EPA/ROD/R04-99/069
1999

EPA Superfund
Record of Decision:

HOMESTEAD AIR FORCE BASE
EPA ID: FL7570024037
OU 05
HOMESTEAD AIR FORCE BASE, FL
09/29/1999

Homestead Air Reserve Base, Florida

Final

Record of Decision for Operable Unit No. 5, Site WP-1 Electroplating Waste Disposal Area

June 1997

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA. GEORGIA 30303-8960

Sep 29, 1999

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

4WD-FFB

Maj Gen. David R Smith
Vice Commander, AFRC/CV
155 Second Street
Robins AFB, GA 31098-1635

SUBJ Record Of Decision - Operable Unit 5
Homestead Air Force Base NPL Site
Homestead. Florida

Dear Maj Gen. Smith,

The U.S. Environmental Protection Agency (EPA) Region IV has reviewed the subject decision document and concurs with the selected remedy for the remedial action at Operable Unit (OU) 5 at the former Homestead Air Force Base (HAFB). This remedy is supported by the previously completed Remedial Investigation, Feasibility Study, and Baseline Risk Assessment Reports. The selected remedy consists Land Use Controls which include:

- Posting of signs
- Restriction on construction
- Notify workers before they excavate
- Obtain FDEP and EPA approval prior to construction design
- Restrict groundwater access
- No water supply wells within restricted area
- No residential usage
- "Dig permit" required prior to construction
- Conduct inspections and correct discrepancies

The determination to implement this course of action at this site is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA) and the National Contingency Plan (40 CFR 300).

Concurrence with the Record of Decision (ROD) is conditioned on the express understanding that the Air Force is committed to the agreement reached with EPA Region IV and the Florida Department of Environmental Protection (FDEP) that complies with EPA's

April 21, 1998 Memorandum titled "Assuring Land Use Controls at Federal Facilities" We reiterate as we advised Air Force Regional Environmental Office representatives in our meeting on May 21, 1998, our concurrence with this particular ROD is based on the understanding that the Air Force is committed to the Memorandum of Agreement (MOA) consistent with the above-referenced Land Use Control (LUC) Policy. Furthermore, the Homestead Air Force Base BRAC Cleanup Team (BCT) will be expected to craft specific provisions for Land Use Controls as part of the resulting Land Use Control Implementation Plan for OU- 5, that will prohibit residential land use.

EPA appreciates the level of effort that was put forth in the documents leading to this decision. EPA looks forward to working with HAFB as we move towards final cleanup of the National Priorities List (NPL) site.

If you have any questions, please call me at (404) 562-8651, or Doyle T. Brittain at (404) 562-8549.

Sincerely,

Richard D. Green, Director
Waste Management Division

cc: Thomas J. Bartol, HAFB/AFBCA
John Mitchell, HAFB/AFRES
Jim Woolford, EPA/FFRO
Jorge Caspary, FDEP

DEPARTMENT OF THE AIR FORCE
AIR FORCE RESERVE COMMAND

September 8, 1999

MEMORANDUM FOR: SEE DISTRIBUTION

FROM: 482d SPTG/CEV
29050 Coral Sea Blvd,
Bldg. 232
Homestead ARS, FL 33039-1299

SUBJECT: Insertion of Institutional Control language into the Record of Decision for OU-5

Enclosed please find a copy of a paragraph to be inserted into the Record of Decision dated April, 1997 for OU-5. This paragraph incorporates language committing to institutional controls as included in the Land Use Control Implementation Plan (LUCIP) for this site.

If you have any questions, please do not hesitate to contact me at (305) 224-7163.

John B. Mitchell, Chief
Environmental Engineering Flight

Attachment:
ROD Insertion

Cc:
HQ AFRC/CEVV, Mr. Philippe Montaigne
AFBCE/DD Homestead, Mr. Tom Bartol
Gannett Fleming, Hugh Vick

DISTRIBUTION:
U.S. EPA, Doyle T. Brittain
FDEP, Jorge R. Caspary
DERM, James A. Carter

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE AIR FORCE

AIR FORCE RESERVE

MEMORANDUM FOR: SEE DISTRIBUTION November 3, 1997

FROM: 482d SPTG/CEV
29050 Coral Sea Blvd.
Building 232
Homestead ARS, Florida 33039-1299

SUBJECT: Record of Decision (ROD): Operable Unit #5

Attached for your approval and records is the final ROD signed by the Homestead Air Force Base Installation Commander, Air force Reserves for Operable Unit #5. Please contact Mr. Enrique Escalera at (305) 224-7324 or myself if you have any questions.

John B. Mitchell, Chief
Environmental Engineering Flight

cc: w/o attach
AFBCA/DD
DERM, James A. Carter
HQ AFRC, Toni B. Thorne

DISTRIBUTION:
U.S. EPA, Doyle T. Brittain
FDEP, Jorge R. Caspary

RECORD OF DECISION

Operable Unit 5
Site WP-1
Electroplating Waste Disposal Area
Homestead Air Reserve Base
Homestead, Florida
FDEP Facility No. 138521996

June 1997

Montgomery Watson appreciates the opportunity to work for the U.S. Army Corps of Engineers, at the Homestead Air Reserve Base facility in Homestead, Florida. If you have any questions or comments concerning this report, please contact Mr. John B. Mitchell, Remedial Program Manager, Homestead Air Reserve Base.

Respectfully submitted,

MONTGOMERY WATSON

Jerry L. Gaccetta

Jerry D. Gaccetta, P.G.
Project Manager

Jerry L. Gaccetta

Freddie Moreton, P.G. For
Project Geologist

FINAL

RECORD OF DECISION

FOR

OPERABLE UNIT 5
SITE WP-1,
ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

June 1997

Prepared for:

U. S . Army Corps of Engineers
Missouri River Division
Omaha District
Omaha, Nebraska

Prepared by:

Montgomery Watson
107 Mallard Street, Suite D
St. Rose, Louisiana 70087

RECORD OF DECISION
OPERABLE UNIT FIVE
MOA INCORPORATION LANGUAGE

By separate Memorandum of Agreement (MOA) dated 15 March, 1999, with U.S. Environmental Protection Agency (U.S. EPA) and the Florida Department of Environmental Protection (FDEP), HARS, on behalf of the Department of the Air Force, agreed to implement base-wide, certain periodic site inspection, condition certification and agency notification procedures designed to ensure the maintenance by Installation personnel of any site-specific Land Use Controls (LUCs) deemed necessary for future protection of human health and the environment. A fundamental premise underlying execution of that agreement was that through the Air Force's substantial good-faith compliance with the procedures called for therein, reasonable assurances would be provided to U.S. EPA and FDEP as to the permanency of those remedies which included the use of specific LUCs.

Although the terms and conditions of the MOA are not specifically incorporated or made enforceable herein by reference, it is understood and agreed by the Air Force, U.S. EPA and FDEP that the contemplated permanence of the remedy reflected herein shall be dependent upon the Installation's substantial good-faith compliance with the specific LUC maintenance commitments reflected therein. Should such compliance not occur or should the MOA be terminated, it is understood that the protectiveness of the remedy concurred in may be reconsidered and that additional measures may need to be taken to adequately ensure necessary future protection of human health and the environment.

Land Use Controls Implemented:

Homestead ARS Installation Restoration Manager coordinates inspections and forwards discrepancies for correction.

Maintenance of signage to prevent unauthorized access.

Restrict construction. Workers must be notified that contamination exists and OSHA regulations apply if excavation activities are proposed on the site. Obtain concurrence from USEPA and FDEP prior to design. No residential usage allowed. Restrict groundwater access. No water supply wells allowed within the restricted area. Prior to all construction activities, a dig permit is required which also restricts groundwater access for this site.

Objective:

Prevent direct contact with contaminated media. Prevent trespasser and residential use.

Homestead Air Reserve Base, Florida
Operable Unit 5, Site WP-1
Electroplating Waste Disposal Area

Declaration for the Record of Decision

DECLARATION STATEMENT

FOR THE

RECORD OF DECISION FOR

OPERABLE UNIT NO. 5
HOMESTEAD AIR RESERVE BASE SUPERFUND SITE

SITE NAME AND LOCATION

Homestead Air Reserve Base
Homestead, Dade County, Florida
Operable Unit No. 5, Site WP-1,
Electroplating Waste Disposal Area (Former Site SP-1)

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the former Electroplating Waste Disposal Area, Operable Unit No. 5 (OU-5), Site WP-1, at the Homestead Air Reserve Base (ARB) (formerly Homestead Air Force Base), in Homestead, Florida. The selected remedial action is chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site.

The State of Florida, the U.S. Environmental Protection Agency (USEPA), and the U.S. Air Force (USAF) concur with the selected remedy presented in the Record of Decision (ROD).

DESCRIPTION OF THE SELECTED REMEDY

No Further Investigation (NFI) with Land Use Controls.

DECLARATION STATEMENT

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies, to the maximun extent practicable for the site. Because the previous removal/remedial action at this site left contaminants at industrial levels, institutional controls are required to prevent unacceptable exposures from hazardous substances that remain above health-based levels. This site will require a five-year review to assure there has been no migration of contaminants off site and that the institutional controls are effective in safeguarding human health and the environment.

United States Air Force
Homestead Air Reserve Base

By: Richard J Eustace ______________ Date: ____________

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Decision Summary for the Record of Decision

DECISION SUMMARY

FOR THE

RECORD OF DECISION

1.0 SITE NAME, LOCATION, AND HISTORICAL DESCRIPTION

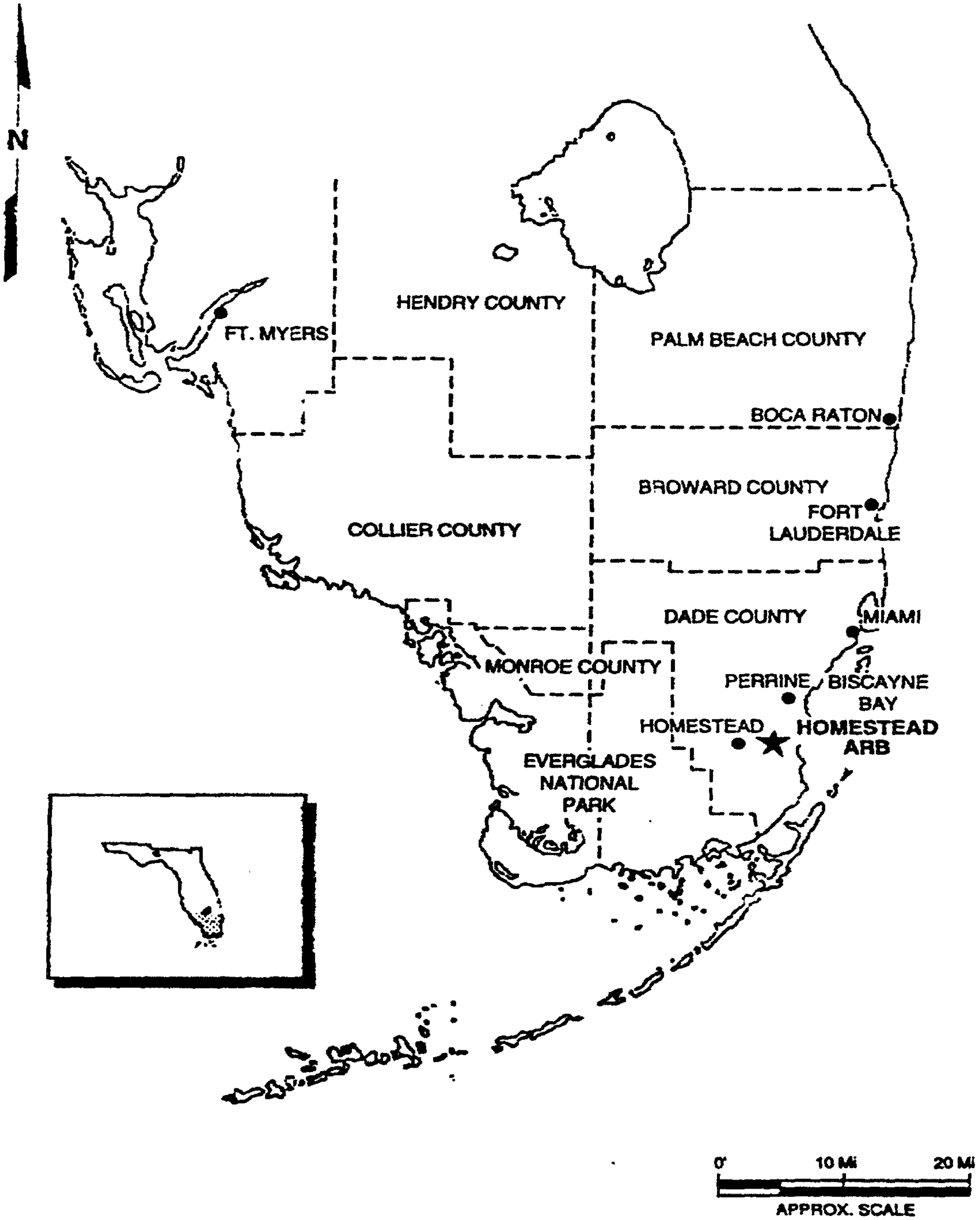
Homestead Air Reserve Base (ARB) is located approximately 25 miles southwest of Miami and 7 miles east of Homestead in Dade County, Florida (Figure 1-1). The main Installation covers approximately 2,916 acres while the surrounding areas are serni-rural. The majority of the Base is surrounded by agricultural land. The land surface at Homestead ARB is relatively flat, with elevations ranging from approximately 5 to 10 feet above mean sea level (msl). The Base is surrounded by a canal (Boundary Canal) that discharges to Outfall Canal and ultimately into Biscayne Bay approximately 2 miles east.

The Biscayne Aquifer underlies the Base and is the sole source aquifer for potable water in Dade County. Within 3 miles of Homestead ARB over 4,000 area residents obtain drinking water from the Biscayne Aquifer while 18,000 acres of farmland are irrigated from aquifer wells (USEPA, 1990). All recharge to the aquifer is through rainfall.

Homestead Army Air Field, a predecessor of Homestead Air Reserve Base, was activated in September 1942, when the Caribbean Wing Headquarters took over the air field previously used by Pan American Air Ferries, Inc. The airline had developed the site a few years earlier for pilot training. Prior to that time, the site was undeveloped. Initially operated as a staging facility, the field mission was changed in 1943 to training transport pilots and crews.

In September 1945, a severe hurricane caused extensive damage to the air field. The Base property was then turned over to Dade County and was managed by the Dade County Port Authority for the next eight years. During this period, the runways were used by crop dusters and the buildings housed a few small industrial and commercial operations.

In 1953, the federal government again acquired the airfield, together with some surrounding property, and rebuilt the Site as a Strategic Air Command (SAC) Base. The Base operated under SAC until July 1968 when it was changed to the Tactical Air Command (TAC and the



HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

LOCATION OF
HOMESTEAD AIR RESERVE BASE

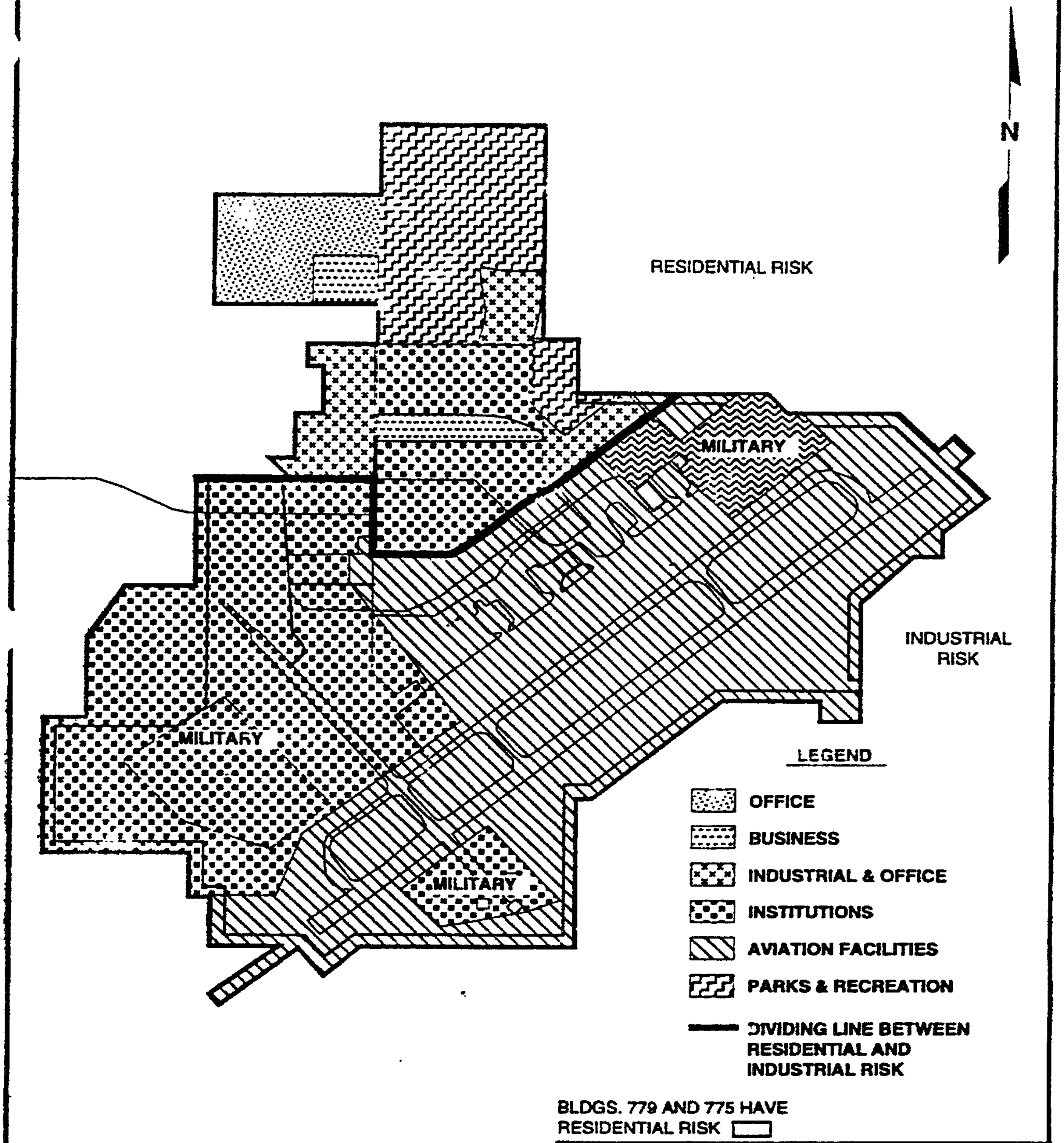
FIGURE 1-1

4531st Tactical Fighterwing became the new host. The Base was transferred to Headquarters Air Combat Command on June 1, 1992.

In August 1992, Hurricane Andrew struck south Florida causing extensive damage to the Base. The Base was placed on the 1993 Base Realignment and Closure (BRAC) list and slated for realignment with a reduced mission. Air Combat Command departed the Base on March 31, 1994 with Air Force Reservists activated at the Base on April 1, 1994. The 482nd Reserve Fighter Wing now occupies approximately 1/3 of the Base with the remaining 2/3 slated for use and oversight by Dade County. Figure 1-2 depicts the proposed future land use for the Base.

1.1 SITE DESCRIPTION

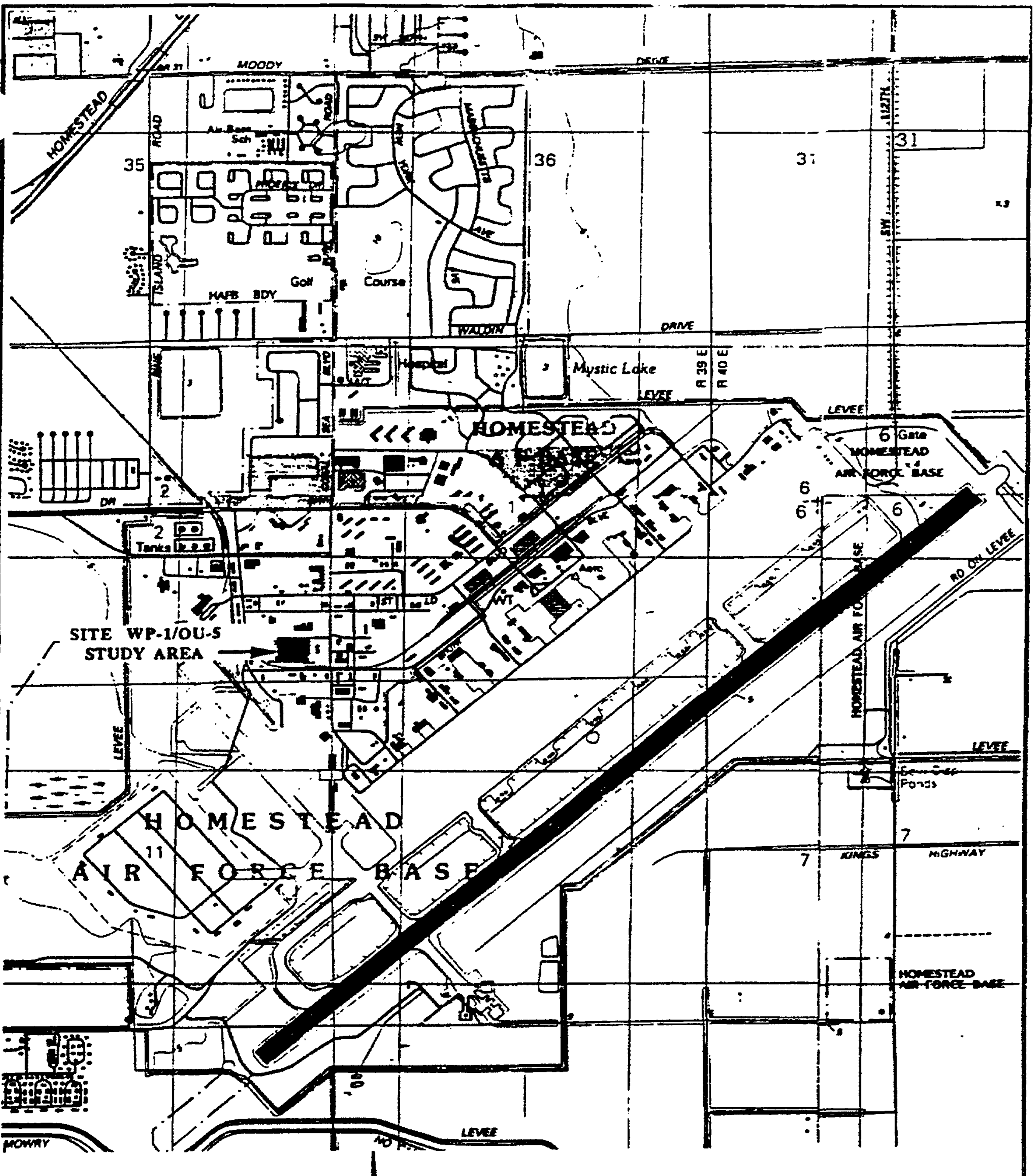
The Homestead ARB location map is depicted in Figure 1-3. The former Electroplating Waste Disposal Area (OU-5/Site WP-1) is located in the west-central portion of the Facility (Figure 1-4). The site is located in the portion of the Base remaining under control of the 482nd Reserve Fighter Wing. The site is in the cantonment area, east of Building 164 and consists of a grass lawn adjacent to Building 164, which is approximately 50 feet wide, and approximately the western third of the asphalt parking lot east of the grass lawn (Figure 1-4). Biggs Street is located north of the of the site and Buildings 163, 159, and 176 are located west, southeast, and southwest, respectively, of the site. A grassy drainage swale (low lying depressed stretch of land), with a north to south drainage flow direction, transects the grass lawn located adjacent to Building 164. Asphalt parking areas are located east of the grassy drainage swale and west of Building 164. The drainage swale east of Building 164, discharges into an underground culvert located south of Building 164. The underground culvert extends southward under Bikini Blvd. and an equipment storage area for approximately 500 feet and discharges into an unlined drainage swale just south of the equipment storage area. The equipment storage area also serves as a motor pool for large vehicles and contains an equipment/vehicle washrack. The unlined drainage swale is approximately five feet wide and three feet deep and has sparse terrestrial vegetation growing in the bottom of it and grass along the sides. The underground culvert collects runoff from OU-5/Site WP-1, Bikini Road, the equipment storage area, and other surrounding areas. South of the equipment storage area the drainage swale flows southwest into a drainage canal which travels for approximately one-half mile before entering the Boundary Canal. A second drainage swale, which flows from west to east into the culvert, is located southeast of Building 164 and south of Building 159. The two drainage swales located near Building 164



HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

FUTURE LAND USE MAP

FIGURE 1-2



N

1000 0 2000

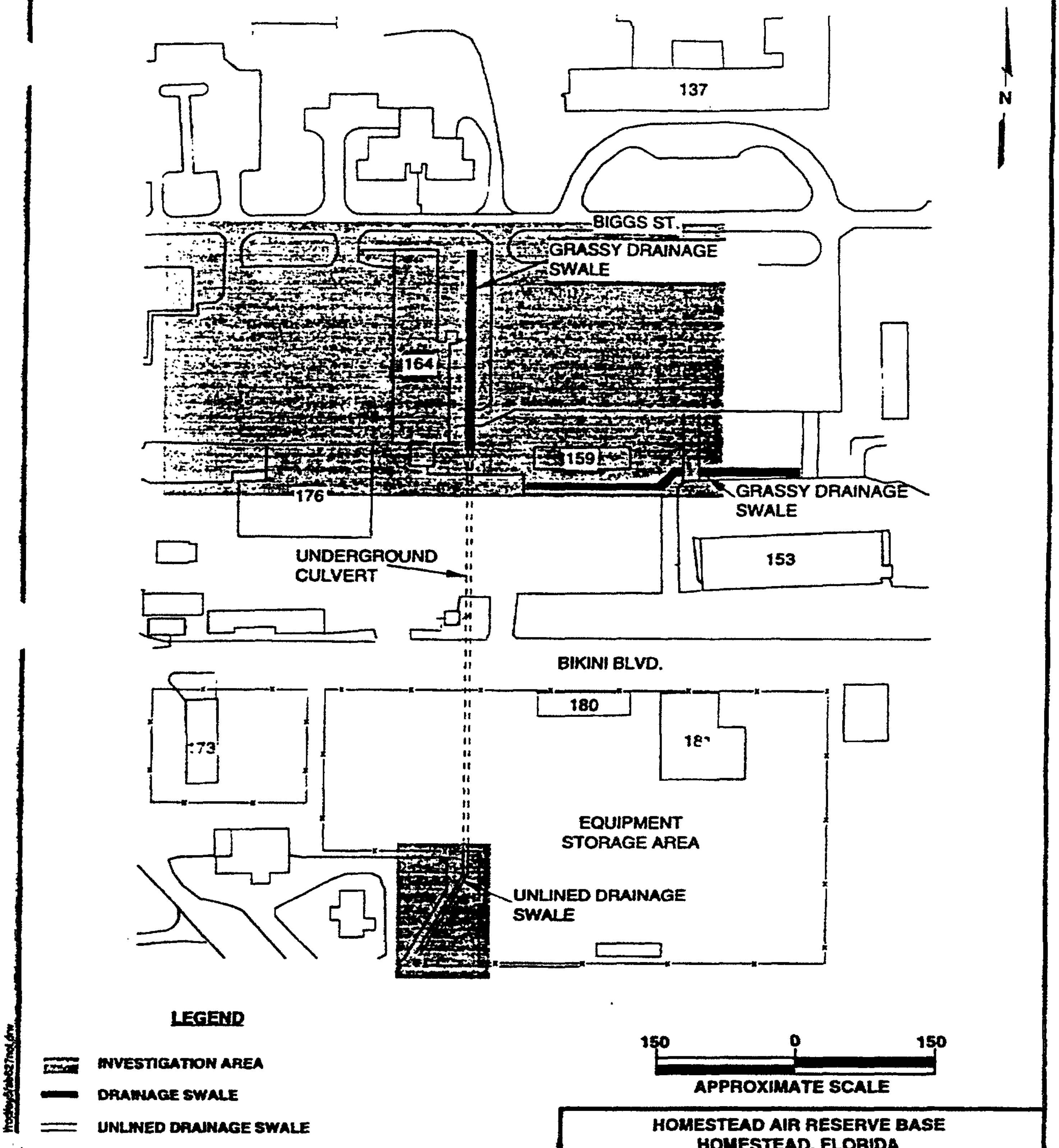
FEET

Source: USGS 7.5 minute
Topographic Quadrangles
Arsenicker, Homestead,
Goulds, and Perrine.

HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

SITE LOCATION MAP

FIGURE 1-3



HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

SITE LOCATION MAP
ELECTROPLATING WASTE DISPOSAL AREA
SITE WP-1/OU-5

FIGURE 1-4

and the unlined drainage Swale located south of the equipment storage area contain surface water only during heavy rain storms.

1.2 REGIONAL LAND USE

The area adjacent to Homestead ARB including OU-5/Site WP-1, to the west, east, and south within a half-mile radius is primarily composed of farmland and plant nurseries. Residential areas are located within a half-mile to the north and southwest of the Base. Woodlands are located approximately one-half-mile east of the facility and mangroves and marsh occur adjacent to Biscayne Bay. The Biscayne National Park is located 2 miles east of Homestead ARB; the Everglades National park is located 8 miles west-southwest of the Base; and the Atlantic Ocean is approximately 8 miles east of the Base.

1.3 SURFACE HYDROLOGY

Surface hydrology at Homestead ARB, including OU-5/Site WP-1 is controlled by five main factors: 1) relatively impermeable areas covered by runways, buildings and roads; 2) generally high infiltration rates through the relatively thin layer of soil cover; 3) flat topography; 4) generally high infiltration rates through the outcrop locations of the Miami Oölite Formation; and 5) relatively high precipitation rate compared to evapotranspiration rate. Infiltration is considered to be rapid through surfaces of oölite outcrop and areas with a thin soil layer. Infiltration rates are accelerated by fractures within the oölite, as well as naturally occurring solution channels. Precipitation percolates through the relatively thin vadose zone to locally recharge the unconfined aquifer.

Natural drainage is limited because the water table occurs at or near land surface. The construction of numerous drainage canals on Homestead ARB has improved surface water drainage and lowered the water table in some areas. Rainfall runoff from within Homestead ARB boundaries is drained via diversion canals to the Boundary Canal.

A drainage divide occurs within the Homestead ARB facility property, running from the northern end of the facility, toward the center. Water in the Boundary Canal flows generally south and east along the western boundary of the property, and south along the eastern boundary, converging at a storm-water reservoir located at the southeastern corner of the Base. Flow out of the stormwater reservoir flows into Outfall Canal, which, in turn, flows east into Biscayne Bay, approximately 2 miles east of the Base. Water movement is typically not visible in the canals in dry weather due to the lowered water table and the very low surface gradient (0.3 feet per mile) that exists at the Base.

1.3.1 Regional Hydrogeologic Setting

The regional hydrogeology in the southeast Florida area consists of two distinct aquifers: the surficial aquifer system, which consists of the Biscayne Aquifer and the Grey Limestone Aquifer, and the lower aquifer, the Floridan Aquifer.

Biscayne Aquifer. The Biscayne Aquifer at Homestead ARB consists of the Miami Oölite, Fort Thompson Formation, and the uppermost part of the Tamiami Formation. In general, the most permeable parts of the aquifer lie within the Miami Oö1ite and the Fort Thompson Formation.

The Biscayne Aquifer underlies all of Dade, Broward, and southeastern Palm Beach Counties. The Biscayne Aquifer is the sole source of potable water in Dade County and is a federally-designated sole-source aquifer pursuant to Section 1425 of the Safe Drinking Water Act (SDWA). The Biscayne Aquifer supplies drinking water to approximately 2.5 million people within local communities. All recharge to the aquifer is derived from local rainfall, part of which is lost to evaporation, transpiration, and runoff.

The Biscayne Aquifer has reported transmissivities ranging from approximately 4 to 8 million gallons per day per foot (mgd/ft) (Allman et al., 1979).

Water-table contours indicate that under natural conditions, groundwater flows southeasterly toward Biscayne Bay. The hydraulic gradient is approximately 0.3 ft/mile. The water table at Homestead ARB generally is encountered within 5 to 6 feet of land surface, but may occur at or near land surface during the wet season (May to October). Fluctuations of groundwater levels and local variations in the direction of groundwater flow are due to several factors: (1) differences in infiltration potential, (2) runoff from paved areas, (3) water-level drawdown near pumping wells, (4) significant but localized differences in lithology (e.g., silt-filled cavities) and (5) drainage effects of canals and water-level control structures.

Floridan Aquifer. Underlying the low-permeability sediments of the Tamiami Formation and Hawthorn Group are the formations which constitute the Floridan Aquifer.

The Floridan Aquifer is made up of limestones and dolomites. It is under artesian pressure and water levels in deep wells may rise 30 to 40 ft above ground surface. Groundwater within these Miocene and Eocene age formations tends to contain dissolved constituents at levels significantly above those recommended for drinking water. In view of the poor water quality and the depth of water yielding zones (800 to 900 feet bgs), the Floridan Aquifer is of limited usefulness as a source of potable water supply in the study area.

1.4 SITE GEOLOGY AND HYDROGEOLOGY

The stratigraphy of the shallow aquifer system as determined from soil borings performed during site investigations by Geraghty & Miller (G&M) and Montgomery Watson consists of a surficial weathered Miami Oölite ranging in depth from 2 to 6 feet below ground surface (bgs). The weathered limestone consists of a white to brown semi-consolidated oölitic limestone. This strata is underlain by consolidated to semi-consolidated oölitic and coral limestone interbedded with coarse to fine sand and clayey sand layers and lenses down to the total depth of borings (approximately 40 feet bgs).

The Biscayne Aquifer is one of the most transmissive aquifers in the world. It underlies Homestead ARB. A thin vadose zone, nominally less than 5 feet deep, overlays the groundwater table at the site. As previously stated, the aquifer structure is a calcium carbonate matrix. This lithology is known to have natural concentrations of target analyte list (TAL) metals. In descending order by concentration, calcium, aluminum, iron magnesium, sodium, and potassium can be considered the primary metals of carbonate rock. The other TAL metals occur in trace concentrations, less than 50 milligrams per kilogram (mg/kg). The range and the standard deviations are not provided at this time. It should be expected that, as precipitation infiltrates and recharge takes place, leaching of metal ions from the weathered vadose zone and shallow unsaturated zone occurs. Regional data collected suggest that concentrations of trace metals can be expected to be the greatest in the shallow portion of the aquifer because of the proximity to the source (i.e., the weathering vadose structure) and the decreasing retention time with decreasing depth of the saturated zone. These observations support a hydrogeologic model in which the shallow portion of the aquifer has a greater horizontal transmissivity than the vertical component during recharge events. However, it is not possible, from the available data at the site, to quantitatively differentiate horizontal and vertical components of the aquifer’s hydrologic conductivity. The possible presence of vertical solution zones is well documented in literature. The site-specific effects have not been fully investigated. Nevertheless, the available data does not lead to the immediate conclusion that this is a necessary task. The conceptual model that the shallow groundwater is discharging to the ditches and canals provides sufficient detail for the purpose of discussing Site OU-5/WP- 1.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 OPERABLE UNIT NO. 6 HISTORY

2.1.1 Past Site Usage

OU-5/Site WP- 1 was formerly used as a disposal area for spent plating baths and rinses from a plating shop located in Building 164. During the period between 1946 and 1953, when Homestead ARB was inactive and ownership of the property was transferred to Dade County, a small electroplating operation was located in Building 164. Spent plating solutions containing chromium, nickel, copper, and sulfuric and hydrochloric acid were routinely disposed of by discharging them on the ground in an area just east of Building 164 (Engineering-Science, 1993). Wastes were generated at a rate of approximately 250 gallons per month, and the electroplating operation continued for about two years (Engineering-Science, 1983). According to 1958, 1962, and 1973 aerial photographs, the asphalt parking lot located east of Building 164 did not exist when the electroplating company was operating and the area was covered with trees and grass. The parking lot was constructed between 1962 and 1973. No visible evidence of waste residue is observed on the ground surfaces that are presently exposed (not covered by parking lot). The high amount of rainfall typical of the area is suspected to have dissipated the waste residues.

2.1.2 Future Site Usage

OU-5/Site WP-1 is within the cantonment area of the 482nd Air Force Reserve unit. The cantonment area has restricted access and is fenced off from other areas of the Base.

2.2. ENFORCEMENT HISTORY

2.2.1 CERCLA Regulatory History

The Comprehensive Environmental Response. Compensation and Liability Act of 1980 (CERCLA) established a national program for responding to releases of hazardous substances into the environment. In anticipation of CERCLA, the Department of Defense (DOD) developed the Installation Restoration Program (IRP) for response actions for potential releases of toxic or hazardous substances at DOD facilities. Like the U.S. Environmental Protection Agency's (USEPA's) Superfund Program, the IRP follows the procedures of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Homestead ARB was already engaged in the IRP Program when it was placed on the National Priorities List (NPL) on August 30, 1990. Cleanup of DOD facilities is paid for by the Defense Environmental Restoration Account (DERA), which is DOD's version of Superfund.

The Superfund Amendment and Reauthorization Act (SARA), enacted in 1986, requires federal facilities to follow NCP guidelines. The NCP was amended in 1990 (see 40 CFR 300 et seq.) to implement CERCLA under SARA. In addition, SARA requires greater USEPA involvement and oversight of Federal Facility Cleanups. On March 1, 1991, a Federal Facility Agreement (FFA) was signed by Homestead ARB (formerly Homestead AFB), the USEPA, and the Florida Department of Environmental Protection (FDEP). The FFA guides the remedial design/remedial action (RD/RA) process.

The purpose of the FFA was to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at Homestead ARB in accordance with existing regulations. The FFA requires the submittal of several primary and secondary documents for each of the operable units at Homestead ARB. This ROD concludes all of the remedial investigation/feasibility study (RI/FS) requirements for OU5/Site WP- 1.

As part of the RI/FS process, Homestead ARB has been actively involved in the Installation Restoration Program (IRP). From 1983 to 1992, 27 Potential Sources of Contamination (PSCs) were identified at Homestead ARB. Ten sites have been investigated in the PA/SI stage of CERCLA, with four sites warranting no further investigation and six sites requiring further investigation. One of the PSCs sites has been closed under the Resource Conservation and Recovery Act (RCRA) guidelines and seven sites were investigated under the FDEP petroleum contaminated sites criteria (Florida Administrative Code (FAC) 62-770). Additionally, a RCRA Facility Investigation (RFI) has been conducted to evaluate numerous solid waste management units (SWMUs) identified during the RCRA Facility Assessment (RFA). A cleanup effort was initiated after Hurricane Andrew to prepare the base for realignment. This included the removal of fuel storage tanks and oil1water separators. Additional PSC have been identified subsequent to 1992 as a result of investigations and/or remediation of the base. The following PSC sites are currently in various stages of reporting under the CERCLA RI/FS guidelines.

PSC Name	Operable Unit No.
Fire Protection Training Area 2	1
Residual Pesticide Disposal Area	2
Oil Leakage Behind the Motor Pool	4
Electroplating Waste Disposal Area	5
Aircraft Washrack Area	6
Entomology Storage Area	7
Fire Protection Training Area 3	8
Boundary Canal	9
Landfill LF-12	10
Sewage Treatment Plant/Incinerator Ash Disposal Area	11
Entomology Shop	12
Landfill SS-22	13
Drum Storage Area	14
Hazardous Storage Bldg.	15
Missile Site	16
Hangar 793	17
Construction Debris Landfill	18
Bldg. 208	19
Bldg. 618 Parking Lot	20
# 32,Bldg. 619 Parking Lot	21
Bldg. 761/764	22
Bldg. 814	25
Bldg. 745	26
Bldg. 268 & 268 A	27
Bldg. 750	28
Bldg. 760	29

Operable Unit No. 3 PCB Spill, C.E. Storage Compound has been closed out with a No Further Action Record of Decision (ROD) in June 1994. Operable Units 1, 2, 4, and 6 have been completed through the ROD stage requiring various levels of remedial action/remedial design. OU-8 has been closed out under CERCLA with a No Further Investigation Decision Document and is being transfered to the FAC 62-770 program. Two Solid Waste Management Units, OU-23 and OU-24, have been closed out while three areas of concern (AOC-1, AOC-3, and AOC-5) are in the preliminary assessment phase of investigation.

Figure 2-1 depicts the above-listed CERCLA sites, as well as the FAC 62-770 fuel contaminated sites currently under investigation.

The Base Realignment and Closure (BRAC) Cleanup Plan currently incorporates both the IRP and associated environmental compliance programs to support full restoration of the base.

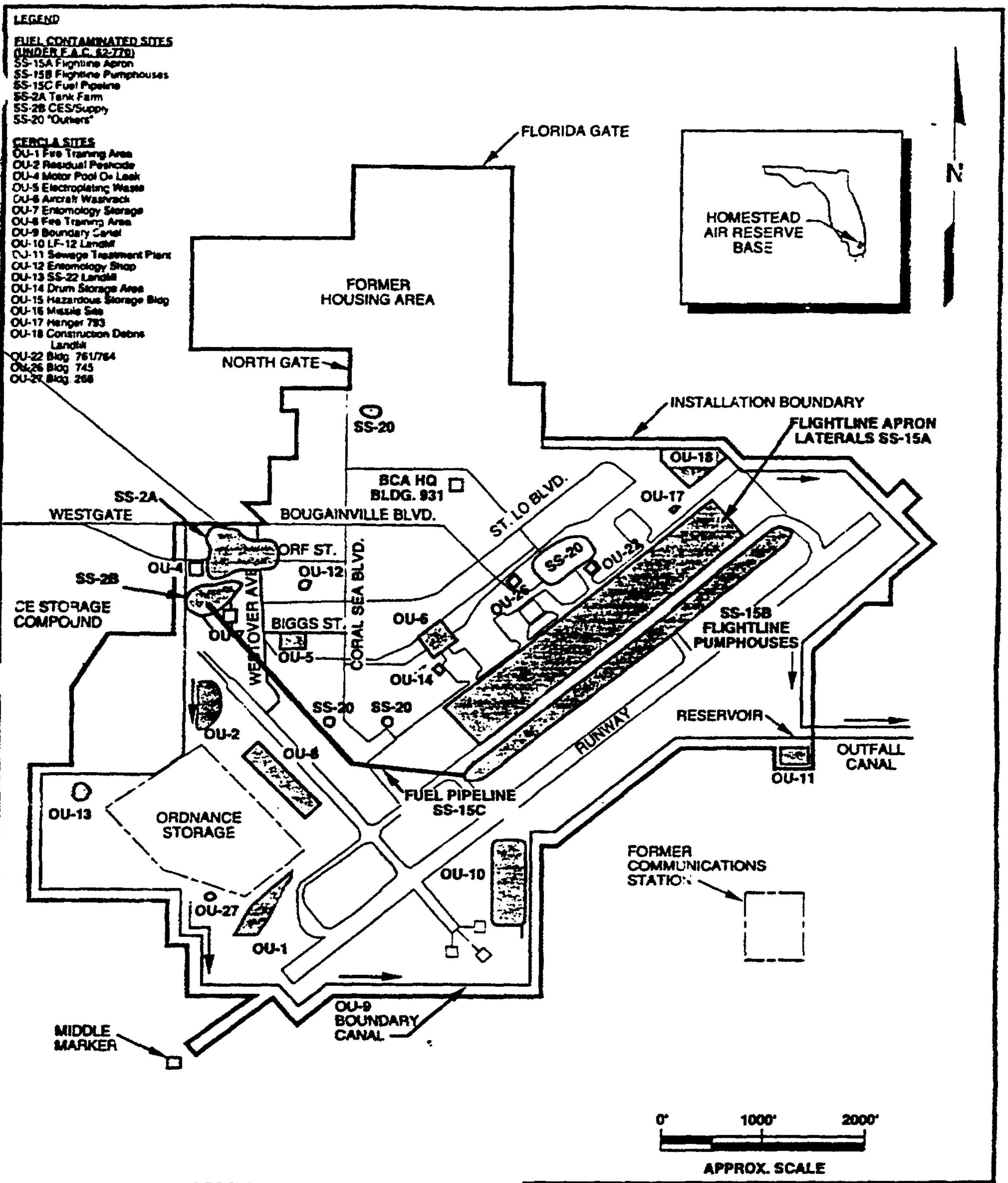
2.3 INVESTIGATION HISTORY

2.3.1 IRP Phase I - Record Search

An IRP Phase I - Records Search was performed by Engineering Science, and is summarized in their report, dated August 1983 (Engineering-Science, 1983). During the Phase I study, sites with the potential for environmental contamination resulting from past waste disposal practices were identified. Thirteen sites of potential concern were identified by reviewing available installation records, interviewing past and present Base employees, inventorying wastes generated and handling practices for these wastes, conducting field inspections, and reviewing geologic and hydrogeologic data. In general, Phase I studies are used to determine if a site requires further investigation.

The thirteen identified sites were ranked using the Hazard Assessment Rating Methodology (HARM) developed by JRB Associates of McLean, Virginia, for the U.S. Environmental Protection Agency (USEPA). HARM was later modified for application to the Air Force IRP. The following factors are considered in HARM: (1) the possible receptors of the contaminants; (2) the characteristics of the waste; (3) potential pathways for contaminant migration; and (4) waste management practices. HARM scores for the sites ranked at Homestead ARB ranged from a high of 72 to a low of 7 out of 100. Eight of the thirteen sites were determined to have a moderate-to-high contamination potential, one of which was the Electroplating Waste Disposal Area. These sites were recommended for additional monitoring. The remaining five sites were determined to have a low potential for environmental contamination.

