calcium	**500**	1,280	1,400	21,300	
Chromium	10	**6.5***	—	11.3	**50**
Cobalt	12	9.5	59	—	
Copper	15	7.5	6.2	—	1,000
Iron	**19**	1,220	1,300	12,300	**300**
Load	1	2.6	1.6	7.1+	W
Magnesium	**500**	1,400	1,430	2.470	
Manganese	**2**	108	105	271	**50**
Nickel	**10**	15.4	—	—	
Potassium	**500**	1,030	665	802	
Selenium	1	1.2(M)	—	1.1(M)	**10**
Sodium	**500**	7,140	6,300	8,100	**160,000**
Zinc	**4**	15.7	11.9*	161	**5,000**
Dissolved Metals					
Aluminum	**62**	**192(E)**	**230(E)**	103	
Arsenic	1	—	—		W
Barium	10	10.3	10.3	113	1,000
Calcium	**500**	1,320	1,270	20,700	
Chromium	10	**6.2***	—	—	**50**
Copper	15	5.1	3.6	—	**1,000**
Iron	19	**463**	427	6,530	**300**
Load	1	—	1.2		W
Magnesium	**500**	1,440	1,460	2,390	
Manganese	**2**	107	107	272	W
Nickel	10	10.4	10.4	—	
Potassium	**500**	1,180	675	798	
Sodium	**500**	7,120	7,110	8,330	160,0 n
Zinc	**4]**	**13.8***	**8.6***	59.4	**5,000]**

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Table 3-11 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W032D[b] (OH32)	P01WTB04[c] (Bottle Trip Blank)	P01WTB06[c] (Bottle Trip Blank)	(FPCWS/ FSDWS
Total Metals					
Aluminum	62	1,090	NA	NA	
Arsenic	1	**1.2(M)**	NA	NA	SO
Barium	**10**	127	NA	NA	1,000
Beryllium	1	--	NA	NA	
cadmium	1	--	NA	NA	10
Calcium	**500**	21,000	NA	NA	
Chromium	**10**	--	NA	NA	SO
Cobalt	12	--	NA	NA	
Copper	1S		NA	NA	1,000
Iron	19	9,730	NA	NA	300
Lead	1	3.5	NA	NA	SO
Magnesium	**500**	2,510	NA	NA	
Manganese	2	267	NA	NA	SO
Nickel	**10**	--	NA	NA	
Potassium	**500**	1,090	NA	NA	
Selenium	1	--	NA	NA	10
sodium	**500**	0,290	NA	NA	160,000
Zinc	4	74.6	NA	NA	**5,000**
Dissolved Metals					
Aluminum	62	--	NA	NA	
Araenic	1	--	NA	NA	SO
Barium	10	117	NA	NA	1,000
Calcium	**500**		NA	NA	
Chromium	10	21,700	NA	NA	SO
Copper	15	--	NA	NA	1,000
Iron	19	6,360	NA	NA	300
Lead	1	--	NA	NA	**50**
Magnesium	**500**	2,540	NA	NA	
Manganese	2	268	NA	NA	SO
Nickel	**10**	--	NA	NA	
Potassium	**500**	953	NA	NA	
Sodium	**500**	8,500	NA	NA	160,000
Zinc	**4]**	81.4	NA	NA	**5,000]**

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Table 3-11 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01WRB03[d] (Sampling Equipment Rinsate)	P01WRB04[d] (Sampling Equipment Rinsate)	P01WFB03 (Field (Blank)	[FPDWR/ FSDWR
Total Metals					
Aluminum	62	—	58.5(E)	65	
Arsenic	1	—	—	—	50
Barium	10	—	—	—	1,000
Beryllium	1	—	—	—	
Cadmium	1	—	—	—	10
Calcium	500	—	665	—	
Chromium	10	—	—	—	50
Cobalt	12	—	—	—	
Copper	15	—	4.1	—	1,000
Iron	19	21.7	174	—	300
Lead	1	15.1	—	1	50
Magnesium	500	—	219	—	
Manganese	2	—	3	—	50
Nickel	10	—	—	—	
Potassium	we	—	—	—	
Selenium	1	—	—	—	10
sodium	500	057	904	888	160,000
Zinc	I	—	56.2	—	5,000
Dissolved Metals					
Aluminum	62	07.4	27.2 E)	62	
Arsenic	1	—	—	—	W
Barium	10	—	—	—	1,000
Calcium	500	—	380	—	
Chromium	10	—	—	—	50
Copper	15	—	7.5	—	1,000
Iron	19	—	138	60.7	300
Lead	1	—	—	(N,R)	H
Magnesium	500	—	—	—	
Manganese	2	—	2.5	—	50
Nickel	10	—	—	—	
Potassium	we	—	—	—	
Sodium	500	492	559	—	160,000
Zinc	4]	5.1	19.5*	—	5,000]

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Table 3-11 (Cont.)