According to the IRP Phase I Report, Site OU-5/WP-1 received a moderate to high HARM score of 72 due to the nature of the waste (persistent metals) that were disposed of at the site (Engineering-Science, 1983). In addition, Site OU-5/WP-1 scored high as a potential migration pathway because of the extremely permeable nature of the underlying rock, shallow groundwater, and the proximity of the drainage swale to the site. This score,



LEGEND

―	BOUNDARY CANAL
▭ OU-5	LOCATION AND DESIGNATION OF STUDY AREA

HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

SITE LOCATIONS

FIGURE 2-1

however, did not reflect the site conditions which have probably caused dissipation of the wastes; including heavy rain infiltration and the amount of time (30 years) since the disposal activities ceased. The Phase I report recommended sampling the existing Base supply well, the one currently or most recently in service, from Well Field No. 1 and analyzing for pH, total dissolved solids (TDS), chromium, nickel, copper, and sulfate.

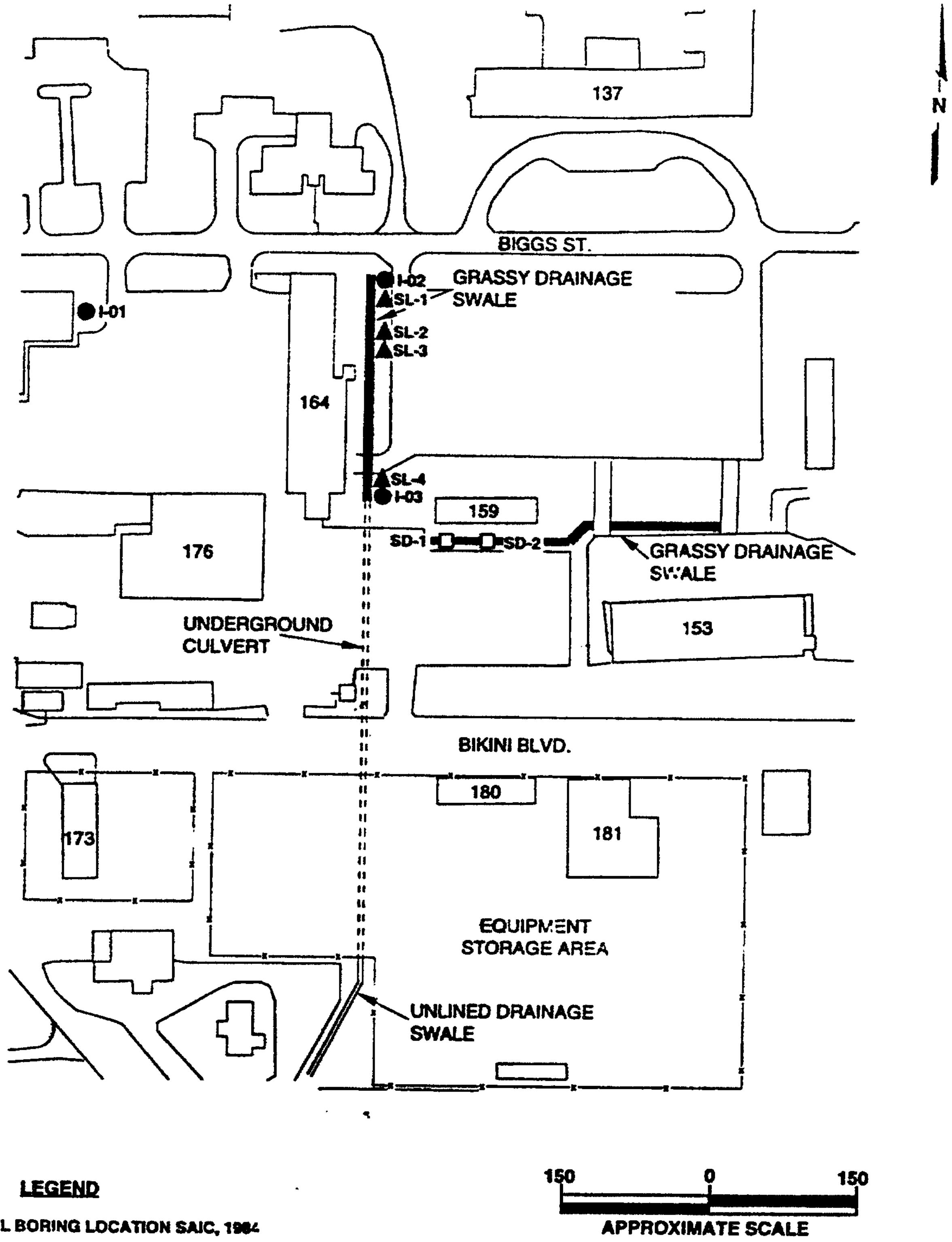
2.3.2 IRP Phase II - Confirmation/Quantification

An IRP Phase II study was performed by Science Applications International Corporation in 1984 and a report was completed in March 1986 (SAIC, 1986). The objectives of a Phase II study are to confirm the presence or absence of contamination, to quantify the extent and degree of contamination, and to determine if remedial actions are necessary. During the Phase II study, additional investigations were performed at the eight sites recommended for monitoring in the Phase I report, as well as two of the other thirteen originally-identified sites. The Electroplating Waste Disposal Area was included in this investigation.

The Phase II - Confirmation/Quantification investigation included installation of three monitoring wells (I-01 through I-03) and four soil borings (SL-1 through SL-4), collection of two sediment samples (SD-1 and SD-2), and groundwater sampling. The monitoring wells were sited for the purpose of confirming and quantifying suspected contaminants. The locations of these monitoring wells and the sampling points are shown in Figure 2-2. The soil, sediment, and groundwater samples were analyzed for total metals (cadmium, chromium, copper, lead, nickel, zinc) and cyanide. The groundwater samples were also analyzed for hexavalent chromium.

The groundwater analyses indicated the presence of metals; however, the concentrations detected were below applicable Federal and Florida drinking water standards. The detected levels of metals in the soil and sediment samples are comparable to common background levels for those metal constituents. Elevated levels of cyanide, however, were detected in the soil and sediment samples. Table 2-1 presents the analytical results for the groundwater samples and Table 2-2 presents the analytical results for soil and sediment samples collected during the 1984 IRP investigations.

The Phase II report contained the following alternatives for additional investigation at this site: (1) resample existing wells for inorganics; (2) install an additional monitoring well located southeast of Building 159; (3) collect surface-water (and sediment) samples from the drainage canal and runoff from the site and other areas to assess the contaminant contribution



LEGEND

▲ SOIL BORING LOCATION SAIC, 1984

● SHALLOW MONITORING WELL INSTALLED 1984 BY SAIC, SAMPLED 1984 AND 1988

☐ SEDIMENT SAMPLING LOCATION SAIC, 1984

▬ DRAINAGE SWALE

═ UNLINED DRAINAGE SWALE

HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

PHASE II (1984) AND PHASE IV-A (1988)
SAMPLING LOCATIONS
ELECTROPLATING WASTE DISPOSAL AREA
SITE WP-1/OU-5

FIGURE 2-2

TABLE 2-1

ANALYTICAL RESULTS FOR PHASE II GROUNDWATER SAMPLES
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
SAIC, 1984 INVESTIGATION

Homestead Air Reserve Base, Florida

ANALYTE	LOCATION	I-01	I-02	REPLICATE I-02	I-03
Field Parameters					
pH (Std. Units)		6.8	6.8	6.8	NA
Temp (°C)		29	24	24	29
Specific Conductance (umhos/cm)		420	420	420	430
Metals: ug/L:					
Cadmium		0.2	0.2	<0.2	0.4
Total Chromium		19.7	<0.5	<0.5	<0.5
Hexavalent Chromium		0.3	<0.1	<0.1	1.7
Copper		4.2	5.3	4.8	7.0
Lead		7.8	6.8	9.0	5.7
Nickel		10.6	10.8	9.2	16.9
Zinc		15.1	16.3	15.7	16.3
Cyanide ug/L		<5.0	<5.0	<5.0	<5.0

Source: Geraghty & Miller, Inc., 1992

NA - Not Available

TABLE 2-2

ANALYTICAL RESULTS FOR PHASE II SOIL AND SEDIMENT SAMPLES COLLECTED
SITE WP-1/OU.5, ELECTROPLATING WASTE DISPOSAL AREA
SAIC, 1984 INVESTIGATION

Homestead Air Reserve Base, Florida

	SOIL					SEDIMENTS		
					REPLICATE			REPLICATE
ANALYTE (mg/Kg)	SL-1	SL-2	SL-3	SL-4	SL-4	SD-1	SD-2	SD-21
Cadmium	0	0	0	0	0	0	0.01	0.01
Total Chromium	0.07	0.02	0.03	0.04	0.04	0.02	0.09	0.07
Copper	0.08	0.02	0.03	0.11	0.12	0.01	0.04	0.05
Lead	0.17	0.09	0.11	0.21	0.20	0.11	1.18	1.17
Nickel	0.02	0.01	0.04	0.05	0.04	0	0.01	0.01
Zinc	0.72	0.12	0.15	0.28	0.24	0.18	0.92	0.80
Cyanide	1.3	0.60	0.70	0.80	0.80	0.60	3.00	3.90

Source: Geraghty & Miller, Inc., 1992

Shading indicates sediments have been removed during the 1995 Interim Removal Action.

mg/kg - milligrams per kilogram

of the site area and whether significant levels of inorganics are migrating from the site via surface water, (4) collect additional soil samples to delineate soil contamination; and (5) a combination of alternatives one and three. The recommendations of the Phase II report included: sampling the canal water and sediments southeast of Building 159 at two locations during the wet season to determine the role of surface water as a pathway; resampling existing monitoring wells for comparison with Stage I results to determine the statistical significance of the elevated inorganics indicated by Stage I analysis, and installation and sampling of two additional monitoring wells. A complete discussion of the methods and results of this study are presented in the Phase II - *Confirmation/Quantification Report* (SAIC, 1986).

2.3.3 IRP Phase III - Technology Base Development

The IRP Phase III is a research phase and involves technology development for an assessment of environmental impacts. There have been no Phase III tasks conducted at the Base to date.

2.3.4 IRP Phase IV - Additional Investigations

The IRP Phase IV investigations congist of two areas of work activity. Phase IV-A involves additional site investigations necessary to meet the Phase II objectives, a review of all management methods and technologies that could possibly remedy site problems, and preparation of a baseline risk assessment to address the potential hazards to human health and the environment associated with the constituents detected at the site. Detailed alternatives are developed and evaluated and a preferred alternative is selected. The preferred alternative is then described in sufficient detail to serve as a baseline document for initiation of Phase IV-B.

An IRP Phase IV-A investigation was performed at Site OU-5/WP- 1 by Geraghty & Miller in 1988. The results of this investigation are included in the report entitled *Draft Remedial Investigation Report for the Building 207 Underground Storage Tank Area, Residual Pesticide Disposal Area, and the Electroplating Waste Disposal Area, Homestead Air Force Base, Florida*, October 1988.

The Phase IV-A - Remedial Actions investigations included additional groundwater analysis, water-level measurements, and a topographic survey. Groundwater samples from the existing wells were collected and analyzed for total metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, sodium) and cyanide. Arsenic and sodium were the only constituents detected at concentrations exceeding the quantitation limit (Table 2-3). All detected concentrations were below applicable Federal and Florida standards. The locations of the permanent monitoring wells, as well as significant topographic features of the site, have been indicated on Figure 2-2.

No significant risks to public health or the environment were identified in the baseline risk assessment; therefore, the *Draft RI Report* (Geraghty & Miller, 1988) recommended no further action at this site. A "no further action" recommendation specifies that additional investigations and/or remedial action are not warranted at the site.

2.3.5 1991 Remedial Investigation

In 1991, G&M conducted a remedial investigation at OU-5/Site WP-1. This investigation included the installation of one additional monitoring well (SP1-MW-0001), sampling of the three existing monitoring wells plus the new well, collection of four shallow soil/weathered rock samples, two sediment, and two surface water samples. The 1991 sampling locations are shown on Figure 2-3. All samples were analyzed for the USEPA Target Compound List (TCL) VOCs and BNAs, and the Target Analyte List (TAL) metals and cyanide using USEPA SW-846 the methods. The results of these analyses are presented in Sections 2.6.2, 2.6.3, 2.6.4, and 2.6.5. Complete results of the 1991 RI are presented in G&Ms report titled *Remedial Investigation Report for Site WP-1 Electroplating Waste Disposal Area*, June 1992. Geraghty & Miller’s conclusion presented in the RI Report was that no additional study was recommended.

2.3.6 1993 Remedial Investigation Addendum

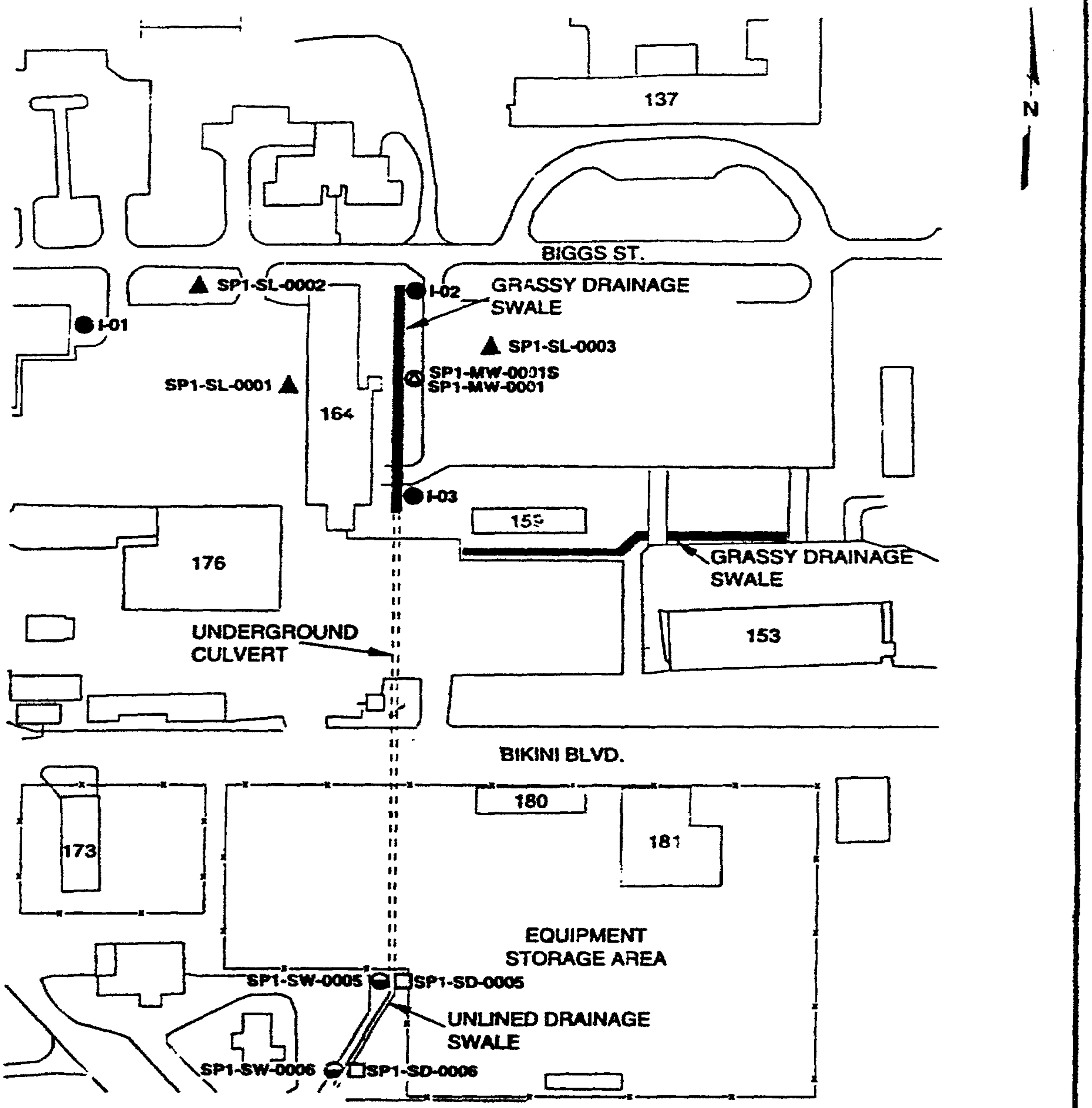
In 1993, Montgomery Watson Americas, Inc. performed supplemental RI activities to evaluate the soil and groundwater quality with respect to the USEPA target compound list/target analyte list (TCL/TAL), to fill data gaps from the previous field investigations, and to evaluate any impacts due to Hurripane Andrew. The 1993 investigation included the drilling of five soil borings, groundwater sampling of seven shallow and one deep monitoring well, and the collection of three sediment and surface water samples. Sampling locations are illustrated on Figure 2-4. All samples were analyzed for TCL Organochlorine Pesticides/PCBs and cyanide. All sediments, one soil, and one groundwater sample were also analyzed for the presence of TCL VOCs, BNAs, and TAL metals. Dissolved (filtered)

TABLE 2-3

ANALYTICAL RESULTS OF PHASE IV-A GROUNDWATER SAMPLES
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
GERAGHTY & MILLER, 1988 INVESTIGATION
Homestead Air Reserve Base, Florida

	LOCATION		
Analytes	I-01	I-02	I-03
Metals (ug/L)			
Total arsenic	24	13	[8.1]
Total barium	[7.6]	[5.7]	[5.8]
Total cadmium	<0.12	[0.48]	<0.12
Total chromium	[8.9]	[9.4]	[9.1]
Total copper	<7.8	<7.8	[8.3]
Total lead	[1.4]	[2.6]	[1.6]
Total mercury	<0.13	[0.15]	[0.16]
Total nickel	[14]	<11	<11
Total selenium	[1.0]	[0.54]	[0.99]
Total sodium	33,500	7710	31,400
Total cyanide	[7.4]	<2.6	24

Source: Geraghty & Miller, Inc., 1992
ug/L - micrograms per liter
< Less than stated quantitation limit
[ ] Value is between level of quantition and instrument detection limit.



LEGEND

▲ SOIL BORING LOCATION

● MONITORING WELL INSTALLED BY SAIC, 1984

□ SEDIMENT SAMPLING LOCATION

⊖ SURFACE WATER SAMPLING LOCATION

▬ DRAINAGE SWALE

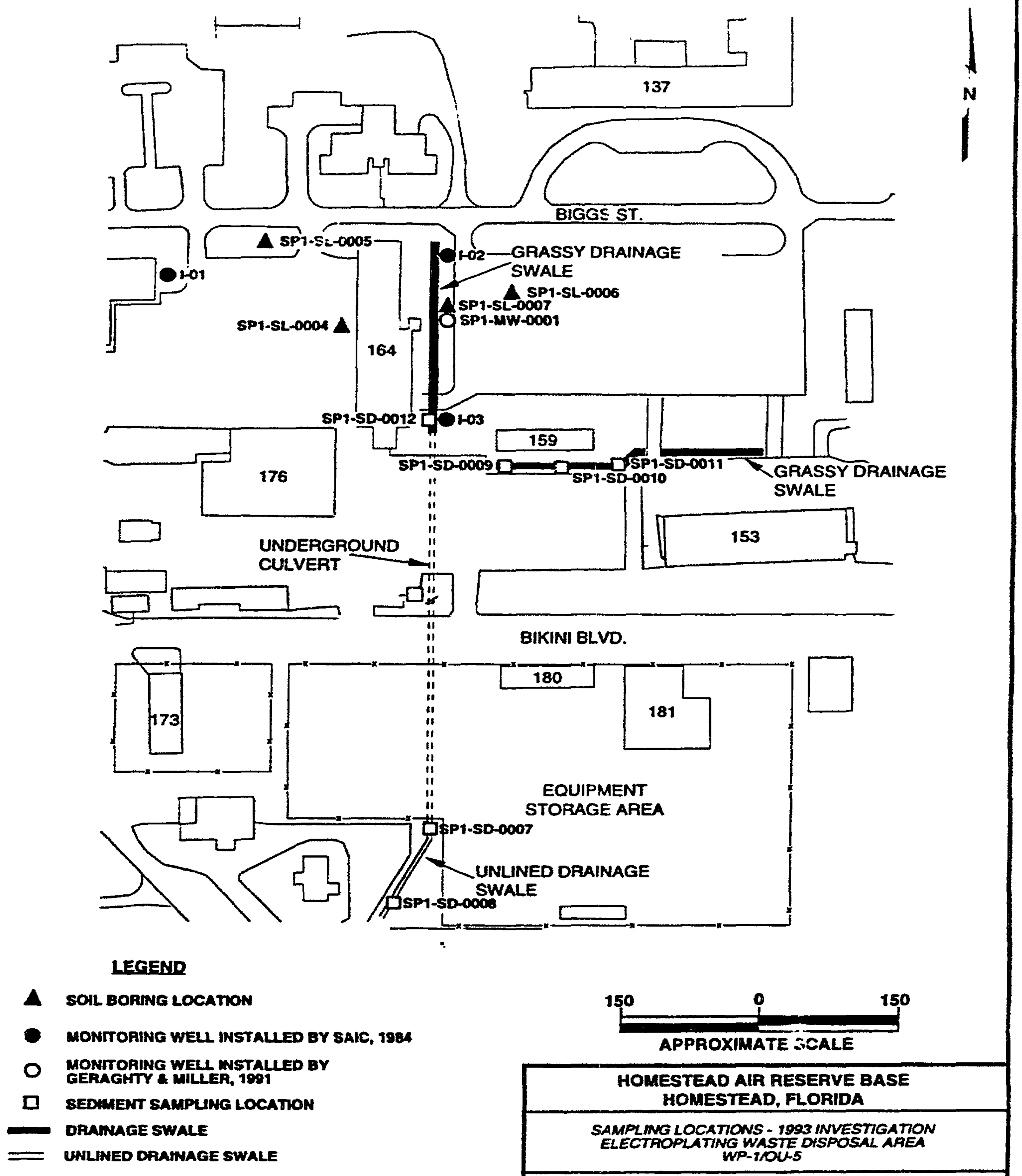
⊙ SOIL SAMPLING LOCATION FROM MONITORING WELL BORE HOLE INSTALLED BY GERAGHTY & MILLER, 1991

═ UNLINED DRAINAGE SWALE

HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

SAMPLING LOCATIONS - 1991 INVESTIGATION
ELECTROPLATING WASTE DISPOSAL AREA
SITE WP-1/OU-5

FIGURE 2-3



HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

SAMPLING LOCATIONS - 1993 INVESTIGATION
ELECTROPLATING WASTE DISPOSAL AREA
WP-1/OU-5

FIGURE 2-4

TAL metals were also analyzed for in groundwater samples. The results of these analyses are presented in Sections 2.6.2, 2.6.3, 2.6.4, and 2.6.5.

2.3.7 1994 and 1995 Investigations

Confirmatory samples were collected during the summer of 1994 from 28 shallow borings at the locations shown in Figure 2-5. This work was completed under the direction of the USACE-Mobile District. For the purposes of this evaluation, samples collected from the two borings advanced west of Building 164 and the five borings in the grassy swale east of Building 164 were considered soil samples due to their location in a asphalt paved parking area and the absence of a well defined drainage system in the swale. The remaining samples were considered sediments. The two samples collected from the borings located west of Building 164 were analyzed for semi-volatile organic compounds (USEPA SW-846 Method 8270) and TAL metals (USEPA SW-846 Method 6010, 7060, 7421, 7740, and 7471). The remaining 26 soil/sediment samples were analyzed for semi-volatile organics, TAL metals, and pesticides (USEPA Method 8080). All analyses were performed in accordance with USEPA SW-846 protocol. The results of these analyses are presented in Sections 2.6.2 and 2.6.4. Further information regarding the collection of the 28 confirmatory soil samples collected during the 1994 sampling event is provided in the IT report entitled *Confirmation Sampling Results: Electroplating Waste Disposal Area* (IT Corporation, August 29, 1994).