Parameter	Detection Limit	Sample Number (Location/Type) P01WPB03[e] (Preservative Blank)	FPDWS/ FSDWS
Total Metals			
Aluminum	62	NA	
Arsonic	1	NA	SO
Barium	10	NA	1,000
Beryllium	1	NA	
Cadmium	1	NA	10
Calcium	500	NA	
Chromium	10	NA	SO
Cobalt	12	NA	
Copper	1s	NA	1,000
Iron	19	NA	300
Lead	1	NA	SO
Magnesium	500	NA	
Manganese	2	NA	SO
Nickel	10	NA	
Potassium	500	NA	
Selenium	1	NA	10
Sodium	500		160,000
Zinc	4	NA	5,000
Dissolved Metals			
Aluminum	62	--	
Arsonic	1	--	SO
Barium	lo	--	1,000
Calcium	500	--	
Chromium	10	--	SO
Copper	15	--	1,000
Iron	19	22.4	300
Load	1	1.4(M)	50
Magnesium	500	--	
Manganese	2	--	SO
Nickel	10	--	
Potassium	500	--	
Sodium	500	1,350	160,000
Zinc	4]	--	5,000]

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Key:

NA = Analyses not performed.
Dash (—) indicates compound not detected.
*Duplicate analysis not within control limits.
+Correlation coefficient for tho MSA is less than 0.995.

[a]Duplicate of sample P01W005.
[b]Duplicate of sample P01W032.
[c]Analyzed for VOCs only.
[d]Analyzed for total metals, dissolved metals, cyanide, VOCs, BNAs, pesticides, PCBs, TRPHs, and gross alpha radioactivity only.
[e]Analyzed for dissolved metals, cyanide, VOCs, and TRPHs only.

Qualifier:
(E) = Reported value is estimated because of tho presence of interference.
(M) = Duplicate injection precision not mot.
(N) = Spiked sample recovery not within control limits.
(R) = Tho data are unusable (analyte may or may not bo present).

Source: Ecology and Environment, Inc., 1991.

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Table 3-12

SUMMARY TCL ORGANIC AND INORGANIC ANALYTICAL RESULTS FOR GROUNDWATER AND FIELD QA/QC SAMPLES (FROM PERMANENT MONITORING WELLS) NAS PENSACOLA SITE 1
(All results in µg/L, unless noted)

Parameter	[Detection Limit	Sample Number (Location/Type) P01W005 (GM05)	P01W005D[a] (GM05)	P01W032 (GM32)	[FFDMS/ FSDMS
Vinyl Chloride	10	10	9(J)	—	1
Methylene Chloride	10	30(B[a])	16(B[a])	6(B[a])	
Acetone	10	—	—	12(B[a])	
Carbon Disulfide	5	—	—	2(J)	
1,2-Dichloroethene (Total)	5	7	6	—	7]
Chlorobenzene	5	—	3(J)	3(J)	
1,2-Dichlorobenzene	10	—	1(J)	—	
Di-N-Butyl-Phthalate	10	—	—	—	
Bis(2-Ethylhexyl)Phthalate	10	3(B[a],J)	2(B[a],J)	10(B[a])	
Tentatively Identified Compounds*					
2-Propanol		—	—	—	
Freon 113		—	—	7(B[a] J)	
Hexane		18(B[a],J)	13(B[a],J)	11(B[a] J)	
2-2'-Oxybis-Ethanol		—	—	53(B[a] J)	
N,N-Dimethyl-Benzenamine		—	—	—	
Bis(Dimethyl Ethyl) Butylidene		—	14(J)	—	
Ethyl Methyl Benzene Isomer		—	—	—	
Tribromophenol Isomer		—	—	—	
Unknown Acid		—	—	(3) 210(J)	
Unknown Hydrocarbon		(4) 63(J)	(2) 18(J)	(3) 30(J)	
Unknown Hydrocarbon		—	—	140(B[a],J)	
Unknown Phenol		—	—	14(J)	
Unknown Siloxane		—	—	—	
Unknown Compound		(2) 57(J)	(4) 108(J)	(3) 64(J)	
Unknown Compound		(2) 59(B[a],J)	(2) 74(B[a],J)	—	
Total Alkalinity (mg/L as $CaCo_3$)	1	—	—	50	
Total Hardness (mg/L as $CaCo_3$)	1	14	15	59	
Total Organic Carbon (mg/L)	1]	9.8	5.7	9.9	
Gross Alpha Radioactivity (pCi/L)		<2	<2	3±2	

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Table 3-12 (Cont.)

Paramtor	[Detection Limit	Sample Number (Location/Type) P01W032D[b] (GM32)	P01WTB04[c] (Bottle Trip Blank)	P01WTB06[c] (Bottle Trip Blank)	[FPDWS/ FSDWS
Vinyl Chloride	10	--	--	--	1
Methylene Chloride	10	9(B[a])	9(B[a])	21(B[a])	
Acetone	10	15(B[a])	11(B[a])	32(B[a])	
Carbon Disulfide	5	--	--	--	
1.2-Dishloroothono (Total)	5	--	--	--	7]
Chlorobenzene	5	--	--	--	
1,2-Dichlorobenzene	10	--	NA	NA	
Di-N-Butyl-Phthalate	10	--	NA	NA	
Bis(2-Ethylhexyl)Phthalate	10	10(B[a])	NA	NA	
Tentatively Identified Compounds.					
2-Propanol		--	--	--	
Freon 113		8(B[a],J)	5.1(J)	--	
Hexane		11(B[a],J)	8(B[a],J)	8(B[a],J)	
2-2'-Oxybis-Ethanol		49(B[a],J)	--	--	
N,N-Dimethyl-Benzenamine		--	--	--	
Bis(Dimethyl Ethyl) Butylidene		--	--	--	
Ethyl Methyl Benzene Isomer		7(J)	--	--	
Tribromophenol Isomer		--	--	--	
Unknown Acid		(4) 173(J)	--	--	
Unknown Hydrocarbon		(2) 18(J)	--	--	
Unknown Hydrocarbon		100(B[a],J)	--	--	
Unknown Phenol		--	--	--	
Unknown Siloxane		--	--	--	
Unknown Compound		(3) 161(J)	5.7(J)	48(J)	
Unknown Compound		--	--	55(B[a],J)	
Total Alkalinity (mg/L as $CaCo_3$)	1	49	NA	NA	
Total Hardness (mg/L as $CaCo_3$)	1	58	NA	NA	
Total Organic Carbon (mg/L)	1]	1.6	NA	NA	
Gross Alpha Radioactivity (pCi/L)		<2	NA	NA	

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Table 3-12 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01WRB03[d] (Sampling Equipment Rinsate)	P01WRB04[d] (Sampling Equipment Rinsate)	P01W7B03 (Field Blank)	[FPDWR/ FSDWR
Vinyl Chloride	10	—	—	—	1
Methylene Chloride	10	9(B[a])	10(B[a])	6(B[a])	
Acetone	10	53(B[a])	—	82(B[a])	
Carbon Disulfide	5	—	—	3(J)	
1,2-Dichloroethene (Total)	5	—	—	—	7]
Chlorobenzene	5	—	—	—	
1,2-Dichlorobenzene	10	—	—	—	
Di-N-Butyl-Phthalate	10	—	2(B[a],J)	—	
Bis(2-Ethylhexyl)Phthalate	10	10(B[a])	5(B[a],J)	15(B[a])	
Tentatively Identified Compounds*					
2-Propanol		—	320(J)	—	
Freon 113		—	—	—	
Hexane		8(B[a],J)	12(B[a],J)	7(B[a],J)	
2-2'-Oxybis-Ethanol		10(B[a],J)	—	120(B[a],J)	
N,N-Dimethyl-Benzenamine		—	—	—	
Bis(Dimethyl Ethyl) Butylidene		—	—	—	
Ethyl Methyl Benzene Isomer		—	—	—	
Tribromophenol Isomer		—	—	15(J)	
Unknown Acid		—	—	—	
Unknown Hydrocarbon		—	—	6(J)	
Unknown Hydrocarbon		95(B[a],J)	—	380(B[a],J)	
Unknown Phenol		—	—	—	
Unknown Siloxane		—	40(J)	—	
Unknown Compound		5.6(J)	(5) 146(J)	—	
Unknown Compound		—	21(B[a],J)	9(B[a],J)	
Total Alkalinity (mg/L as $CaCo_3$)	1	NA	NA	—	
Total Hardness (mg/L as $CaCo_3$)	1	NA	NA	—	
Total Organic Carbon (mg/L)	1]	NA	NA	—	
Gross Alpha Radioactivity (pCi/L)		<2	<2	<2	

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Key at end of table.