In 1995, IT conducted an Interim Action (IA) at OU-5/Site WP-1. This work was completed under the direction of the USACE-Mobile District. The remedial activities included delineation and profiling of contaminated soils/sediments, excavation and disposal of contaminated soils/sediments, and analysis of confirmation samples collected from within the excavation limits. Further details on the activities conducted during the 1995 investigation can be found in the IT report entitled *Interim Action Report: Electroplating Waste Disposal Area* (OU-5) (IT Corporation, November 30, 1995).

After excavation, three confirmation samples were collected from the base of the excavated areas. These confirmation samples were analyzed for semi volatile organics, TAL metals, and pesticides using USEPA SW-846 methods. Confirmation sample locations are depicted on Figure 2-6. The results of these analyses are presented in Section 2.6.2.

During the investigations and excavation activities, 14 analytical samples were collected from soil/sediments that were later excavated during the Interim Action. Of those samples, 2 were collected during the 1984 Science Applications International Corporation (SAIC) investigation, 4 were samples collected during the 1993 Montgomery Watson Investigation, and 14 were samples collected during the 1994 IT Corporation projects. The results from these analysis are no longer representative of current site conditions. A complete list of the soil/sediment samples which were subsequently excavated is presented in Table 2-4.

2.3.8 1996 Confirmation Groundwater Sampling

On January 24 and 25, 1996, OHM, under contract with the Air Force Center for Environnental Excellence (AFCEE), conducted as confirmation groundwater sampling event at OU-5/Site WP-1. During this event groundwater samples were obtained from each of the sites 4 groundwater monitoring wells (SPl-MW-0001, I-01, I02, and I-03) (Figure 2-7). Groundwater samples were collected with USEPA and State of Florida approved methods. The 4 groundwater samples were analyzed by Analytical Technologies, Inc., in Pensacola Florida, for the target compound list (TCL) volatile organic compounds (VOC's), TCL base neutral and acid extractable (BNA's), TCL organochlorine pesticides/PCB's, and target analyte list (TAL) metals and cyanide. The results of these analytes are presented in Section 2.6.3. All samples were analyzed in accordance with USEPA Contract Laboratory Protocol (CLP) requirements.

The results of the site characterization activities conducted during the 1991 and 1993 investigations, as well as the results from the 1994 and 1995 IT Corporation Interim Action and the 1996 OHM confirmation sampling event are presented in Sections 2.6.2, 2.6.3, 2.6.4, and 2.6.5 of this ROD.

2.4 COMMUNITY RELATIONS HISTORY

The Remedial Investigation/Baseline Risk Assessment Report and the Proposed Plan (PP) for Homestead ARB, OU-5/Site WP-1 were released to the public in October and December 1996, respectively. These documents were made available to the public in both the administrative record and an informal repository maintained at the Air Force Base Conversion Agency OL-Y office. A public comment period will be held from March 16, 1997 to April 14, 1997 as part of the comunity relations plan for OU-5/Site WP-1. Additionally, a public meeting was be held on Thursday, March 13, 1997 at 7:00 pm at the South Dade Senior High School. A Public Notice was published in the Miami Herald and the South Dade News Leader on February 21, 1997. At this meeting, the USAF, in coordination with USEPA Region 4, FDEP and Dade County Environmental Resources Management (DERM), will be prepared to discuss the Remedial Investigation, the

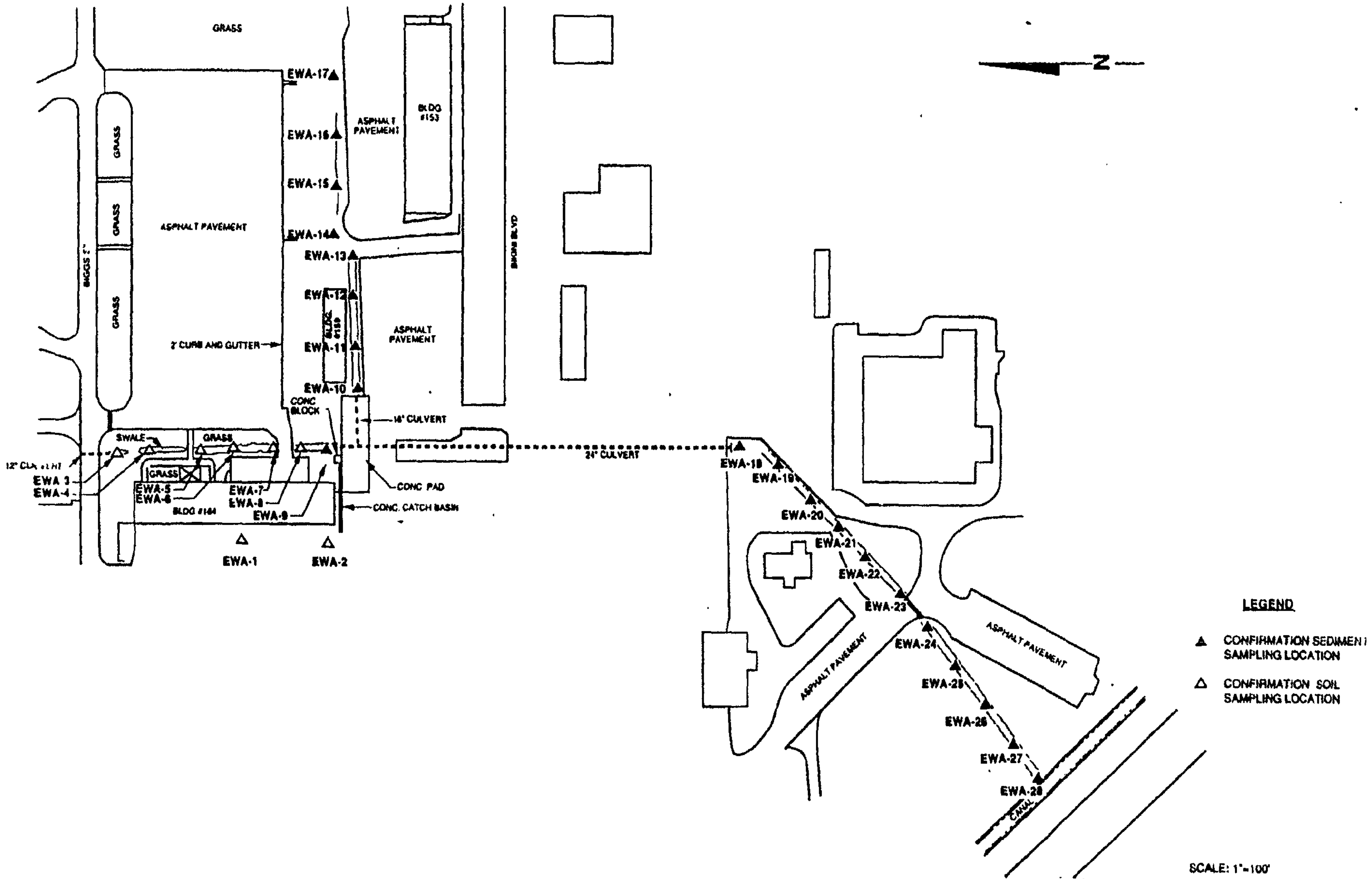
TABLE 2-4

SUMMARY OF EXCAVATED SAMPLES
Site WP-1/OU-5, Electroplating Waste Disposal Area
IT Corporation, 1995 Interim Removal Action (IRA)
Homestead Air Reserve Base, Florida

Sample Identifier	Sampling Depth Interval	IRA Excavation Depth	Investigation	Comments
NORTH AREA (a)				
SD-1 (sediment)	(a)	1'	1984 (SAIC)	Excavated
SD-2 (sediment)	(a)	1'	1984 (SAIC)	Excavated
SP1-SD-0009 (sediment)	0'-1'	1'	1993 (Montgomery Watson)	Excavated
SP1-SD-0010 (sediment)	0'-1'	1'	1993 (Montgomery Watson)	Excavated
SP1-SD-0011 (sediment)	0'-1'	1'	1993 (Montgomery Watson)	Excavated
SP1-SD-0012 (sediment)	0'-1'	1'	1993 (Montgomery Watson)	Excavated
EWA-6 (soil)	0'-0.5'	1'	1994 (IT Corporation)	Excavated
EWA-7 (soil)	0'-0.5'	1'	1994 (IT Corporation)	Excavated
EWA-8 (sediment)	0'-0.5'	1'	1994 (IT Corporation)	Excavated
EWA-10 (sediment)	0'-0.5'	1'	1994 (IT Corporation)	Excavated
EWA-11 (sediment)	0'-0.5'	1'	1994 (IT Corporation)	Excavated
EWA-12 (sediment)	0'-0.5'	1'	1994 (IT Corporation)	Excavated
EWA-13 (sediment)				
EWA-15 (sediment)				

NOTES:

(a) Sample interval unknown

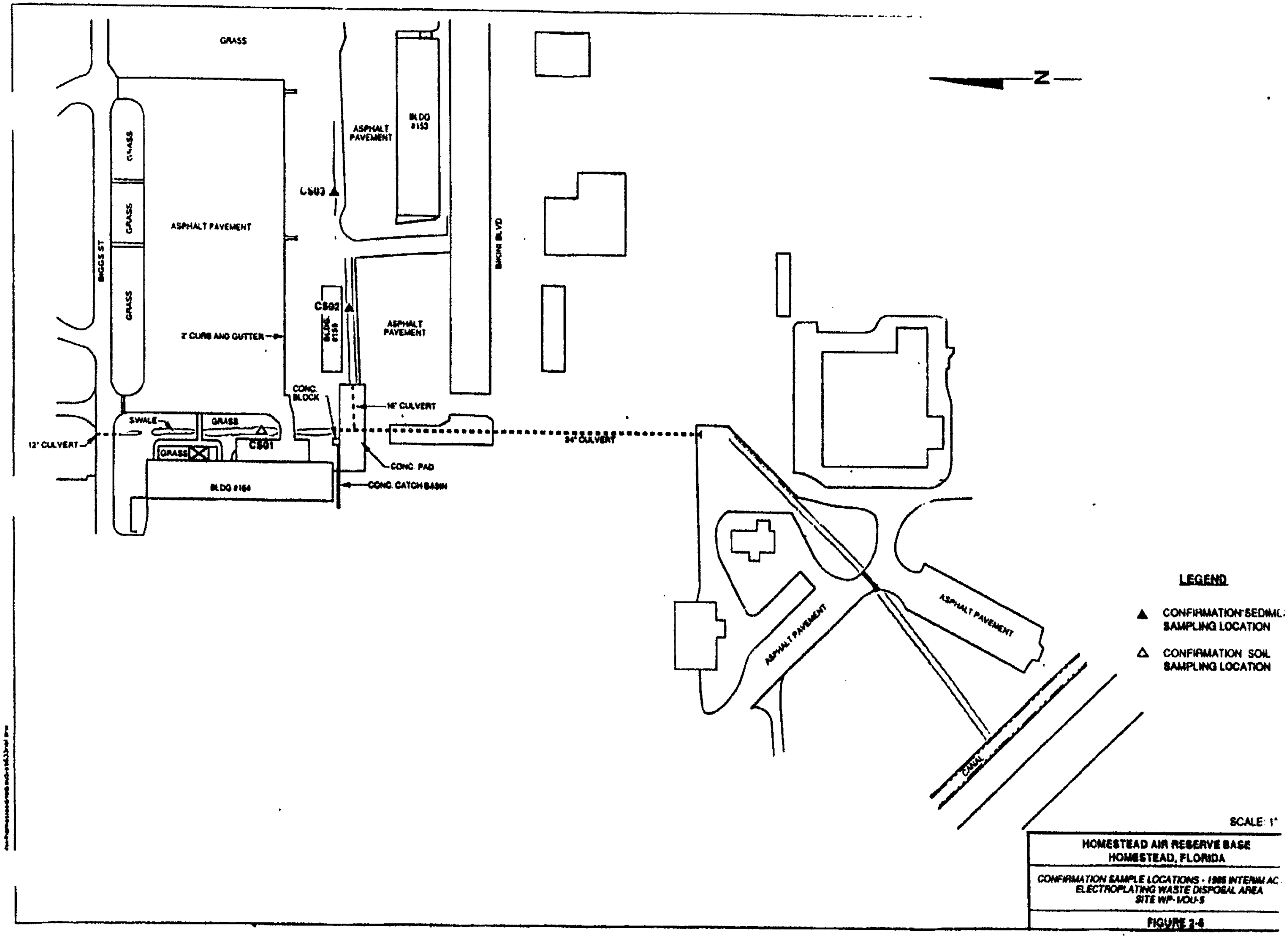


SCALE: 1"=100'

HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

1994 CONFIRMATION SAMPLE LOCATIONS
ELECTROPLATING WASTE DISPOSAL AREA
SITE WP-1/OU-5

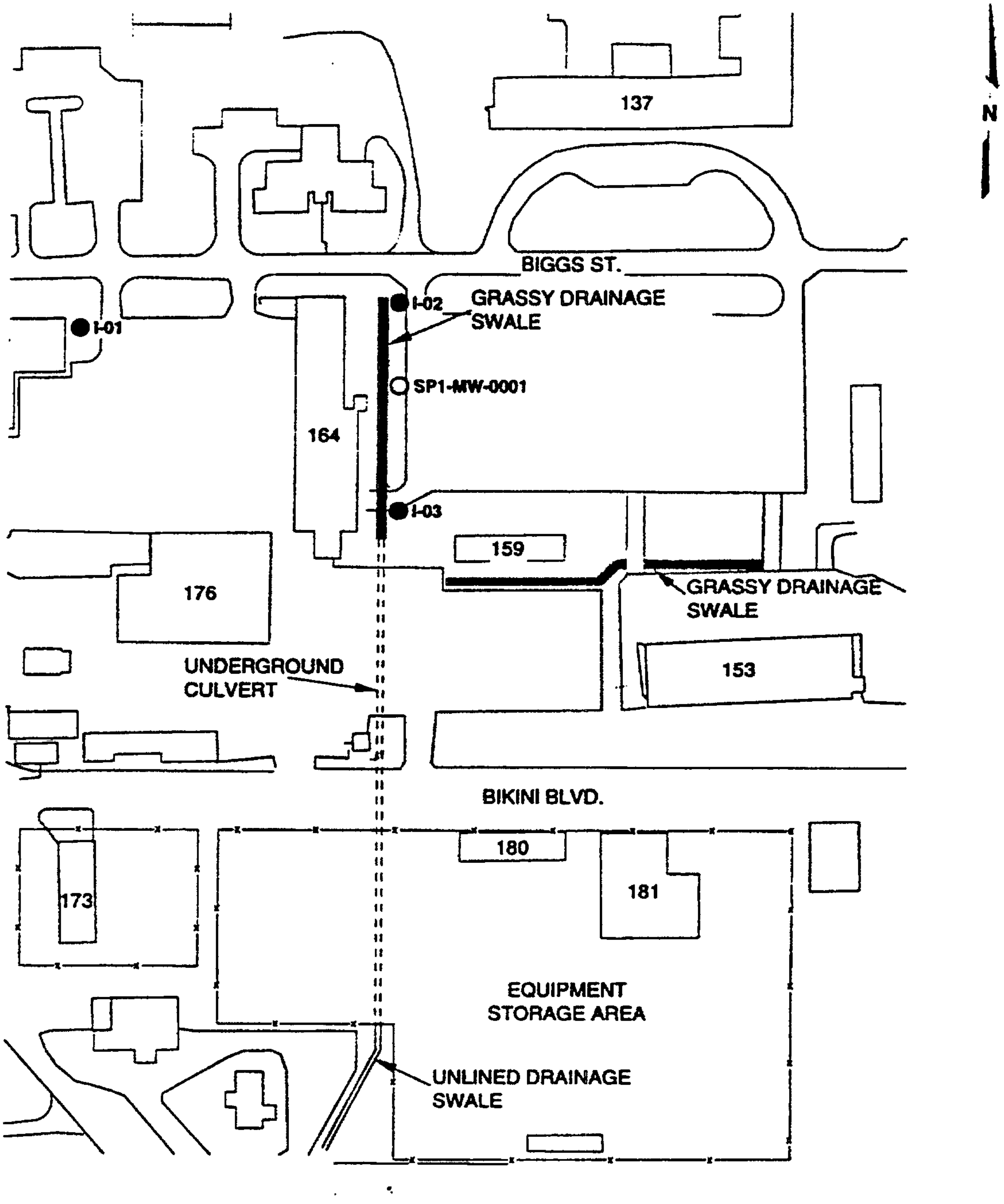
FIGURE 2-6



HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

CONFIRMATION SAMPLE LOCATIONS - 1995 INTERIM AC
ELECTROPLATING WASTE DISPOSAL AREA
SITE WP-VOU-5

FIGURE 2-6



LEGEND

● MONITORING WELL INSTALLED BY SAIC, 1984

▬ DRAINAGE SWALE

═ UNLINED DRAINAGE SWALE

○ MONITORING WELL
INSTALLED BY GERAGHTY & MILLER, 1991

150 0 150

APPROXIMATE SCALE

HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

1996 GROUNDWATER SAMPLING LOCATIONS
ELECTROPLATING WASTE DISPOSAL AREA
SITE WP-1/OU-5

FIGURE 2-7

Baseline Risk Assessment, and the Preferred Alternative as described in the Proposed Plan. A court reporter will prepare a transcript of the meeting. A copy of the transcript and all written comments received during the comment period will be placed in the Administrative Record. A response to the comments received during this period will be included in the Responsiveness Summary section of a later draft of this ROD. This decision document presents the selected remedial action for OU-5/Site WP-1 at Homestead ARB, chosen in accordance with CERCLA, as amended by SARA and, to the extent practicable, the National Contingency Plan. The decision for this site is based on the administrative record.

2.5 SCOPE AND ROLE OF RESPONSE ACTION

Homestead ARB, Florida with concurrence from the FDEP and USEPA, has elected to define Operable Unit 5 as the former Electroplating Waste Disposal Area and associated potential soil and groundwater contamination only. The remedial actions planned at each of the Operable Units at Homestead ARB are, to the extent practicable, independent of one another. However, with respect to OU-5 and OU-9 (Boundary Canal), the definition of these two operable units has resulted in the necesity to assign different physical media to each operable unit. Consequently, all sediment and surface water samples collected in association with investigations conducted at OU-5 have been evaluated in the OU-9, Boundary Canal RI through ROD.

2.6 SUMMARY OF SITE CHARACTERISTICS

OU-5/Site WP-1 was formerly used as a disposal area for spent plating baths and rinses from a plating shop located in Building 164. During the period between 1946 and 1953, when Homestead ARB was inactive and ownership of the property was transferred to Dade County, a small electroplating operation was located in Building 164. Spent plating solutions containing chromium, nickel, copper, and sulfuric and hydrochloric acid were routinely disposed of by discarding them on the ground in an area just east of Building 164 (Engineering-Science, 1983). Wastes were generated at a rate of approximately 250 gallons per month, and the electroplating operation continued for about two years (Engineering-Science, 1983). According to 1958, 1962, and 1973 aerial photographs, the asphalt parking lot located east of Building 164 did not exist when the electroplating company was operating and the area was covered with trees and grass. The parking lot was constructed between 1962 and 1973. No visible evidence of waste residue is observed on the ground surfaces that are presently exposed (not covered by parking lot). The high amount of rainfall typical of the area is suspected to have dissipated the waste residues.

2.6.1 Nature and Extent of Contamination

This section describes the nature and extent of contamination defined to-date at the Electroplating Waste Disposal Area, OU-5/Site WP-1. Subsurface investigations at the site were initiated by SAIC in 1984 (SAIC, 1986). Further field investigations were conducted by G&M in 1988 and 1991 following IRP and CERCLA directives. The results of the 1984 activities are reported in *"Installation Restoration Program Phase II - Confirmation/Quantification, Stage I, Homestead AFB, Florida"* prepared by SAIC. The 1991 investigative results are reported in *"Remedial Investigation Report for Site WP-1, Electroplating Waste Disposal Area, July 1992"* (G&M, 1992). Based on recommendations following the 1992 RI report by G&M, Montgomery Watson performed an additional field and sampling investigations in 1993. The Montgomery Watson investigation was conducted in accordance with the approved *Facility Work Plan and Work Plan Addenda* (G&M, 1991a,b,c).

In 1994, IT Corporation completed a soil and sediment confirmation sampling program at the Electroplating Waste Disposal Area, OU-5/Site WP-1. This confirmation sampling program was developed to further define the nature and extent of contamination at the OU-5/Site WP1 area. Based on the findings of this investigation, excavation of sediments from the northern swale was performed (Figure 2-6). Upon completion of the excavation, three confirmation soil/sediment samples were collected from the base of each of the three excavations in the North Area. Additionally, groundwater samples were collected from each of the 4 site monitoring wells in 1996 by OHM Corporation. This action was completed based on USEPA recommendations to confirm the groundwater quality of the site given there has been a three year delay between sampling and reporting.

A summary of the scope of previous investigations, including those associated with the 1994 and 1995 Interim Action, the 1996 Groundwater Sampling event, and a discussion of data collected to-date at OU-5/Site WP-1 are presented below.

An IRP Phase II investigation was completed by SAIC in 1984. The Phase II Confirmation Quantification investigation included installation of three monitoring wells (I-01 through I-03) and four soil borings (SL-1 through SL-4), collection of two sediment samples (SD-1 and SD-2), and sampling of groundwater. All of the samples were analyzed for total metals (cadmium, chromium, copper, lead, nickel, and zinc) and cyanide. The groundwater was also analyzed for hexavalent chromium. Locations of the wells and soil borings are shown in Figure 2-2. Analytical results for this sampling are discussed in Section 2.3.2.

Based on the presence of contamination at the site, a Phase IV-A investigation was performed in 1988 by G&M to further define the extent and degree of contamination. The 1988 work included groundwater analysis, water-level measurements, and a topographic survey. The three existing wells were sampled and analyzed for total metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, sodium) and cyanide. Results of the 1988 groundwater sampling are discussed in Section 2.3.4. Well locations are shown on Figure 2-2.

2.6.1.1 1991 Investigation. In 1991 additional CERCLA field investigations were performed by G&M to evaluate groundwater and soil quality with respect to the U.S. Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) analyte list for organics (TCL) and inorganics (TAL). This field effort included the installation of one shallow monitoring well (SP1 -MW-0001) and the collection of groundwater samples from this new well and from the three existing wells (I-01, I-02, and I-03) at OU-5/Site WP-1. Monitoring Well SP1-MW-0001 was completed to 13 ft bls at a location east of Building 164 approximately midway between existing monitoring wells I-02 and I-03. The well is located near the SL-3 sampling location of the 1984 Phase II investigation; this location is the suspected center of the waste disposal area. Three shallow soil/weathered rock samples (SP1-SL-0001, SP1-SL-0002, SP1-SL-0003; plus SP1-SL-9002, the duplicate of SP1-SL-0002) were collected. In addition, one soil sample (SP1-MW-0001-S) from the monitoring well boring was collected. All soil samples were collected from the 2-4 ft bls interval. Two sediment and two surface water samples were collected from the unlined drainage swale south of the equipment storage area. The sediment/surface water pairs were identified as SP1-SW/SD-0005 and SP1-SW/SD-0006. Locations of the water and soil/sediment sampling points are illustrated on Figure 2-3. All samples were analyzed for the Target Analyte List (TAL) and the Target Compound List (TCL) elements or compounds excluding pesticides/PCBs. USEPA SW846 methodologies were employed for all analyses performed in 1991. Analytical results for soil, groundwater, sediment, and surface water samples are discussed in Sections 2.6.2, 2.6.3, 2.6.4 and 2.6.5, respectively. Tables 2-5, 2-6, 2-7, and 2-8 provide a summary of analytical results for the 1991 investigation.