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Table 3-12 (Cont.)

Parameter	[Detection Limit	Sample Number (Location/Type) P01WPB03[e] (Preservative Blank)	[FPDWS/ FSDWS
Vinyl Chloride	10	—	1
Methylene Chloride	10	8(B[a])	
Acetone	10	28(B[a])	
Carbon Disulfide	5	—	
1,2-Dichloroethene (Total)	5	—	7]
Chlorobenzene	5	—	
1,2-Dichlorobenzene	10	NA	
Di-N-Butyl-Phthalate	10	NA	
Bis(2-Ethylhexyl)Phthalate	10	NA	
Tentatively Identified Compounds.			
2-Propanol		—	
Freon 113		—	
Hexane		6(B[a],J)	
2-2'-Oxybis-Ethanol		—	
N,N-Dimethyl-Benzenamine		7(B[a],J)	
Bis(Dimethyl Ethyl) Butylidene		—	
Ethyl Methyl Benzene Isomer		—	
Tribromophenol Isomer		—	
Unknown Acid		—	
Unknown Hydrocarbon		7(J)	
Unknown Hydrocarbon		—	
Unknown Phenol		—	
Unknown Siloxane		—	
Unknown Compound		—	
Unknown Compound		(2) 13.2(B[a],J)	
Total Alkalinity (mg/L as $CaCo_3$)	1	NA	
Total Hardness (mg/L as $CaCo_3$)	1	NA	
Total organic Carbon (mg/L)	1]	NA	
Gross Alpha Radioactivity (pCi/L)		NA	

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Note: Tho number within parentheses preceding tho eoncontration is tho number of tentatively identified compounds (TICs) in this parameter group. Tho listed concontration represents tho sum of tho individual group-member concentrations.

Key:

[FPDWS = Florida Primary Drinking Water Standard.
FSDWS = Florida Secondary Drinking Water Standard.]
NA = Analyses not performed.
Dash (--) indicates compound not detected.

[*Values for TICs are estimated. No detection limits were established for TICs.]

[a]Duplicate of sample P01W005.
[b]Duplicate of sample P01W032.
[c]Analyzed for VOCs only.
[d]Analyzed for total metals, dissolved metals, cyanide, VOCs, BNAs, pesticides, PCBs, TRPHs, and gross alpha radioactivity only.
[e]Analyzed for dissolved metals, cyanide, VOCs, and TRPHs only.

Qualifiers:
(B[a]) = Present in method blank.
(J) = [For non-TICs,] estimated value; compound present [but] below detection limit. [Also indicates that TIC concentrations are estimated because no detection limits were established for TICs.]

Source: Ecology and Environment, Inc., 1991.

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blanks and *can* therefore be attributed to laboratory-derived contamination; the detected contaminants do not represent significant on-site contamination, and/or the detected levels are too low to significantly impact interpretation of the field sample analytical results.

3.11.2 Laboratory QA/QC Samples

3.11.2.1 Analytical Screening Samples

Methylene chloride, a common laboratory-derived contaminant BPA 1988), was detected in several method blanks. This compound was present at a concentration only slightly above the method detection limit in the analytical method blank associated with the 11 sediment samples, which also exhibited similar levels of methylene chloride. The presence of this compound can therefore be attributed to laboratory-derived contamination. Methylene chloride was also present at concentrations slightly above the detection limit in the two surface soil analytical method blanks. With one exception, similar methylene chloride concentrations vere also observed in the surface soil samples and can therefore be attributed to labratoe-derived contamination. However, the detected methylene chloride level in sample SO12 is too high to be unequivocally attributed entirely to the presence of laboratory-derived contamination.

3.11.2.2 [TAL and) TCL Samples

Methylene chloride, acetone, carbon disulfide, di-n-butyl-phthalate, and bis(2-ethylhexyl)phthalate and several TICs (i.e., Freon 113, hexane, 2-2'-oxybis-ethanol, and other unknown compounds) were each detected in one or more of the [TAL and] TCL groundvater samples and in the associated method blanks. Therefore, the presence of these compounds is attributable to laboratory-derived contamination. In addition, total xylenes were detected in the method blank associated vith two groundvater samples (WO33 and WO34) in vhich xylenes vere detected. The trace level of xylenes exhibited by groundvater sample V033 are similar to the level of xylenes detected in the wthod blank; therefore, the presence of xylenes in this sample can be attributed to

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the presence of laboratory-derived contamination. However, the level of xylenes detected in groundwater sample W034 are too high to be attributed entirely to the presence of laboratory-derived contamination. Although di-n-octyl phthalate was not detected in the method blanks, the recorded low levels (i.e., below the detection limit) of this compound and specific TICs present may also reflect the presence of laboratory-derived contamination (see tables 3-10 and 3-11). Several additional laboratory QA/QC comments concerning the [TAL and] TCL sample analyses are presented at the end of tables 3-9 through 3-12).