2.6.1.2 1993 Investigation. In 1993, Montgomery Watson performed additional investigations of soil, sediment, and groundwater at OU-5/Site WP-1. Surface water was not present in any of the drainage swales during the 1993 sampling activities; therefore, it could not be collected. The Montgomery Watson field effort included drilling four soil borings (SP1-SL-0004 through SP1-SL-0007). These borings were in the same relative locations as SP1-SL-0001 through SP1-SL-0003 and SP1-MW-0001-S, drilled during the 1991

TABLE 2-6

SUMMARY OF ANALYTICAL CONSTITUENTS DETECTED IN SOILS
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
GERAGHTY & MILLER, 1991 INVESTIGATION
Homestead Air Reserve Base, Florida

Analyte	G&M Sample I.D. Laboratory I.D. Sampling Date	Average Carbonate Composition(b)	Average Homestead AFB Background 2-4 ft bls	SP1-SL-0002 13950-009 10/22/91	SP1-SL-0002-split 36713-1 10/22/91	Composite Background Sample(a)	SP1-SL-0001 13950-001 10/22/91	SP1-SL-0003 13950-005 10/22/91	SP1-MW-0001-B 13950-007A 10/22/91
VOLATILE ORGANIC COMPOUNDS (ug/Kg dw):									
Acetone		–	1028.97	1287.94	960 J	1,288	<6	<5.95	7301.33
BASE/NEUTRAL and ACID EXTRACTABLE COMPOUNDS (ug/Kg dw):									
Benzo(a)anthracene		–	21.5	<625	[25]	[25]	<581	<595	<602
Benzo(a)pyrene		–	22	<1250	[30]	[30]	<1163	<1190	<1205
Benzo(b)fluoranthene		–	37	<2500	[37]	[37]	<2326	<2381	<2410
Benzo(g,h,i)perylene		–	8.1	<2500	[8.1]	[8.1]	<2326	<2381	<2410
Benzo(k)fluoranthene		–	44	<2500	[44]	[44]	<2326	<2381	<2410
bis(2-Ethylhexyl) phthalate		–	94	<375	[110]	[110]	<349	<357	<361
Chrysene		–	46	<625	[46]	[46]	<581	<595	<602
2-Chlorophenol		–	14	<625	[10]	[10]	<581	<595	<602
Fluoranthene		–	41	<625	[55]	[55]	<581	<595	<602
Phenanthrene		–	10	<625	[10]	[10]	<581	<595	<602
Pyrene		–	42	<375	[58]	[58]	<349	<357	<361
METALS (mg/Kg dw):									
Aluminum		8,970	1,187	1050	685	1,050	728	9270	1710
Arsenic		1.8	0.61	0.61	<1.1	0.61	0.26	1.5	0.83
Barium		30	6.6	9.3	8.0 J	9.3	5.3	14.1	6.6
Beryllium		0.18	ND	<0.12	<2.9	<0.12	<0.11	0.31	<0.12
Calcium		272,000	381,443	464239	420000	464,239	537638	490772	646718
Chromium		7.1	7.6	9.5	6.8	9.5	7.2	23.4	9.2
Cobalt		0.12	ND	<0.38	<1.2	<0.38	<0.34	1	<0.35
Copper		4.4	1.8	1.8	<2.9	1.8	1.7	2.2	2.6
Iron		8,190	621	584	320	584	302	5090	946
Lead		16	3.3	4.3	4.7 J	4.75	0.64	5.5	2.4
Magnesium		45,300	1,140	1220	1200 J	1,220	1450	1500	1350
Manganese		842	17	14.2	12 J	14.2	5.1	139	14.8
Mercury		0.046	0.011	<0.05	0.011 J	0.011 J	<0.06	<0.06	<0.05
METALS (mg/Kg dw) cont'd:									
Nickel		13	1	1.1	<4.6	1.1	0.87	5.2	2.8
Potassium		2,390	33	33.4	<120	33.4	28	123	36.3
Sodium		393	657	741	620	741	689	605	652
Vanadium		13	6	8.2	<5.8	8.2	8.3	14.7	9.1
Zinc		16	3	3.3	<12	3.3	2.2	2.9	2.9
CYANIDE (mg/Kg dw)		–	0.5	<0.5	<1.2	<0.5	<0.5	<0.5	<0.5

Source: Geraghty & Miller, Inc., 1992

ug/kg dw	micrograms per kilogram dry weight
mg/kg dw	milligrams per kilogram dry weight
[ ]	Value is greater than instrument detection limit but less than practical quantitation limit.
<	Analyte was not detected at or above the indicated concentration.
J	Positive result has been classified as qualitative.
a/	Background Samples are SP1-SL-0002 values and SP1-SL-0002-Split. These values are a combination of both samples. If both were detects, the lower measured analytical concentration was used. If only one result was positive that concentration was used.
b/	Hem, 1989
c/	Could not be determined.

TABLE 2-6

SUMMARY OF CONSTITUENTS DETECTED IN GROUNDWATER
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
GERAGHTY & MILLER, 1991 INVESTIGATION
Homestead Air Reserve Base, Florida

Analyte	Florida Drinking Water Standards	EPA Maxium Contaminant Level	EPA Maximum Contaminant Level Goal	Range of CONSTITUENTS Detected Min.	Max.	SP1-MW-0001 37428-18 11/13/91	SP[1]-I-01 37460-4 11/14/91	SP1-I-01 37508-14 11/18/91	SP1-I-02 37460-1 11/14/91	SP1-I-03 37428-17 11/13/91	SP1-I-9002 37460-2 11/14/91	SP1-EB-0023 37460-3 11/14/91
VOLATILE ORGANIC COMPOUNDS (ug/L):												
Methylene chloride	5	NS	NS	BDL	[3.1]	< 5.0	[1.4]	NA	[3.1]	< 5.0	< 5.0	< 5.0
BASE/NEUTRAL and ACID EXTRACTABLE COMPOUNDS (ug/L):												
bis(2-Ethylhexyl) phthalate	6	6	0	BDL	320 J	[0.7]	< 10	NA	[0.9] J	320 J	< 10	< 10
METALS (ug/L):												
Aluminum	200 i	50-200 l,h	NS	5700 J	24000	3000	5700 J	NA	24000	3000	6400	< 200
Arsenic	50 k	50 g	NS	11 J	92 J	11 J	92 J	NA	60 J	19 J	42 J	< 10
Barium	2,000 k	2,000 l,g	2,000 i	25	150	33	63 J	NA	150	25	89	< 10
Cadmium	5 k	5 l	5 i	BDL	BDL	< 5.0	< 25 UJ	NA	< 25	< 5.0	< 25	< 5.0
Calcium	NS	NS	NS	130000	5400000	130000	3100000 J	NA	5400000	130000	2600000	370
Chromium	100 k	100 i,g	100 i	22	130	22	59 J	NA	130	34	62	< 10
Iron	300 l	300 h	NS	1700 J	18000 J	1700 J	3600 J	NA	18000 J	1800 J	4900 J	< 50
Lead	15 k	15 d	0	8.6 J	30 J	8.6 J	11 J	NA	30 J	5.4 J	30 J	< 5.0
Magnesium	NS	NS	NS	3900	14000	3900	7300 J	NA	14000	3800	6600	< 50
Manganese	50 l	50 h	NS	33 J	200 J	53 J	75 J	NA	200 J	33 J	110 J	< 10
Potassium	NS	NS	NS	1600 J	3900	3900	1600 J	NA	2600	2100	2000	< 1000
Selenium	50 k	50 i,g	50 i	BDL	BDL	< 50 UJ	< 50 UJ	NA	< 50 UJ	< 50 UJ	< 50 UJ	< 10
Sodium	160,000 k	NS	NS			18000	23000	NA	26000	20000	20000	< 500
Vanadium	NS	NS	NS			12	< 50 UJ	NA	82	12	< 50 UJ	< 10
Zinc	5,000 l	5,000 h	NS			25	< 100 UJ	NA	< 100	26	< 100	< 20
CYANIDE	200 k	200 n	200 n			< 10	NA	10	< 10	< 10	< 10	< 10
TOTAL DISSOLVED SOLIDS (mg/L)	500 l	500 h	NS			NA	NA	NA	300	NA	290	< 5.0

TABLE 2-6

SUMMARY OF CONSTITUENTS DETECTED IN GROUNDWATER
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
GERAGHTY & MILLER, 1991 INVESTIGATION
Homestead Air Reserve Base, Florida

Analyte	Florida Drinking Water Standards		EPA Maxium Contaminant Level		EPA Maximum Contaminant Level Goal		Range of CONSTITUENTS Detected Min.	Max.	TB-1114-SP1 37460-5 11/14/91	TB-1113-SP4 37428-6 11/14/91
VOLATILE ORGANIC COMPOUNDS (ug/L):										
Methylene chloride	5		NS		NS				< 5.0	NA
BASE/NEUTRAL and ACID EXTRACTABLE COMPOUNDS (ug/L):										
bis(2-Ethylhexyl) phthalate	6		6		0				NA	NA
METALS (ug/L):										
Aluminum	200	l	50-200	i,h	NS				NA	NA
Arsenic	50	k	50	g	NS				NA	NA
Barium	2,000	k	2,000	i,g	2,000	i			NA	NA
Cadmium	5	k	5	i	5	i			NA	NA
Calcium	NS		NS		NS				NA	NA
Chromium	100	k	100	i,g	100	i			NA	NA
Iron	300	l	300	h	NS				NA	NA
Lead	15	k	15	d	0				NA	NA
Magnesium	NS		NS		NS				NA	NA
Manganese	50	l	50	h	NS				NA	NA
Potassium	NS		NS		NS				NA	NA
Selenium	50	k	50	i,g	50	i			NA	NA
Sodium	160,000	k	NS		NS				NA	NA
Vanadium	NS		NS		NS				NA	NA
Zinc	5,000	l	5,000	h	NS				NA	NA
CYANIDE	200	k	200	n	200	n			NA	NA
TOTAL DISSOLVED SOLIDS (mg/L)									NA	NA

Source: Geraghty & Miller, Inc.,1992

NOTES:

d	Federal Action Level - the action level is exceeded if the level of copper/lead in more than 10% of targeted tap samples is greater than the action level.
f	Numbers represent EPA's Proposed Primary MCL, Federal Register, Vol. 55, No. 143, July 1990.
g	Numbers represent EPA's Primary MCL for Inorganics.
h	Numbers represent EPA's Secondary MCL for Inorganics which are non-enforceable taste, odor or appearance guidelines.
i	Numbers represent EPA's Final MCL effective July 1992, Federal Register, January 30, 1991.
J	Positive result has been classified as qualitative.
k	Florida Primary Drinking Water Standard.
l	Florida Secondary Drinking Water Standard.
m	Florida Ground-Water Guidance CONSTITUENTS for Minimum Criteria Requirements (Rule 62-3.402,FAC), Florida Department of Environmental Regulation, February 1989.
n	Proposed Primary MCL or MCLG
NS	No Standard Available
NA	Not analyzed.
U	Classified as undetected.
UJ	Analyte was not detected at or above the indicated concentration and has not been classified as qualitative.
[ ]	Value is greater than instrument detection limit but less than practical quantitation limit.

TABLE 2-7

SUMMARY OF CONSTITUENTS DETECTED IN SEDIMENT SAMPLES COLLECTED IN 1991
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
GERAGHTY & MILLER, 1991 INVESTIGATION
Homestead Air Reserve Base, Florida

Analyte G&M Sample I.D. Sampling Date	SQC (ug/Kg OC) 1/	SQC at 1% OC (ug/Kg)	NOAA ER-L 3/ ug/Kg	NOAA ER-M 4/ ug/Kg	[redacted] [redacted]	[redacted] [redacted]	[redacted] [redacted]	Trip Blank #2 08/26/91	BC-SD-0100 Background Sample
VOLATILE ORGANIC COMPOUNDS (ug/kg dw):									
Acetone	NS	NS	N	N	[redacted] U	[redacted] U	< [redacted]	[4.7]	NA
Methylene chloride	NS	NS	N	N	< [redacted]	< [redacted]	< [redacted]	[1.5]	NA
Tetrachloroethene	NS	NS	N	N	< [redacted]	< [redacted]	[redacted]	< 5.0	NA
Trichloroethene	NS	NS	N	N	< [redacted]	< [redacted]	[redacted]	< 5.0	NA
BASE/NEUTRAL and ACID EXTRACTABLE COMPOUNDS (ug/kg dw):									
Acenaphthene	732,000	7,320	150	650	[redacted]	< [redacted]	[redacted]	NA	< 1400
Anthracene	NS	NS	85	960	[redacted]	< [redacted]	[redacted]	NA	< 1400
Benzo(a)anthracene	1,317,000	13,170	230	1600	[redacted]	[redacted]	[redacted]	NA	< 1400
Benzo(a)pyrene	1,063,000	10,630	400	2500	[redacted]	[redacted]	[redacted]	NA	< 1400
Benzo(b)fluoranthene	NS	NS	N	N	[redacted]	[redacted]	[redacted]	NA	< 1400
Benzo(g,h,i)perylene	NS	NS	N	N	[redacted]	[redacted]	[redacted]	NA	< 1400
Benzo(k)fluoranthene	NS	NS	N	N	[redacted]	[redacted]	[redacted]	NA	< 1400
bis(2-Ethylhexyl) phthalate	NS	NS	N	N	[redacted]	< [redacted]	[redacted]	NA	< 1400
Butylbenzylphthalate	NS	NS	N	N	< [redacted]	< [redacted]	[redacted]	NA	< 1400
Chrysene	NS	NS	400	2800	[redacted]	[redacted]	[redacted]	NA	< 1400
Dibenzo(a,h)anthracene	NS	NS	60	260	[redacted]	< [redacted]	[redacted]	NA	< 1400
Dibenzofuran	NS	NS	N	N	[redacted]	< [redacted]	< [redacted]	NA	< 1400
Fluoranthene	1,883,000	18,830	600	3600	[redacted]	[redacted]	[redacted]	NA	< 1400
Fluorene	NS	NS	35	640	[redacted]	< [redacted]	[redacted]	NA	< 1400
Indeno (1,2,3-cd)pyrene	NS	NS	N	N	[redacted]	[redacted]	[redacted]	NA	< 1400
Phenanthrene	139,000	1,390	225	1380	[redacted]	[redacted]	[redacted]	NA	< 1400
Pyrene	1,311,000	13,110	350	2200	[redacted]	[redacted]	[redacted]	NA	< 1400

TABLE 2-7

SUMMARY OF CONSTITUENTS DETECTED IN SEDIMENT SAMPLES COLLECTED IN 1991
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
GERAGHTY & MILLER, 1991 INVESTIGATION
Homestead Air Reserve Base, Florida

Analyte	G&M Sample I.D. Sampling Date	SQC (ug/Kg OC) 1/	SQC at 1% OC (ug/Kg)	NOAA ER-L 3/ ug/Kg	NOAA ER-M 4/ ug/Kg	[illegible] [illegible]	[illegible] [illegible]	[illegible] [illegible]	Trip Blank #2 08/28/91	BC-SD-0100 Background Sample
METALS (mg/kg dw):										
Aluminum		NS	NS	N	N	[illegible]	1400	1400	NA	2700
Arsenic		NS	NS	33	85	[illegible] J	[illegible]	[illegible]	NA	2
Barium		NS	NS	N	N	[illegible]	[illegible]	[illegible]	NA	14
Cadmium		NS	NS	5	9	[illegible]	[illegible]	[illegible]	NA	< 2.1
Calcium		NS	NS	N	N	[illegible]	180000	70000	NA	310000
Chromium		NS	NS	80	145	[illegible] J	[illegible] J	[illegible] J	NA	11 J
Cobalt		NS	NS	N	N	< [illegible]	[illegible]	< [illegible]	NA	< 4.2
Copper		NS	NS	70	390	[illegible] J	[illegible] J	[illegible] J	NA	16 J
Iron		NS	NS	N	N	[illegible]	2700	2200	NA	1700
Lead		NS	NS	35	110	[illegible]	[illegible]	[illegible]	NA	11
Magnesium		NS	NS	N	N	[illegible]	[illegible]	[illegible]	NA	1000
Manganese		NS	NS	N	N	[illegible] J	[illegible] J	[illegible] J	NA	< 29
Mercury		NS	NS	0.15	1.3	[illegible]	[illegible]	[illegible]	NA	0.043
Sodium		NS	NS	N	N	[illegible] J	[illegible] J	[illegible] J	NA	290 J
Vanadium		NS	NS	N	N	[illegible] J	[illegible] J	[illegible] J	NA	5.7 J
Zinc		NS	NS	120	270	[illegible] J	[illegible] J	[illegible] J	NA	27 J
CYANIDE		NS	NS	N	N	< [illegible]	[illegible]	< [illegible]	NA	NA

ug/kg dw micrograms per kilogram dry weight
mg/kg dw milligrams per kilogram dry weight
NA Not Analyzed
< Analyte was not detected at or above the indicated concentration.
[ ] Value is greater than instrument detection limit but less than pactical quantitation limit.
J Positive result has been classified as qualitative.
UJ Analyte was undetected. Classified as qualitative.
U Classified as undetected.
N Not Available
NS No Standard
1/ Organic Carbon
2/ The sediment quality criteria (SQC) cannot be directly compared with the drainage swale data because the SQC are presented as normalized to organic carbon (i.e. presented on a per organic carbon weight basis). To allow a direct comparison between the sediment data and SQC, the SQC for an organic carbon content of 1.0% OC were calculated. The SQC (ug/Kg) at 1% OC were derived by multiplying the SQC (ug/Kg OC) by an OC content of 1% (.01 Kg of OC/Kg of sediment).
3/ National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NOS OMA 52; ER-L is effects Range - Low (10th percnetile).
4/ Effects Range - Median (50th percentile).
▨ Source sediments may have been removed during the 1995 Interim Removal Action. However, DATA MAY STILL REPRESENT SITE CONDITIONS.

TABLE 2-8

SUMMARY OF CONSTITUENTS DETECTED IN SURFACE-WATER SAMPLES COLLECTED IN 1991
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
GERAGHTY & MILLER, 1991 INVESTIGATION
Homestead Air Reserve Base, Florida

Analyte	G&M Sample I.D. Savannah I.D. Sampling Date	Florida Surface-Water Quality Standard d/	Federal Water Quality Criterion	Trip Blank 35504-6 08/28/91	SP1-EB-0002 35504-2 08/28/91	SP1-SW-0005 35504-3 08/28/91	SP1-SW-0006 35504-1 08/28/91	SP1-SW-9005 35504-4 08/28/91
VOLATILE ORGANIC COMPOUNDS (ug/L):								
Acetone		NS	NS	[4.7]	[3.7]	[7.8] U	[5.5] U	[9.2] U
1,1-Dichloroethene		NS	NS	[1.5]	< 5.0	< 5.0	< 5.0	< 5.0
Methylene chloride		NS	NS	< 5.0	[2.0]	[1.7] U	[1.1] U	[0.86] U
BASE/NEUTRAL and ACID EXTRACTABLE COMPOUNDS (ug/L):								
Anthracene		NS	NS	NA	< 5.0	< 5.0	[0.96]	< 5.0
Benzo(a)anthracene		NS	NS	NA	< 5.0	< 5.0	15	< 5.0
Benzo(a)pyrene		NS	NS	NA	< 5.0	< 5.0	14	< 5.0
Benzo(b)fluoranthene		NS	NS	NA	< 5.0	< 5.0	22	[2.0]
Benzo(k)fluoranthene		NS	NS	NA	< 5.0	< 5.0	17	< 5.0
bis(2-Ethylhexyl) phthalate		NS	NS	NA	< 5.0	< 5.0	< 5.0	[3.0]
Chrysene		NS	NS	NA	< 5.0	< 5.0	26	< 5.0
Fluoranthene		NS	NS	NA	10	[3.6] U	41 U	[3.6] U
Phenanthrene		NS	6.3 a	NA	< 5.0	< 5.0	[6.8]	< 5.0
Pyrene		NS	NS	NA	< 5.0	[1.8] J	27 J	[2.4] J
METALS (ug/L):								
Aluminum		NS	NS	NA	< 200	< 200	3000	< 200
Barium		NS	NS	NA	< 10	< 10	170	< 10
Cadmium		1.2 b	2	NA	< 0.80	< 0.80 UJ	9.7 J	< 0.80 UJ
Calcium		NS	NS	NA	< 50	14000	250000	13000
Chromium		50	11(IV), 424 (III) c	NA	< 10	< 10	42	< 10
Copper		30	25	NA	< 2.0	8.6 J	92 J	8.1 J
Iron		1000	1000	NA	< 50	170	4100	190
Lead		30	9.7 c	NA	< 5.0	12 J	230 J	15 J
Magnesium		NS	NS	NA	< 50	270	2900	300
Manganese		NS	NS	NA	< 10	< 10	83 J	< 10
Mercury		0.2	0.012	NA	< 0.10	< 0.10 UJ	0.54 J	< 0.10 UJ
Potassium		NS	NS	NA	< 1000	< 1000	2900	< 1000
Silver		0.07	18	NA	< 0.070	< 0.070 UJ	0.47	< 0.070
Sodium		NS	NS	NA	< 500	1300	21000	1100
Vanadium		NS	NS	NA	< 10	< 10	17	< 10
Zinc		30	223 c	NA	26	64 U	820	63 U
CYANIDE (mg/L)		5	5.2	NA	< 10	< 10	< 10	< 10

Notes:
Source: Geraghty & Miller 1991

ug/L	micrograms per liter
mg/L	milligrams per liter
NA	Not Analyzed
[ ]	Value is greater than instrument detection limit but less than pactical quantitation limit.
<	Analyte was not detected at or above the indicated concentration
J	Positive result has been classified as qualitative.
UJ	Analyte was not detected. Classified as qualitative.
U	Classified as undetected.
NS	No Standard
a/	Proposed Chronic Federal Water Quality Criterion; USEPA, 1988
b/	For hardness greater than 150 mg/L.
c/	Federal Water Quality Criterion Calculated using a hardness value of 240 mg/L.
d/	Florida Surface-water Quality Standards for Class III Surface Waters (Rule 17-302.560 & 17-302.510 FAC).

investigations by G&M. Soil/weathered rock samples were collected from each of the 1993 borings at the 0-1 or 0-2 ft bls intervals. Groundwater samples were collected from the four shallow monitoring wells at OU-5/Site WP-1. A total of six sediment samples were collected from the three drainage swales. Sediment thickness varied with sampling location and were encountered underlying several inches of benthic organic material such as algae in the drainage swales. Figure 2-4 illustrates the locations of all samples collected during this current investigation. Each matrix was analyzed using USEPA CLP protocols for TCL organics and TAL inorganics. All samples were analyzed for TCL organochlorine pesticides/PCBs and cyanide. All sediments, one soil and one groundwater sample were also analyzed for the presence of TCL VOCs, BNAs and TAL metals. Dissolved (filtered) TAL metals were also analyzed for in groundwater samples. All samples were analyzed by Savannah Laboratories, Tallahassee, Florida. Analytical results of the montgomery Watson sampling are discussed in Section 2.6.2 and 2.6.3, and 2.6.4. Tables 2-9, 2-10, and 2-11 provide a summary of analytical results for the 1993 investigation.