4. CONCLUSIONS

Sediment, surface soil, and groundwater contamination are present on and in the vicinity of Site 1 at clearly or potentially significant levels. Only low levels of surface water contamination (chromium, zinc, and chlorobenzene) were detected locally; however, iron contamination at levels exceeding Florida standards, as well as manganese contamination, may also be present. Most of the detected contamination is clearly associated with disposal activities on or leachate migration from the landfill. However, additional, perhaps ambient, sources of contamination also appear to be present. Overall, the results of E & E's Phase I investigation and those of previous site investigations (NEESA 1983; G & M 1984; and G & M 1986) do not clearly indicate that extensive off-site migration of significant levels of contamination from the landfill has occurred. However, sediments in adjacent surface water bodies (including Bayou Grande) appear to have been impacted by leachate migration, and significant levels of soil and shallow groundwater contamination are clearly present, at least locally, within and immediately adjacent to the landfill boundaries. The Phase I investigation results also suggest that more extensive off-site migration of groundwater contaminants may be occurring in the deeper portions of the surficial zone of the Sand-and-Gravel Aquifer.

Elevated levels of metals (primarily chromium, zinc, and lead), TRPHs, PAHs, and/or phenols were detected in the sediment samples; iron and manganese may also be present at elevated levels. Most of the detected contamination, especially in the pond sediments, can be attributed to leachate migration from the landfill via discharge of contaminated groundwater. However, PAH and TRPH contamination, especially in Bayou Grande sediments, could reflect the presence of other, perhaps ambient, sources of contamination in the site vicinity.

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Significant levels of surface soil contamination (VOCs, TRPHs, PAHs, and/or phenols were detected at only two locations: the "tar pit" (northwest corner of 1970s landfill area) and the "collapse-feature depression" (northwest corner of 1950s landfill area). These data suggest that significant levels of subsurface soil contamination may be present not only in these areas, but also in three other areas, identified on the aerial photographs but now covered over, where "concentrated" disposal of wastes might have occurred: two "pits" along the western landfill **boundary,** south-of the identified "tar pit," and a large stained area in the north-central part of the 1970s landfill area. **Based** on the **EM-31** and **EM-34** survey data and groundwater sample analytical results, leachate migration beyond the landfill boundaries **may** be impacting subsurface aquifer matrix sediments below the water table.

Metals (iron, manganese, and, in one sample only, arsenic), VOCs (benzene, chlorobenzene, vinyl chloride, trichloroethene, and tetra-chlorethene), PAHs-base/neutral extractables, and phenols-acid actractables represent the primary shallow groundwater contaminants. Several of the detected contaminants were present at concentrations that exceed Florida standards or guidance concentrations. Shallow groundwater organic contamination was restricted primarily to areas immediately adjacent to the landfill boundary (in particular, near the 1970s landfill area). This distribution indicates limited off-site migration and the potential for greater levels of contamination, at least locally, within the landfill. However, the distribution of volatile halocarbon occurrences in the shallow groundwater samples was more sporadic and more likely to be associated with wells located further from the landfill boundaries. Given that these contaminant species have higher specific gravities than water, the somewhat anomalous distribution identified could indicate off-site migration within deeper zones of the Sand-and-Gravel Aquifer.

It is not clear whether contaminants have migrated below the surficial zone of the Sand-and-Gravel Aquifer into at least the upper part of the main producing zone. A downward hydraulic gradient appears to exist between these zones across most of the site, and G & M (1986)

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detected high levels of benzene in two on-site deep well samples. In contrast, only low levels of mostly volatile and BNA TICs appear to have been present in E & E's Phase I samples from the on-site deep wells.

Eowever, the presence of even low levels of these TICs, in combination with the G & M 1986 data, the somewhat anomalous distribution of volatile halocarbons in E & E's Phase I groundwater samples, and the presence of elevated electromagnetic conductances revealed by the deeper EM-31 and EM-34 surveys in areas adjacent to the landfill, all suggest the potential presence of deeper groundwater contamination below and adjacent to the landfill.

Additional assessment activities will be required at and in the vicinity of Site 1.

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