2.6.1.3 1994 And 1995 Investigation. The 1994 Interim Action was performed in accordance with Section 300.415 (b) of the National Contingency Plan (NCP) and CERCLA. The purpose of this non-time critical removal action was to clean-up and remove contaminated media in order to prevent damage to the public health or welfare of the environment. Prior to the removal action, an engineering evaluation/cost analysis (EE/CA) was completed which identified the objectives of the removal action and ananlyzed the various alternatives that were available to satisfy the objectives for cost, effectiveness, and implemtability. From this evaluation, the recommended alternative is implemented.

In 1994, IT Corporation conducted an investigation of affected soils/sediment at OU-5/Site WP-1. This work was performed under contract to USACE - Mobile District. The investigation consisted of completing 28 soil borings at the locations identified on Figure 2-5. Two borings, EWA-1 and EWA-2, were completed in the paved parking area west of Building 164. These borings were extended to a depth of 2 ft below the asphalt. The remaining 26 borings were located at points within the drainage swales and advanced to a depth of six inches. The draining swales have been divided in to a North and a South Area. The North Area is located between Building 164 and 153. The South Area is located between Building 179 and 185. Soil/sediment samples were collected from each boring to obtain a sample for laboratory analysis. The samples collected from the two borings drilled west of Building 164 and the five northern most borings (EWA-3 through EWA-7) are considered soil/ weathered rock samples. These five northern most points were considered to be representative of soil/weathered rock due to the absence of a well defined drainage system

TABLE 2-9

SUMMARY OF CONSTITUENTS DETECTED IN SOILS
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
1993, 1994, AND 1995 INVESTIGATIONS
Homestead Air Reserve Base, Florida

Analyte	1995 FDEP Health Based Soil Target Levels	Removal Action Level	Sample ID. Sample Interval (ft) Date Collected	MW 1993 SPI-SL-0005 (0-2) 3/11/93	MW 1993 SPI-SL-0006 (0-2) 3/11/93	MW 1993 SPI-SL-0007 (0-1) 3/11/93	MW 1993 SPI-SL-9007 (0-1) DUPLICATE
VOA TCL Compounds (ug/kg)							
Acetone	1,800,000	ND (1)		NA	NA	21000	27000
Pesticides/PCB TCL Compounds (ug/kg)							
Alpha-Chlordane	3,000	3,210		<2.0	1.9 J	<1.9	<1.9
Beta-Chlordane	3,000	3,210		<2.0	2.3 P	<1.9	<1.9
Chlordane (technical)	3,000	3,210		NA	NA	NA	NA
Endosulfan Sulfate	5,900,000	ND (1)		<3.8	0.77 J	6.4	8.8 P
p,p'DDD	17,000	17,500		<3.8	28	0.75 J	1.4 J
p,p'DDE	11,000	12,400		3.9	130	3.8	6.2
p,p'DDT	12,000	11,300		0.83 J	34	6.3	20
BNA TCL Compounds (ug/kg)							
Acenaphthene	30,000,000	1,000 (2)		NA	NA	5 J	17 J
Anthracene	300,000,000	1,000 (2)		NA	NA	25 J	39 J
Benzo(a)Anthracene	4,900	5,040		NA	NA	260 J	320 J
Benzo(a)Pyrene	500	540		NA	NA	300 J	360 J
Benzo(b)Fluoranthene	5,000	5,010		NA	NA	380	540
Benzo(g,h,i)Perylene	50,000	ND (1)		NA	NA	190 J	230 J
Benzo(k)Fluoranthene	48,000	4,970		NA	NA	390	420
Benzylbutyl Phthalate	310,000,000	ND (1)		NA	NA	24 J	14 J
Bis(2-Ethylexyl) Phthalate	110,000	ND (1)		NA	NA	93 BJ	79 BJ
Carbazole	120,000	224,000		NA	NA	35 J	62 J
Chrysene	500,000	50,300		NA	NA	410	54(
Di-n-Butyl Phthalate	140,000,000	ND (1)		NA	NA	17 BJ	14 B
Di-n-Octyl Phthalate	32,000.00	ND (1)		NA	NA	7 J	<360
Dibenz(a,h)Anthracene	500	505		NA	NA	87 J	68 J
Dibenzofuran	3,500,000	1,000 (2)		NA	NA	4 J	11 J
Fluoranthene	48,000,000	1,000 (2)		NA	NA	650	880
iorene	30,000,000	1,000 (2)		NA	NA	8 J	20 J
eno(1,2,3-C,D)Pyrene	5,000	5,040		NA	NA	200 J	230 J
ienanthrene	21,000,000	1,000 (2)		NA	NA	190 J	340 J
Pyrene	41,000,000	1,000 (2)		NA	NA	510	810
Metals (mg/kg)							
Aluminum	>1,000,000,000	ND (1)		NA	NA	5,460	6,430
Arsenic	3	10 (3)		NA	NA	9.1 N	9.7 N
Barium	4,000	4,940		NA	NA	17.7 B*	21.2 B*
Cadmium	600	1,070		NA	NA	<0.40	0.42 B
Calcium	ND (1)	ND (1)		NA	NA	285,000	296,000
Chromium, Total	430	160		NA	NA	18.6*	18.9*
Cobalt	110,000	ND (1)		NA	NA	0.62 B	0.66 B
Copper	ND (1)	ND (1)		NA	NA	13.8	15.5
Iron	ND (1)	ND (1)		NA	NA	3070 E	3210 E
Lead	1,000	108		NA	NA	38.3*	44.5*
Magnesium	ND (1)	ND (1)		NA	NA	1,160	1,230
Manganese	5,500	ND (1)		NA	NA	72.4	65.1
Mercury	480	17		NA	NA	<0.11	<0.14
Nickel	2,600	3.24		NA	NA	7.2 B	6.1 B
Potassium	ND (1)	ND (1)		NA	NA	680 B	680 B
Sodium	ND (1)	ND (1)		NA	NA	513 B	468 B
Vanadium	4,800	ND (1)		NA	NA	8.4 B	9.4 B
Zinc	560,000	ND (1)		NA	NA	20.1 E	23.3 E

< not detected at specified detection limit
NE - not established
NA - not analyzed
ND (1) - no data
(2) - not listed on the Soil Target Level Table but was listed in 62-775 of the FAC. Total VOC listed in 62-775 as having a max conc. of
ug/kg and 1 mg/kg for Total PAHs.
Removal Action Level as determined by BC T
old - exceeds Action Level
Bold & Shaded - exceeds Action Level and FDEP Soil Target Level
** - 2 samples used to calculate mean

Data Qualifiers for Organic Compounds
J - Estimated value, <CRQL
P - >25 % difference in detected value between two columns
B - Compound detected in an associated blank
C - Confirmed on second column

Data Qualifiers for Inorganic Compounds
B - Reading is less than CRQL but greater than IDL
E - reported value is estimated due to interference
N - spiked sample recovery not within control limits
* - duplicate analysis not within control limits

TABLE 2-9

SUMMARY OF CONSTITUENTS DETECTED IN SOILS
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
1993, 1994, AND 1995 INVESTIGATIONS
Homestead Air Reserve Base, Florida

Analyte	1995 FDEP Health Based Soil Target Levels	Removal Action Level	Sample ID. Sample Interval (ft) Date Collected	IT 1994 EWA1 (0-2)	IT 1994 EWA2 (0-2)	IT 1994 EWA3 (0-0.5)	IT 1994 EWA4 (0-0.5)	IT 1994 EWA5 (0-0.5)	IT 1995 CS-01 (0-1)
VOA TCL Compounds (ug/kg)									
Acetone	1,800,000	ND (1)		NA	NA	NA	NA	NA	NA
Pesticides/PCB TCL Compounds (ug/kg)									
Alpha-Chlordane	3,000	3,210		NA	NA	NA	NA	NA	NA
Beta-Chlordane	3,000	3,210		NA	NA	NA	NA	NA	NA
Chlordane (technical)	3,000	3,210		NA	NA	<50	42	200	1400
Endosulfan Sulfate	5,900,000	ND (1)		NA	NA	<200	<20	<40	<3.3
p,p'DDD	17,000	17,500		NA	NA	9.1 J,C	<4	5.5 C	1400
p,p'DDE	11,000	12,400		NA	NA	240 C	7.8 C	25 C	89
p,p'DDT	12,000	11,300		NA	NA	22 J,C	<4	13 C	<3.3
BNA TCL Compounds (ug/kg)									
Acenaphthene	30,000,000	1,000 (2)		<7500	<3700	<110000	<7200	<3700	<452
Anthracene	300,000,000	1,000 (2)		<7500	<3700	<110000	<7200	<3700	<452
Benzo(a)Anthracene	4,900	5,040		<7500	<3700	<110000	<7200	<3700	691
Benzo(a)Pyrene	500	540		<7500	<3700	<110000	<7200	<3700	460
Benzo(b)Fluoranthene	5,000	5,010		<7500	<3700	<110000	<7200	<3700	530
Benzo(g,h,i)Perylene	50,000	ND (1)		<7500	<3700	<110000	<7200	<3700	420
Benzo(k)Fluoranthene	48,000	4,970		<7500	<3700	<110000	<7200	<3700	460
Benzylbutyl Phthalate	310,000,000	ND (1)		<7500	<3700	<110000	<7200	<3700	<452
Bis(2-Ethylexyl) Phthalate	110,000	ND (1)		<7500	<3700	<110000	<7200	<3700	<452
Carbazole	120,000	224,000		NA	NA	NA	NA	NA	NA
Chrysene	500,000	50,300		<7500	<3700	<110000	<7200	<3700	370
Di-n-Butyl Phthalate	140,000,000	ND (1)		<7500	<3700	<110000	<7200	<3700	460
Di-n-Octyl Phthalate	32,000.00	ND (1)		<7500	<3700	<110000	<7200	<3700	<452
Dibenz(a,h)Anthracene	500	505		<7500	<3700	<110000	<7200	<3700	<452
Dibenzofuran	3,500,000	1,000 (2)		<7500	<3700	<110000	<7200	<3700	<452
Fluoranthene	48,000,000	1,000 (2)		<7500	<3700	<110000	<7200	<3700	1200
	30,000,000	1,000 (2)		<7500	<3700	<110000	<7200	<3700	<452
,2,3-C,D)Pyrene	5,000	5,040		<7500	<3700	<110000	<7200	<3700	<452
hrene	21,000,000	1,000 (2)		<7500	<3700	<110000	<7200	<3700	490
Pyrene	41,000,000	1,000 (2)		<7500	<3700	<110000	<7200	<3700	710
Metals (mg/kg)									
Aluminum	>1,000,000,000	ND (1)		1,670	3010	6640	1250	1710	1600
Arsenic	3	10 (3)		0.43 B	<0.45	<1.5	0.56 B	<0.41	6.9
Barium	4,000	4,940		8.0 B	9.0 B	20.4 B	4.6 B	10.6 B	17
Cadmium	600	1,070		<11	<10.8	<16.5	<10.6	<11.1	1.4
Calcium	ND (1)	ND (1)		341,000	372000	30600	288000	190000	290000
Chromium, Total	430	160		<22.0	<21.6	<43.0	<21.2	<22.1	19
Cobalt	110,000	ND (1)		<22.0	<21.6	<33.0	<21.2	<22.1	1.4
Copper	ND (1)	ND (1)		<22.0	<21.6	109	<21.2	<22.1	160
Iron	ND (1)	ND (1)		1,050	1670	3980	1400	1220	5800
Lead	1,000	108		4.4	4.5	83.2	18.9	22.7	120
Magnesium	ND (1)	ND (1)		1,010 B	1080 B	1240	1110 B	970 B	1100
Manganese	5,500	ND (1)		45.6	24.1 B	63.1	21.7 B	31.9 B	230
Mercury	480	17		<0.11	<0.11	<0.15	<0.09	<0.10	0.4
Nickel	2,600	3.24		<44.0	<43.1	<66.0	<42.4	<44.2	300
Potassium	ND (1)	ND (1)		<2200	2160	<3300	<2120	<2220	110
Sodium	ND (1)	ND (1)		746 B	711 B	688 B	<212	<221	230
Vanadium	4,800	ND (1)		<22.0	<21.6	<33	<21.2	<22.1	9.9
Zinc	560,000	ND (1) *		<11.0	<10.8	154	26.0 B	42.7 B	300

< not detected at specified detection limit
NE - not established
NA - not analyzed
ND (1) - no data
(2) - not listed on the Soil Target Level Table but was listed in 62-775 of the FAC. Total VOC listed in 62-775 as having a max conc. of
• and 1 mg/kg for Total PAHs.
val Action Level as determined by BC T
xceeds Action Level
Bold & Shaded - exceeds Action Level and FDEP Soil Target Level
** - 2 samples used to calculate mean.

Data Qualifiers for Organic Compounds
J - Estimated value, <CRQL
P - >25 % difference in detected value between two columns
B - Compound detected in an associated blank
C - Confirmed on second column

Data Qualifiers for Inorganic Compounds
B - Reading is less than CRQL but greater than IDL
E - reported value is estimated due to interference
N - spiked sample recovery not within control limits
* - duplicate analysis not within control limits

TABLE 2-10

SUMMARY OF CONSTITUENTS DETECTED IN GROUNDWATER
SITE WP 1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
1993 AND 1996 INVESTIGATIONS
Homestead Air Reserve Base, Florida

Analyte	Florida Drinking Water Standard	EPA Drinking Water Standard	EPA Maximum Contaminant Level Goal	Sample ID Data Collected	MW 1993 SP1-I-902 3/1/93	MW 1993 SP1-I-902 3/1/93 DUPLICATE	MW 1993 SP1-EB-0001 3/1/93	OHM 1996 SP1-MW-001 1/25/96
VOA TCL Compounds (ug/l)								
Chloroform	100 (a) (i)	100(a)	0		2J	2J	<10	<10
Bromodichloromethane	100 (a) (i)	100(a)	0		1J	2J	<10	<10
1,2-Dichloropropane	5 (i)	5	0		<10	<10	2J	<10
Methyl Chloride	5	NS	NS		<10	<10	<10	2J
Methyl Ethyl Ketone (2-Butanone	NS	NS	NS		<10	<10	6J	<10
BNA TCL Compounds (ug/l)								
Bis(2-Ethylhexyl)Phthalate	6	6	0		0.3 J	<11	<11	<10
Di-n-Butyl Phthalate	NS	NS	NS		0.5 J	0.5 J	<11	<10
2-Methylnaphthalene	100(b)	NS	NS		<11	2 J	<11	<10
Naphthalene	100(b)	NS	NS		<11	1 J	<11	<10
Metals (ug/l) (c)								
Aluminum	200 (j)	50-200 (h)	NS		**1850**	**2610**	41.8 B	<43.4
Arsenic	50 (i)	50 (g)	NS		18.4	18.1	<5.0	7.8 B
Barium	2000 (i)	2000 (g)	2000		36.9 B	37.5 B	<1.0	4.5 B
Calcium	NS	NS	NS		209000	220000	95.3 B	83900
Chromium	1000(j)	1000 (h)/1300 (d)	1000		3.1 B	3.7 B	<2.0	<3.0
Cobalt	100 (i)	100 (g)	100		<3.0	<3.0	<3.0	4.1 B
Copper	NS	NS	NS		<2	<2	<2	<2.4
Iron	300 (j)	300 (h)	NS		**1560**	**1950**	<7.0	<3.8
Lead	15 (i)	15 (d)	0		9.3	9.1	<3.0	<0.90
Magnesium	NS	NS	NS		2780 B	2980 B	<30.0	1490B
Manganese	50 (j)	50 (h)	NS		26.7	28.5	<1.0	<0.40
Nickel	100 (i)	100	100		<6	<6	<6	<4.4
Potassium	NS	NS	NS		4410 B	4950 B	<325	642B
Sodium	160000 (i)	NS	NS		14300	14500	<30.0	3870B
Vanadium	NS	NS	NS		5.5 B	6.5 B	<3.0	<2.6
Zinc	5000 (j)	5000 (h)	NS		33.5	18.2 B	27.1	<3.9

Data Qualifiers for Organic Compounds	Data Qualifiers for Inorganic Compounds
J - estimated quantity, quality control criteria were not met	B - Reading is less than CRQL but greater than IDL

< not detected at specified detection limit
Bold - equal to or greater than BG
NS - No Standard

Notes;

(a) MCL of 100 ug/L is for total THM’s
(b) total napthalenes must be <100 to meet FAC 62-770 guidlines
(c) Metals listed are total metals
(d) Federal Action Level- the action level is exceeded if the copper/lead in more than 10% or targeted tap samples is greater than the action level.
(f) Numbers represent EPA’s Proposed Primary MCL, Federal Register, Vol. 55. No. 143, July 1990.
(g) Numbers represent EPA’s Primary MCL for Inorganics.
(h) Numbers represent EPA’s Secondary MCL for Inrganics which are non-efforocable, taste, odor or appearance guidlines
(i) Florida Primary Drinking Water Standard.
(ii) Florida Secondary Drinking Water Standard.

TABLE 2-10

SUMMARY OF CONSTITUENTS DETECTED IN GROUNDWATER
SITE WP 1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
1993 AND 1996 INVESTIGATIONS
Homestead Air Reserve Base, Florida

Analyte	**Florida Drinking Water Standard**	**EPA Drinking Water Standard**	**EPA Maximum Contaminant Level Goal**	**Sample ID Data Collected**	**OHM 1996 SP1-I-01 1/25/96**	**OHM 1996 SP1-I-02 1/25/96**	**OHM 1996 SP1-I-02 1/25/96 DUPLICATE**	**OHM 1996 SP1-I-03 1/24/96**
VOA TCL Compounds (ug/l)								
Chloroform	100 (a) (i)	100 (a)	0		<10	<10	<10	<10
Bromodichloromethane	100 (a) (i)	100 (a)	0		<10	<10	<10	<10
1,2-Dichloropropane	5 (i)	5	0		<10	<10	<10	<10
Methyl Chloride	5	NS	NS		7BJ	<10	1J	<10
Methyl Ethyl Ketone (2-Butanone	NS	NS	NS		<10	<10	<10	<10
BNA TCL Compounds (ug/l)								
Bis(2-Ethylhexyl)Phthalate	6	6	0		<10	<10	<10	<10
Di-n-Butyl Phthalate	NS	NS	NS		<10	<10	<10	<10
2-Methylnaphthalene	100(b)	NS	NS		<10	<10	<10	<10
Naphthalene	100(b)	NS	NS		<10	<10	<10	<10
Metals (ug/l) (c)								
Aluminum	200 (j)	50-200 (h)	NS		**<43.4**	**<43.4**	<43.4	<43.4
Arsenic	50 (i)	50 (g)	NS		9.6B	14.8	15.3	3.9B
Barium	2000 (i)	2000 (g)	2000		7.6B	6.3B	6.2	8.2B
Calcium	NS	NS	NS		1140000	99700	98900	10100
Chromium	1000 (j)	1000 (h)/1300 (d)	1000		11.9 B	<3.0	<3.0	3.8B
Cobalt	100 (i)	100 (g)	100		<2.8	4.4B	<2.8	6.2B
Copper	NS	NS	NS		<2.4	<2.4	<2.4	3.5B
Iron	300 (j)	300 (h)	NS		11.4B	<3.8	<3.8	4.9B
Lead	15 (i)	15 (d)	0		<0.90	<0.90	<0.90	<0.90
Magnesium	NS	NS	NS		2740B	1970B	1950B	2210B
Manganese	50 (j)	50 (h)	NS		5.1B	<0.40	<0.40	0.81B
Nickel	100 (i)	100	100		<4.4	<4.4	<4.4	8.0B
Potassium	NS	NS	NS		3130B	<401	838	4030B
Sodium	160000 (i)	NS	NS		10600	4880B	4860	9310
Vanadium	NS	NS	NS		<2.6	2.9B	<2.6	4.5B
Zinc	5000 (j)	5000 (h)	NS		6.7B	<3.9	<3.9	15.2

Data Qualifiers for Organic Compounds	Data Qualifiers for Inorganic Compounds
J - estimated quantity, quality control criteria were not met	B - Reading is less than CRQL but greater than IDL

< not detected at specified detection limit
Bold - equal to or greater than BG
NS - No Standard

Notes;

(a) MCL of 100 ug/L is for total THM's
(b) total napthalenes must be <100 to meet FAC 62-770 guidlines
(c) Metals listed are total metals
(c) Federal Action Level- the action level is exceeded if the copper/lead in more than 10% or targeted tap samples is greater than the action level.
(f) Numbers represent EPA's Proposed Primary MCL, Federal Register, Vol. 55. No. 143, July 1990.
(g) Numbers represent EPA's Primary MCL for Inorganics.
(h) Numbers represent EPA's Secondary MCL for Inrganics which are non-efforocable, taste, odor or appearance guidelines.
(i) Florida Primary Drinking Water Standard.
(j) Florida Secondary Drinking Water Standard.

TABLE 2-11

SUMMARY OF CONSTITUENTS DETECTED IN SEDIMENTS
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
1993, 1994, AND 1995 INVESTIGATIONS
Homestead Air Reserve Base, Florida

Analyte	Background	Sample ID. Sample Interval Date Collected	MW 1993 SPI-SD-0007 3/12/93	MW 1993 SPI-SD-0108 3/12/93	IT 1994 EWA9 0-6"	IT 1994 EWA14 0-6"	IT 1994 EWA16 0-6"	IT 1994 EWA17 0-6"	IT 1994 EWA18 0-6"	IT 1994 EWA19 0-6"
VOA TCL Compounds (ug/kg)										
Acetone	NA	▨	<16000 D	<12	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA	▨	<65	<12	NA	NA	NA	NA	NA	NA
Pesticides/PCB TCL Compounds (ug/kg)										
Alpha-Chlordane	NE	▨	**86 P**	120	NA	NA	NA	NA	NA	NA
Beta-Chlordane	NE	▨	**92**	120	NA	NA	NA	NA	NA	NA
Chlordane (technical)	NE	▨	NA	NA	**680 ****	**82 ****	210 **	**180 ****	330 **	370 **
Endosulfan Sulfate	NE	▨	<85	<20	<1100	<100	<100	<100	<200	<400
p,p'DDD	NE	▨	**38 JP**	<20	130 J	6.6 J	4.4 J	4.2 J	210 C	19 J
p,p'DDE	NE	▨	31 JP	<20	25 J	48 C	8.7 C	8.9 C	59 C	17 J
p,p'DDT	NE	▨	59 JP	<20	12 J	46 C	11 J	12 J	490 C	9.5 J
PCB-1260 (Aroclor 1260)	NE	▨	<850	870	NA	NA	NA	NA	NA	NA
BNA TCL Compounds (ug/kg)										
Acenaphthene	<1400	▨	7 J	93 J	<11000	<11000	1200 J	<11000	<11000	<9800
Acenaphthylene	NE	▨	11 J	<3900	<11000	<11000	<11000	<11000	<11000	<9800
Anthracene	<1400	▨	18 J	220 J	**2100 J**	<11000	**4000 J**	**1900 J**	1200 J	**1500 J**
Benz(a)Anthracene	<1400	▨	140 J	1300 J	**12000**	2000 J	**8500 J**	**5600 J**	**9700 J**	**12000 J**
Benzo(a)Pyrene	<1400	▨	200 J	1300 J	**12000**	2400 J	**6800 J**	**4700 J**	**12000**	**12000**
Benzo(b)Fluoranthene	<1400	▨	380 J	2300 J	**13000**	**3000 J**	**6600 J**	**5000 J**	**14000**	**13000**
Benzo(g,h,i)Perylene	<1400	▨	310 J	**1400 J**	**13000**	<11000	<11000	<11000	**12000**	**9300 J**
Benzo(k)Fluoranthene	<1400	▨	290 J	1300 J	**17000**	**3000 J**	**8100 J**	**6000 J**	**17000**	**16000**
Benzyl Butyl Phthalate	<1400	▨	170 J	71 J	<11000	<11000	<11000	<11000	<11000	<9800
Bis(2-Ethylhexyl) Phthalate	<1400	▨	120 J	230 J	1100 J	<11000	<11000	<11000	<11000	<9800
Carbazole	NE	▨	<450	330 J	NA	NA	NA	NA	NA	NA
4-Chloroaniline	NE	▨	<450	<3900	<11000	<11000	<11000	<11000	<11000	<9800
Chrysene	<1400	▨	330 J	2200 J	**18000**	**2900 J**	**8900 J**	**6000 J**	**15000**	**17000**
Di-n-Butyl Phthalate	NE	▨	**22 BJ**	<3900	<11000	<11000	<11000	<11000	<11000	<9800
Di-n-Octyl Phthalate	NE	▨	<450	<3900	<11000	<11000	<11000	<11000	<11000	<9800
Dibenz(a,h)Anthracene	<1400	▨	<450	<3900	<11000	<11000	<11000	<11000	<11000	<9800
Dibenzofuran	<1400	▨	4 J	54 J	<11000	<11000	<11000	<11000	<11000	<9800
Diethylphthalate	NE	▨	<450	<3900	<11000	<11000	<11000	<11000	<11000	<9800
Dimethyl Phthalate	NE	▨	<450	<3900	<11000	<11000	<11000	<11000	<11000	<9800
2,6-Dinitrotoluene	NE	▨	<450	<3900	<11000	<11000	<11000	<11000	<11000	<9800
Fluoranthene	<1400	▨	430 J	**3600 J**	**35000**	**5100 J**	**19000**	**12000**	**22000**	**29000**
Fluorene	<1400	▨	8 J	110 J	<11000	<11000	**1600 J**	<11000	<11000	<9800
Indeno(1,2,3-cd)Pyrene	<1400	▨	230 J	1100 J	**13000**	<11000	<11000	<11000	**12000**	**9900**
2-Methylnaphthalene	NE	▨	5 J	<3900	<11000	<11000	<11000	<11000	<11000	<9800
N-Nitrosodiphenylamine	NE	▨	<450	<3900	<11000	<11000	<11000	<11000	<11000	<9800
Naphthalene	NE	▨	<450	<3900	<11000	<11000	<11000	<11000	<11000	<9800
Phenanthrene	<1400	▨	120 J	1500 J	**20000**	2400 J	**17000**	**8500 J**	**6800 J**	**18000**
Phenol	NE	▨	<450	<3900	<11000	<11000	<11000	<11000	<11000	<9800
Pyrene	<1400	▨	550	**3300 J**	**35000**	**4600 J**	**17000**	**9900 J**	**22000**	**28000**
Metals (mg/kg)										
Aluminum	2700	▨	**2770**	350	2140	**2800**	2070	**4060**	2380	2100
Antimony	NE	▨	<3.0 N	3.0 BN	<129	<116	<120	<116	<133	<116
Arsenic	2	▨	**7.1 N**	**4.4 N**	**2.6**	**3.9**	**8.1**	**13.8**	**2.6**	**2.8**
Barium	14	▨	**636 ***	**52.9 ***	**2450**	**26.5**	**38.4**	**29.8**	**5390**	**3970**
Beryllium	NE	▨	NA	NA	<2.6	<2.3	<2.4	<2.3	<2.7	<2.3
Cadmium	<2.1	▨	**4.2**	1.7	<12.9	<11.6	<12.0	<11.6	<13.3	<11.6
Calcium	310000	▨	212000	**337000**	281000	**336000**	**333000**	**329000**	285000	225000
Chromium, Total	11 J	▨	**85.6 ***	**15.8 ***	**47.8**	**40.7**	**99.3**	**44.7**	**90.5**	**78.1**
Cobalt	<4.2	▨	3.3 B	<0.40	<25.8	<23.2	<24.0	<23.1	<26.6	<23.1
Copper	16 J	▨	**58**	14.6	**141**	<23.2	<24.0	**23.5**	**60.3**	**39.6**
Iron	1700	▨	**4310 E**	352 E	**9650**	**2500**	**1830**	**2710**	**4400**	**6210**
Lead	11	▨	**216 ***	**189 ***	**408**	**195**	**370**	**397**	**853**	**829**
Magnesium	1000	▨	**1470**	510 B	**2540**	**1960**	**1290**	**1340**	**1690**	**1550**
Manganese	<29	▨	**52.8**	6.6	**49.9**	**60.1**	**46.6**	**61.8**	**31.8**	**55.2**
Mercury	0.043	▨	**0.58**	<0.10	**0.2**	<0.11	**0.4**	**0.30**	**1.1**	**0.24**
Nickel	NE	▨	10.3	<1.2	<51.5	<46.4	<48.0	<46.3	<53.3	<46.2
Potassium	NE	▨	560 B	757 B	<2580	<2320	<2400	<2310	<2660	<2310
Silver	NE	▨	NA	NA	<12.9	13.8	<12.0	<11.6	<13.3	<11.6
Sodium	290 J	▨	269 B	**841 B**	346	**639**	**407**	**507**	361	348
Vanadium	5.7 J	▨	**19.8**	2.4 B	<25.8	<23.2	<24.0	<23.1	<26.6	<23.1
Zinc	27 J	▨	**612 E**	**58.9 E**	**408**	**162**	**152**	**195**	**787**	**722**

Data Qualifiers for Organic Compounds
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- B - compound detected in an associated blank
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- E - Exceeded calibration range of instrument
- C - Confirmed on second column
- * - Elevated detection limit due to either pesticides present or matrix interferences
- ** - Altered pattern

Data Qualifiers for Inorganic Compounds
- B - Reading is less than CRQL but greater than IDL
- E - reported value is estimated due to interference
- N - spiked sample recovery not within control limits
- W - post digestion spike for furnace AA out of control limits
- * - duplicate analysis not within control limits

< not detected at specified detection limit
NE - not established
NA - not analyzed
Bold > equal or greater than *BG
Bold & Shaded > equal or greater than 2*BG

TABLE 2-11

SUMMARY OF CONSTITUENTS DETECTED IN SEDIMENTS
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
1993, 1994, AND 1995 INVESTIGATIONS
Homestead Air Reserve Base, Florida

Analyte	Background	Sample ID, Sample Interval Date Collected	IT 1994 EWA20 0-6"	IT 1994 EWA21 0-6"	IT 1994 EWA22 0-6"	IT 1994 EWA23 0-6"	IT 1994 EWA24 0-6"	IT 1994 EWA25 0-6"	IT 1994 EWA26 0-6"	IT 1994 EWA27 0-6"
VOA TCL Compounds (ug/kg)										
Acetone	NA		NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA		NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCB TCL Compounds (ug/kg)										
Alpha-Chlordane	NE		NA	NA	NA	NA	NA	NA	NA	NA
Beta-Chlordane	NE		NA	NA	NA	NA	NA	NA	NA	NA
Chlordane (technical)	NE		1500 **	270 **	270 **	1400 **	340 **	620 **	360 **	1400 **
Endosulfan Sulfate	NE		<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
p,p'DDD	NE		<200	<200	8.3 J	25 J	22 J	32 J	18 J	21 J
p,p'DDE	NE		100 C	<50	8.2 J	31 J	8.9 J	16 J	9.4 J	15 J
p,p'DDT	NE		<200	14 J	16 J	60 J	110 J	79 J	41 J	29 J
PCB-1260 (Aroclor 1260)	NE		NA	NA	NA	NA	NA	NA	NA	NA
BNA TCL Compounds (ug/kg)										
Acenaphthene	<1400		<9700	440 J	630 J	<4600	<4300	<2700	<5800	<5400
Acenaphthylene	NE		<9700	660 J	1500 J	650J	820 J	790J	1100J	920J
Anthracene	<1400		<9700	1900 J	3400 J	1200 J	1700 J	1400 J	1600 J	1100 J
Benzo(a)Anthracene	<1400		19000	7200	12000	3700 J	5700	6900	6900	3800 J
Benzo(a)Pyrene	<1400		18000	9100	16000	4300 J	8300	9400	11000	6000
Benzo(b)Fluoranthene	<1400		23000	13000	21000	5400	12000	22000 E	18000	8600
Benzo(g,h,i)Perylene	<1400		12000	9100	17000	3700 J	8300	9200	18000	6000
Benzo(k)Fluoranthene	<1400		23000	9800	19000	7000	9100	<2700	11000	7700
Benzyl Butyl Phthalate	<1400		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
Bis(2-Ethylhexyl) Phthalate	<1400		3500 J	1100 J	2000 J	14000	<4300	1700 J	1700 J	<5400
Carbazole	NE		NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	NE		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
Chrysene	<1400		29000	12000	21000	7000	9600	14000	14000	8400
Di-n-Butyl Phthalate	NE		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
Di-n-Octyl Phthalate	NE		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
Dibenz(a,h)Anthracene	<1400		<9700	3300 J	6500	1500 J	<4300	<2700	<5800	<5400
Dibenzofuran	<1400		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
Diethylphthalate	NE		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
Dimethyl Phthalate	NE		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
2,6-Dinitrotoluene	NE		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
Fluoranthene	<1400		55000	20000	33000	13000	15000	19000	20000	12000
Fluorene	<1400		<9700	590 J	1000 J	<4600	490 J	370J	<5800	<5400
Indeno(1,2,3-cd)Pyrene	<1400		14000	<4200	<4900	<4600	<4300	8300	9100	5300 J
2-Methylnaphthalene	NE		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
N-Nitrosodiphenylamine	NE		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
Naphthalene	NE		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
Phenanthrene	<1400		25000	7500	13000	4400 J	4900	5700	5800 J	3200 J
Phenol	NE		<9700	<4200	<4900	<4600	<4300	<2700	<5800	<5400
Pyrene	<1400		52000	15000	26000	10000	12000	17000	17000	11000
Metals (mg/kg)										
Aluminum	2700		1670	2050	2330	3480	2340	3540	3560	3130
Antimony	NE		<109	<128	<135	<137	<129	<149	<167	<157
Arsenic	2		2.8	5.1	4.1	6.5	9.3	9.7	12.8	9.8
Barium	14		3000	202	79.8	62.8	55.6	183	113	77.9
Beryllium	NE		<2.2	6.0	7.0	<2.7	<2.6	<3.0	<3.3	<3.1
Cadmium	<2.1		<10.9	<12.8	<13.5	<13.7	<12.9	<14.9	<16.7	<15.7
Calcium	310,000		242000	343000	303000	286000	344000	278000	290000	323000
Chromium, Total	11 J		83.4	54.8	78.8	160	32.0	116	116	96.9
Cobalt	<4.2		<21.9	<25.6	<27.1	<27.4	<25.8	<29.5	<33.3	<31.3
Copper	16 J		27.8	27.6	43.7	43.4	31.2	51.1	68.4	41.2
Iron	1700		3150	2680	3070	3050	2240	4310	4460	3430
Lead	11		378	341	296	427	354	862	638	683
Magnesium	1100		1330	1500	1340	1470	1350	1620	1630	1520
Manganese	<29		37.8	38.8	45.6	33.9	50.7	68.8	78.6	46.8
Mercury	0.043		0.21	0.16	0.34	0.32	0.34	0.41	0.48	0.27
Nickel	NE		<43.7	<51.2	<54.1	<54.9	<51.6	<59.5	<66.7	<62.7
Potassium	NE		<2190	<2560	<2710	<2740	<2580	<2980	<3330	<3130
Silver	NE		<10.9	<12.8	<13.5	<13.7	<12.9	<14.9	<16.7	<15.7
Sodium	290 J		486	841	599	614	707	605	685	570
Vanadium	5.7 J		<21.9	<25.6	<27.1	<27.4	<25.8	<29.8	<33.3	<31.3
Zinc	27 J		385	331	421	329	313	533	551	666

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- B - Reading is less than CRQL but greater than IDL
- E - reported value is estimated due to interference
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- * - duplicate analysis not within control limits

< not detected at specified detection limit
NE - not established
NA - not analyzed
Bold > equal or greater than *BG
Bold & Shaded > equal or greater than 2*BG

TABLE 2-11

SUMMARY OF CONSTITUENTS DETECTED IN SEDIMENTS
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
1993, 1994, AND 1995 INVESTIGATIONS
Homestead Air Reserve Base, Florida

Analyte	Background	Sample ID. Sample Interval Date Collected	IT 1994 EWA28 0-6"	IT 1995 CS-02 (0-1)	IT 1995 CS-03 (0-1)
VOA TCL Compounds (ug/kg)					
Acetone	NA		NA	NA	NA
Methylene Chloride	NA		NA	NA	NA
Pesticides/PCB TCL Compounds (ug/kg)					
Alpha-Chlordane	NE		NA	NA	NA
Beta-Chlordane	NE		NA	NA	NA
Chlordane (technical)	NE		400 **	1400	<17
Endosulfan Sulfate	NE		<400	<3.3	<3.3
p,p'DDD	NE		7.7 J	<3.3	<3.3
p,p'DDE	NE		6.0 J	150	16
p,p'DDT	NE		13 J	240	<3.3
PCB-1260 (Aroclor 1260)	NE		NA	<33	<33
BNA TCL Compounds (ug/kg)					
Acenaphthene	<1400		<2400	<330	<493
Acenaphthylene	NE		<2400	<330	<493
Anthracene	<1400		590 J	<330	<493
Benzo(a)Anthracene	<1400		**2200 J**	**3100**	480
Benzo(a)Pyrene	<1400		**2700**	**2400**	370
Benzo(b)Fluoranthene	<1400		**4100**	**2600**	690
Benzo(g,h,i)Perylene	<1400		**2200 J**	**1900**	<493
Benzo(k)Fluoranthene	<1400		**3000**	**2100**	<493
Benzyl Butyl Phthalate	<1400		<2400	<330	<493
Bis(2-Ethylhexyl) Phthalate	<1400		<2400	<330	<493
Carbazole	NE		NA	NA	NA
4-Chloroaniline	NE		<2400	<330	<493
Chrysene	<1400		**3600**	<330	<493
Di-n-Butyl Phthalate	NE		<2400	<330	410
Di-n-Octyl Phthalate	NE		<2400	<330	<493
Dibenz(a,h)Anthracene	<1400		<2400	<330	<493
Dibenzofuran	<1400		<2400	<330	<493
Diethylphthalate	NE		<2400	<330	<493
Dimethyl Phthalate	NE		<2400	<330	<493
2,6-Dinitrotoluene	NE		<2400	<330	<493
Fluoranthene	<1400		**3700**	**5600**	830
Fluorene	<1400		<2400	<330	<493
Indeno(1,2,3-cd)Pyrene	<1400		**2000 J**	**1700**	<493
2-Methylnaphthalene	NE		<2400	<330	<493
N-Nitrosodiphenylamine	NE		<2400	<330	<493
Naphthalene	NE		<2400	<330	<493
Phenanthrene	<1400		**2100 J**	<330	530
Phenol	NE		<2400	<330	<493
Pyrene	<1400		**5000**	**3700**	530
Metals (mg/kg)					
Aluminum	2700		**3550**	**4000**	**3900**
Antimony	NE		<131	<5	<5
Arsenic	2		**3.6**	**25**	**22**
Barium	14		**42.5**	**25**	**36**
Beryllium	NE		<2.6	<0.5	<0.5
Cadmium	<2.1		<13.1	**2.7**	**3.5**
Calcium	310,000		**318000**	290000	**310000**
Chromium, Total	11 J		**71.9**	**33**	**19**
Cobalt	<4.2		<26.1	1	<1
Copper	16 J		**43.8**	**28**	14
Iron	1700		**3830**	**3100**	**2300**
Lead	11		**157**	**230**	**180**
Magnesium	1000		**1130**	**1100**	**1100**
Manganese	<29		**32.1**	**67**	**64**
Mercury	0.043		<0.13	**1.9**	**0.14**
Nickel	NE		72.2	6.2	<1
Potassium	NE		<2610	110	160
Silver	NE		<13.1	<1	<1
Sodium	290 J		**790**	**560**	**500**
Vanadium	5.7 J		<26.1	**10**	**7.8**
Zinc	27 J		**239**	**330**	**118**

Data Qualifiers for Organic Compounds
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Data Qualifiers for Inorganic Compounds
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< not detected at specified detection limit
NE - not established
NA - not analyzed
Bold > equal or greater than *BG
Bold & Shaded > equal or greater than 2*BG

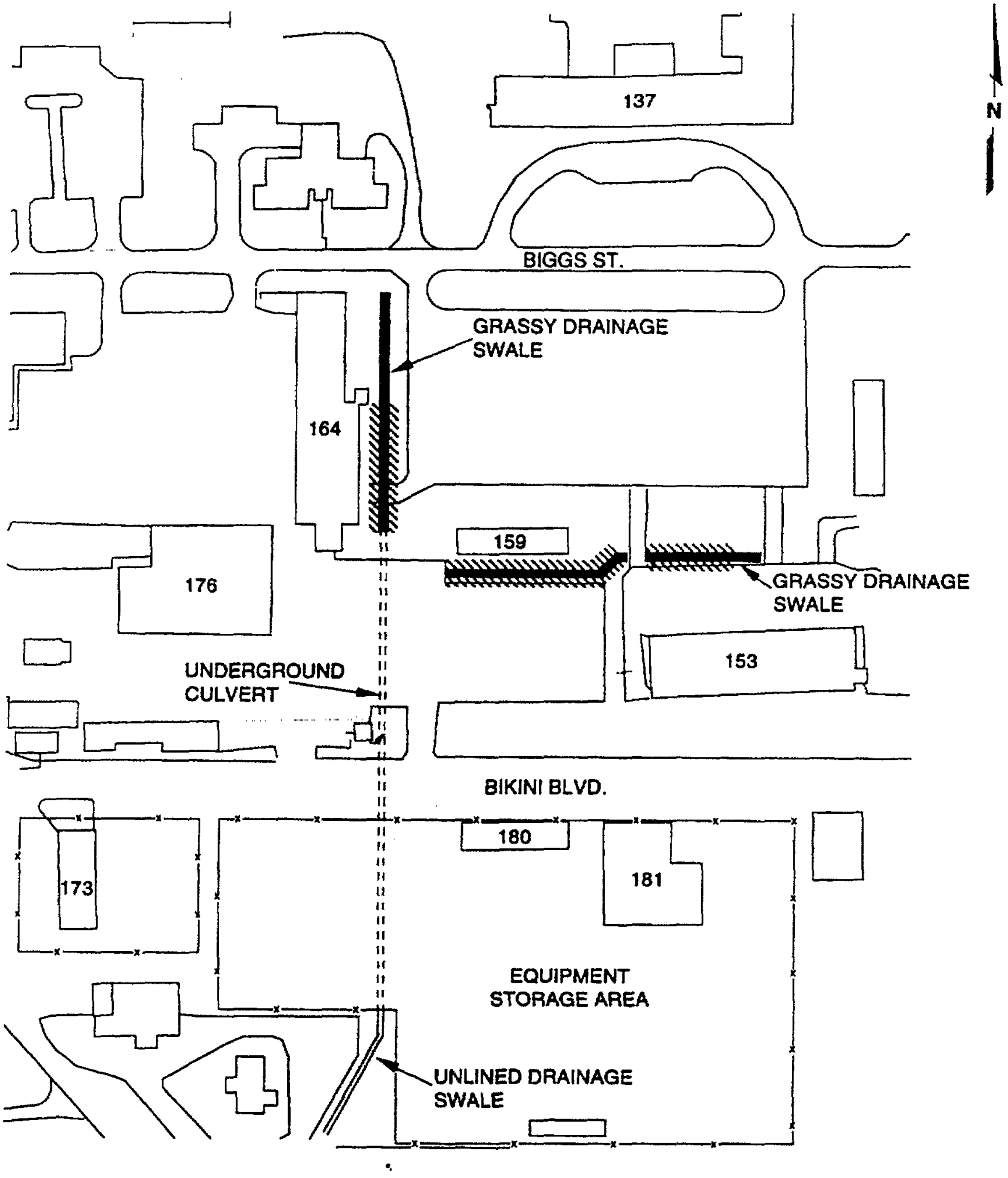
in this area and lack of sediment observed at these locations. The remaining samples were considered sediments based on their location in a well defined drainage ditch or swale and the presence of sediment. The 28 soil/sediment samples were analyzed for base neutral and acid extractable compounds (BNA's) and TAL metals. Additionally, the 21 soil/sediment samples from the drainage swales were further analyzed for pesticides. All analyses were performed in accordance with USEPA SW-846 protocols. Analytical results of the 1994 sampling are discussed in Sections 2.6.2 and 2.6.4. Tables 2-9 and 2-11 provide a summary of analytical results for the 1994 investigation.

In 1995, IT Corporation completed an Interim Action which included the excavation of soil/sediment from selected areas within the northern swale. This work was performed under contract to USACE - Mobile District. The excavations were completed to a depth of 1 ft bls and extended three ft to either side of the centerline of the swale (Figure 2-8). The excavations were completed using a front loader/backhoe combination unit. Excavated soils/sediments were stockpiled on visqueen, bermed with hay bails, and covered at the end of each day's work shift. For the purposes of evaluation, the confirmation sample CS-01 was evaluated as representative of soil/weathered rock while, CS-02 and CS-03 were evaluated as sediments.

Soil/sediment excavation activities were not completed in the south area. Upon completion of the excavation, confirmation samples were collected from each of the three north area excavations (Figure 2-6). The confirmation samples were analyzed for BNAs, TAL metals, and pesticides. Analytical results of the 1995 sampling are discussed in Sections 2.6.2 and 2.6.4. Tables 2-9 and 2-11 provide a summary of analytical results for the 1995 investigation.

2.6.1.4 1996 Confirmation Groundwater Sampling. On January 24 and 25, 1996, OHM Corporation conducted a complete round of groundwater sampling from the four groundwater wells located on OU-5/Site WP-1. This work was performed under contract to AFCEE. This groundwater sampling event was recommended by the USEPA to provide current groundwater quality information for site characterization purposes. OHM Corporation completed the groundwater sampling program in accordance with a USACE internal statement of work dated August 22, 1995.

In accordance with the scope of work, OHM Corporation collected groundwater samples from monitoring wells MW-0001, I-01, I-02, and I-03. Groundwater sampling locations are shown on Figure 2-7. Two equipment blanks, one blind duplicate, and two trip blanks were



LEGEND

▨	AREA OF EXCAVATION
▬	DRAINAGE SWALE
═	UNLINED DRAINAGE SWALE

150 0 150

APPROXIMATE SCALE

HOMESTEAD AIR RESERVE BASE
HOMESTEAD, FLORIDA

AREA OF EXCAVATION - 1995 INTERIM ACTION
ELECTROPLATING WASTE DISPOSAL AREA
SITE WP-1/OU-5

FIGURE 2-8

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mac\proy\fhw

also collected and analyzed as part of the sampling event. Groundwater samples were analyzed for TCL VOCs, TCL BNAs, TCL organcohlorine pesticides/PCBs, TAL metals, and cyanide. Laboratory analyses were performed by Analytical Technologies, Inc., located in Pensacola, Florida. Analytical results of the 1996 sampling are discussed in Section 2.6.3. Table 2-10 provides a summary of analytical results for the 1996 investigation.

A summary of the detected parameters from the 1991, 1993, 1994, 1995, and 1996 investigations are provided in Sections 2.6.2, 2.6.3, 2.6.4, and 2.6.5.

2.6.2 Soil Investigations

This section presents the results from the soil samples that were collected by G&M during the 1991 Remedial Investigation, results from the 1993 Montgomery Watson Remedial Investigation Addendum, and the 1994 and 1995 IT Corporation Interim Action Investigations. Results of soil analyses for the previous and the current investigations are presented by analytical group (i.e., VOCs, metals, etc.). Figures 2-3 and 2-4 provides an illustration of the locations of the soil sampling points for 1991 and1993, Figures 2-5 and 26 present the soil sampling points for the 1994 and 1995 investigations, respectively.

2.6.2.1 Volatile Organic Compounds. 1991 Investigation. A summary of laboratory results of constituents detected in soil during G&M's 1991 investigation are presented in Table 2-5. Acetone was the sole volatile organic compound (VOC) detected in 1991 and was seen in two of four samples, including the background sample (SP1-SL-0002). Concentrations ranged from 1,268 µg/kg to 7,301 µg/kg. G&M calculated the average background to be 1,029 µg/kg for Homestead ARB at the 2-4 ft bls level. Based on current sampling information, and the background soil data, the acetone appears to be related to the degradation of isopropanol used in the decontamination of field sampling equipment.

1993 Investigation. In 1993, only soil sample SP7-SL-0007 and its duplicate, SP7-SL-9007, were analyzed for VOCs as required by the Work Plan. Table 2-9 presents concentrations of compounds detected in soils during the, 1993 investigation. Acetone was detected at 25,000 and 27,000 µg/kg, respectively. These concentrations are well below the State of Florida Health-Based Soil Target Levels. The acetone detected in these samples is believed to be attributable to the degradation of the isopropanol utilized for field decontamination of sampling equipment. Isopropanol samples were analyzed and found to contain acetone at concentrations up to 120,000 µg/L. Acetone, therefore, is most likely a field contaminant introduced into the samples during the decontamination process. A discussion of the isopropanol analysis is included in the Quality Control Summary Report (QCSR) submitted to the USACE-Omaha District under separate cover.

1994 and 1995 Interim Action. Confirmation samples collected during the 1994 and 1995 Interim Action investigations were not analyzed for VOCs.

2.6.2.2 Base Neutral/Acid Extractable Compounds. 1991 Investigation. During the 1991 investigation, five soil samples were collected and analyzed for Base Neutral/Acid Extractable Compounds (BNAs). These samples were identified as SPl-SL-0001, SPl-SL0002-split, SP1-SL-9002 (the duplicate of SP1-SL-0002), SP1-SL-0003, and SP1-MW-0001S. Soil boring SP1-SL-0002 was identified prior to sampling as a background sampling location. All soil samples for the event were collected from the 2-4 ft bls interval. Detected BNAs from the 1991 sampling event are listed in Table 2-5.

Several BNA compounds (mainly polynuclear aromatic hydrocarbons [PAHs]) were detected in background sample SP1-SL-0002-split, although, at very low levels. Concentrations of PAHs detected in the background sample, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene, are estimated values because they are between the method detection limit and the practical quantitation limit (PQL). Additionally, two non-PAH BNAs, bis(2-ethylhexyl)phthalate and 2-chlorophenol, were detected in sample SP1-SL0002-split at estimated concentrations of 110 and 10 µg/kg, respectively. PAHs were not detected in sample SP1-SL-9002, or the three other OU-5/Site WP-1 soil samples.

The concentrations of PAHs, bis(2-ethylhexyl)phthalate and 2-chlorophenol detected in OU5/Site WP-1 background samples were equal to or less than the average Homestead ARB background concentrations for the 2-4 ft depth interval. The PAH, bis(2-ethylhexyl)phthalate, and 2-chlorophenol concentrations are similar because the background data collected at OU-5/Site WP-1 was included in the average Homestead ARB calculations and some PAH compounds and 2-chlorophenol were only detected in background data collected at OU-5/Site WP-1. The PAH, and bis(2-ethylhexyl)phthalate concentrations detected at OU-5/Site WP-l were less than the average Homestead ARB background concentrations for the 0-2 ft depth interval. PAHs and 2-chlorophenol were not detected in the Homestead ARB background samples included in the 4-6 ft depth interval. Additionally, the concentrations of bis(2-ethylhexyl)phthalate detected at OU-5/Site WP-1 were below the average Homestead ARB concentration of this compound calculated for the 4-6 ft interval.

1993 Investigation. Of the four samples collected in 1993, only one sample (SP1-SL-0007) and its duplicate (SP1-SL-9007) were analyzed for BNAs (Table 2-9). This sample was collected from the 0-1 ft bls interval. Fifteen PAH compounds were detected at comparable levels in both samples. Additionally, dibenzofuran, carbazole and four phthalates were detected. Carbazole concentrations were 35 and 62 µg/kg and are estimated below the contract required quantitation limit (CRQL). Di-n-butyl phthalate and bis-2-ethylhexyl phthalate were detected at less than the CRQL and were also detected in the laboratory blank. Benzylbutyl phthalate and di-n-octyl phthalate at 24 µg/kg and 7 µg/kg, respectively, were detected in SP1-SL-0007. SP1-SL-9007 contained 14 µg/kg of benzylbutyl phthalate. All phthalate concentrations were below the CRQL. The total phthalate concentration of 141 µg/kg is slightly greater than the average Homestead background of 126 µg/kg. The total PAH concentrations for SP1-SL-0007 and SP1-SL-9007 were 3,609 µg/kg and 4,825 µg/kg, respectively. However, only five of the PAH compounds were above the CRQL: fluoranthene (650 and 880 µg/kg), pyrene (510 and 810 µg/kg), benzo(b) fluoranthene (380 and 540 µg/kg), benzo(k)fluoranthene (390 and 420 µg/kg), and chrysene (410 and 540 µg/kg). All other individual PAH compounds were detected at less than the CRQL. None of the detected BNA compounds exceed the State of Florida Health-Based Soil Target Levels.

The background soil samples for OU-5/Site WP-1 are samples SP1-SL-0002 and its duplicate, SP 1-SL-9002, collected by Geraghty & Miller in 1991. Soil sample SP1-SL-0007 (0-1 ft bls), collected during the 1993 investigation, indicates an order of magnitude greater concentration of BNAs when compared to the 1991 background sample SP1-SL-0002 (2-4 ft bls). Background total PAHs at Homestead ARB as presented by G&M for the 0-2 ft bls interval were 739 µglkg. In 1993, Total PAHs were 3,609 and 4,825 µg/kg detected in samples SP1-SL-0007, and SP1-SL-9007, respectively.

A comparison of the 1991 sample, SP1-MW-0001-S, with the 1993 sample SP1-SL-0007 indicate an absence of detected PAHs above the method detection limit in 1991, while 17 PAH compounds were detected in 1993. However, with the exception of pyrene (<361 µg/kg in 1991 and 510 µg/kg in 1993), the reported quantitation limits for the PAHs analyzed in 1991 were above the quantities reported in 1993. PAH compounds are not generally associated with electroplating waste. Sample SP1-SL-0007 is located in close proximity to the asphalt parking lot. These PAH results may be indicative of run-off from the parking area. The PAH concentrations reported for OU-5/Site WP-1 were near the values reported for urban areas and are within the range of values reported for road dust (Menzie, et al., 1992).

The background soil samples for OU-5/Site WP-l are samples SP1-SL-0002 and its duplicate, SP1-SL-9002, collected by Geraghty & Miller in 1991. Soil sample SP1-SL-0007 (0-1 ft bls), collected during the 1993 investigation, indicates an order of magnitude greater concentration of BNAs when compared to the 1991 background sample SP1-SL-0002 (2-4 ft bls). Background total PAHs at Homestead ARB as presented by G&M for the 0-2 ft bls interval were 739 µg/kg. In 1993, Total PAHs were 3,609 and 4,825 µg/kg detected in samples SPl-SL-0007, and SP1-SL-9007, respectively.

A comparison of the 1991 sample, SP1-MW-0001-S, with the 1993 sample SP1-SL-0007 indicate an absence of detected PAHs above the method detection limit in 1991, while 17 PAH compounds were detected in 1993. However, with the exception of pyrene (<361 µg/kg in 1991 and 510 µg/kg in 1993), the reported quantitation limits for the PAHs analyzed in 1991 were above the quantities reported in 1993. PAH compounds are not generally associated with electroplating waste. Sample SP1-SL-0007 is located in close proximity to the asphalt parking lot. These PAH results may be indicative of run-off from the parking area. The PAH concentrations reported for OU-5/Site WP-1 were near the values reported for urban areas and are within the range of values reported for road dust (Menzie, et al., 1992).

Dibenzofuran was detected in SP1-SL-0007 and the duplicate at 4 and 11 µg/kg, respectively. Carbazole was also detected at 35 and 62 µg/kg. All values reported for dibenzofuran and carbazole are less than the CRQL. Carbazole was not analyzed in the 0-2 ft Homestead ARB background samples and was not detected at a quantitative limit of 1,250 µg/kg in the 2-4 ft background sample. Dibenzofuran was not detected in the background samples for the Base or OU-5/Site WP-1.

1994 and 1995 Interim Action. During the 1994 confirmation sampling program, 7 of the 28 samples collected were considered soil/weathered rock due to their position either underlying the asphalt parking area (EWA-1 and EWA-2) or within the grassy swale east of Building 164 (EWA-3 through EWA-7). Two of the soil samples EWA-6 and EWA-7, are no longer considered representative of site conditions, given that the area from which they were sampled, was excavated during the 1995 excavation and removal activity. Analytical results of the 5 remaining samples did not indicate the presence of BNA compounds above the specified detection limit. The 1994 BNA soil analytical results for these 5 samples have been summarized and are presented in Table 2-9. However, elevated detection limits were reported in each of the samples. Ten BNAs were reported in the two soil samples (EWA-6 and EWA-7) collected from areas that were subsequently excavated. Five of the BNAs detected exceeded the State of Florida Health-Based Soil Target Levels in sample EWA-7. The BNAs exceeded include; benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, fluoranthene, and indeno (1, 2, 3-C, D)pyrene. Concentrations of these compounds ranged from 11,000 µg/kg to 32,000 µg/kg.

Soil analytical results from the 1995 confirmation sample (CS-01) collected from the base of the excavation associated with the 1994 soil samples EWA-6 and EWA-7, indicate detectable concentrations of 10 BNA compounds, primarily PAHs. The compounds detected include 9 of the compounds found in the pre-excavation sample, di-n-butyl phthalate was the only compound not previously reported. The concentration of detected BNA compounds ranged from 370 µg/kg to 1260 µg/kg. None of the compounds detected were reported above the State of Florida Health-Based Soil Target Levels. However, the concentration of PAHs in this sample exceed the FDEP 62-775 maximum level of 1000 µg/kg Total PAHs.

A summary of the 1995 soil BNA analytical results is provided in Table 2-9.

2.6.2.3 Organochlorine Pesticides/PCBs. 1991 Investigation. Soil samples collected by G&M during the 1991 investigation were not analyzed for Pesticides and PCBs.

1993 Investigation. Four soil samples plus one duplicate were collected and analyzed for organochlorine pesticides and PCBs. A summary of the pesticide/PCB constituents detected is provided in Table 2-9. No PCBs were detected in any of the soils collected. Concentrations of pesticides detected in 1993 soil samples are well below the CALs as well as the State of Florida Health-Based Soil Target Levels. Sample SP1-SL-0004 at the 0-2 ft bls interval showed no detectable concentrations of pesticides. DDT and its metabolites were detected in the three soil samples SP1-SL-0006, SP1-SL-0007, and the background sample, SP1-SL-0005. DDT ranged in concentration from 0.83 (background SP1-SL-0005) to 34 µg/kg. The DDE metabolite was seen at 3.8 to 130 µg/kg (SP1-SL-0006). The background sample was reported at 3.9 µg/kg DDE. The DDD metabolite was not observed in SPl-SL-0005, but was detected in samples SP1-SL-0006 and SP1-SL-0007 and the SPl-SL-0007 duplicate at concentrations ranging from 0.75 to 28 µg/kg. Endosulfan sulfate was detected in two locations: SP1-SL-0006 (0.77 µg/kg) and SP1-SL-0007 (6.4 and 8.8 µg/kg). Alpha and beta chlordane were detected in SP1-SL-0006 at 1.9 and 2.3 µg/kg, respectively.

soil samples were collected adjacent to the grassy swale located east of Building 164 (Figure 2-2) where runoff from the surrounding area collects. Analytical data for the 1984 sampling is presented in Table 2-2. Low concentrations of cyanide and all metals analyzed, except cadmium, were detected in the four samples as follows: cyanide concentrations ranged from 0.60-1.3 mg/kg, total chromium concentrations ranged from 0.02-0.07 mg/kg; copper concentrations ranged from 0.08-0.11 mg/kg; lead concentrations ranged from 0.09-0.21 mg/kg; nickel concentrations ranged from 0.01-0.05 mg/kg; and zinc concentrations ranged from 0. 12-0.72 mg/kg. Concentrations of chromium, copper, lead, nickel, and zinc detected in these surficial samples are below concentrations detected in background soil sample SP1-SL-0002, collected northwest of Building 164 during the 1991 investigation. In addition, concentrations of chromium, copper, lead, nickel, and zinc were well below the average Homestead ARB background concentrations (7.6, 1.8, 3.3, 1.1, and 3.3 mg/kg, respectively) for the 2-4 ft bls soil interval and the average carbonate composition concentrations reported by Hem (1989).

1991 Investigation. TAL metals detected in the four soil samples collected from 2-4 feet bls in 1991 included aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, vanadium zinc, and lead (Table 2-5). These constituents are typically present in carbonate rocks and soils. According to the average carbonate-composition data presented by Hem (1989), calcium, magnesium, aluminum, iron, potassium, manganese, and sodium are the most common constituents of carbonates. Arsenic, barium, beryllium, chromium, cobalt, copper, lead, nickel, vanadium, and zinc occur at trace levels. Concentrations of most of the metals detected in the background samples for OU-5/Site WP-1, SP1-SL-9002 and SP1-SL-0002-split, were below the average carbonate composition concentrations with the exception of calcium, chromium, and sodium. Similarly, most metals detected in the three soil samples collected at OU-5/Site WP-1, SP1-SL-0001, SP1-SL-0003, and SP1-MW-0001-S, were below the average limestone composition concentrations except for concentrations of calcium and chromium. Additionally, concentrations of aluminum, beryllium, and vanadium in sample SP1-SL-0003 were above the average carbonate concentrations. Cyanide, which is not a common constituent of limestone, was not detected in the soil samples collected in 1991.

Concentrations of chromium (7.2 to 23.4 mg/kg), copper (1.7 to 2.6 mg/kg), lead (0.64 to 5.5 mg/kg), nickel (0.87 to 5.2 mg/kg), and zinc (2.2 to 2.9 mg/kg) detected in the soil samples collected in 1991 were higher than concentrations detected in 1984 except for cyanide which was not detected in the 1991 samples. The different sampling intervals used during these investigations may explain the difference in detected concentrations of these metals: the samples collected in 1984 were surficial samples and the samples collected in 1991 were bedrock samples of Miami Oö1ite collected from 2 to 4 ft b1s.

Concentrations of TAL metals detected at OU-5/Site WP-1 were compared to background concentrations, which were determined by combining results from background soil samples SP1-SL-9002-split and SP1-SL-0002. Concentrations of calcium, magnesium, and vanadium detected in samples SP1-SL-0001, SP1-SL-0003, and SP1-MW-0001S were above the background concentrations of these metals. In addition, concentraiions of aluminum, copper, iron, manganese, nickel, potassium, and arsenic detected in samples SP1-SL-0003 and SP1-MW-0001-S were greater than background concentrations. Sample SP1-SL-0003 also contained concentrations of barium, beryllium, chromium, cobalt, and lead that were greater than background concentrations.

Concentrations of TAL metals detected at OU-5/Site WP- 1 were also compared to average Homestead ARB background concentrations for the 2-4 ft bls depth interval. Concentrations of calcium, magnesium, and vanadium detected in samples SP1-SL-0001, SP1-SL-0003, and SP1-MW-0001S were above the average Homestead ARB background concentrations of these metals in the 2-4 ft bls depth interval. Concentrations of aluminum, arsenic, chromium, copper, iron, nickel, and potassium detected in samples SP1-SL-0003 and SP1-MW-0001-S were greater than the average Homestead ARB background concentrations for the 2-4 ft bls depth interval. Additionally, concentrations of barium, lead, and manganese detected in sample SP1-SL-0003 and sodium detected in sample SPl-SL-0001 were also above the average Homestead ARB background concentrations for the 2-4 ft bls interval.

1993 Investigation. Four soil samples were collected in 1993 and analyzed for cyanide: SP1-SL-0004 (0-2 ft b1s), SP1-SL-0005 (0-2 ft b1s), SP1-SL-0006 (0-2 ft b1s), and SP1-SL0007 (0-1 ft b1s), and a duplicate, SP1-SL-9007 (0-1 ft b1s). Cyanide was not detected above the CRQLs which ranged from 0.28 to 0.29 mg/kg dry weight.

Only sample SP1-SL-0007 and its duplicate, SP1-SL-9007, were analyzed for TAL metals. Aluminum, arsenic, barium, cadmium (duplicate only), calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, vanadium, and zinc were detected at this location (Table 2-9). With the exception of cadmium in the duplicate, and cobalt, these same metals were detected during the 1991 sampling. Calcium (285,000 mg/kg), magnesium, (1,160 mg/kg), and sodium, (513 mg/kg) were below the OU-5/Site WP-1 background sample collected by G&M in 1991 (SP1-SL-0002). Barium, (17.7 mg/kg) and cobalt (0.62) were below the Homestead ARB average of 1.2 mg/kg. The remaining metals were detected at concentrations slightly above site background and also above Homestead ARB background. Aluminum (5,460 mg/kg), iron (3,070 mg/kg), manganese (72.4 mg/kg), nickel (13 mg/kg), potassium (630 mg/kg), and vanadium (8.4 mg/kg) were below average carbonate composite values (HEM, 1989).

Arsenic is the only metal detected which exceeds the State of Florida Health-Based Soil Target Level of 3 and was reported at 9.1 mg/kg and 9.7 mg/kg in the duplicate. However, arsenic is a common constituent in the environment and is present throughout Homestead ARB. A CAL of 10 mg/kg was established for the base by USEPA, FDEP, and DERM. While the arsenic levels approached the CAL of 10 mg/kg, it was not exceeded. Nickel was also detected in soil sample SP1-SL-0007 and its duplicate SP1-SL-9007 at concentrations of 7.2 mg/kg and 6.1 mg/kg, respectively. These nickel concentrations exceed the CAL of 3.24 mg/kg but are well below the State of Florida Health-Based Soil Target Level of 2,600 mg/kg. Furthermore, the nickel concentrations are below the average carbonate concentration and the common concentration of nickel found in the Eastern United States.

Chromium was detected at 18.6 and 18.9 mg/kg. Copper (13.8 and 15.5 mg/kg), lead (38.3 and 44.5 mg/kg), and zinc (20.1 and 23.3 mg/kg estimated due to interference) were also detected. Arsenic, copper, lead, and zfnc levels were slightly higher in the 1993 soil samples than those reported by G&M in 1992.

The furnace metals, arsenic, lead, selenium, and thallium, are qualified as estimated due to inherent interference from the limestone nature of the soil. In general, the metals concentration values for aluminum, beryllium, cadmium, calcium, cobalt, copper, magnesium, manganese, mercury, nickel, potassium, sodium, and vanadium are unqualified data. Data for antimony, barium, chromium, iron, lead, silver, and zinc are qualified as estimated due to interference or difficulty with reproducibility, again caused by the nature of the samples. Further discussion of these interferences is addressed in the associated QCSR.

As reported by G&M in 1991, the metals constituents observed are typically present in carbonate soils and rocks. With the exception of arsenic (9.1 mg/kg), calcium (285,000 mg/kg), chromium (18.6 mg/kg), cobalt (0.62 mg/kg), copper (13.8 mg/kg), lead (38.3 mg/kg), sodium (513 mg/kg), and zinc (20.1 mg/kg), the metals were below the carbonate soils averages.

1994 and 1995 Interim Action. Soil samples collected during the 1994 and 1995 Interim Action were each analyzed for TAL metals. Cyanide was not analyzed for during these investigations. Results from the 1994 and 1995 investigations have been summarized and are presented in Table 2-9. With the exception of cobalt, copper, lead, mercury, and nickel, metal results are comparable to previous sampling results. The concentrations of these metals were typically higher than 1993 and 1991 results. Cobalt was not detected in any of the 1994 samples, but was detected in the 1995 soil samples, CS-01 at a concentration of 1.4 mg/kg. The maximum concentrations of copper were detected in the 1994 soil samples EWA-3 at a concentration of 109 mg/kg and the 1995 soil sample CS-01 at a concentration of 160 mg/kg. Elevated detection limits were reported for cobalt and copper in the 1994 soil samples. Lead was detected in each of the 1994 and 1995 samples ranging in concentration from 4.4 mg/kg to 799 mg/kg. The maximum lead concentration was reported in sample EWA-7. This sampling point has been subsequently excavated. Mercury and nickel were only detected in the 1995 soil samples at concentrations of 0.40 mg/kg and 300 mg/kg. The levels of cobalt, copper, lead, mercury, nickel and silver appear to have higher concentrations in the excavated portions of the North Area swale, i.e., at sampling points EWA-6 and EWA-7.

The concentrations of metals in the 1994 and 1995 soil samples are below the State of Florida Health-Based Soil Target Levels with the exception of arsenic. Arsenic, lead, and nickel concentrations exceed the CALs of 10 mg/kg, 108 mg/kg and 3.24 mg/kg in the 1994 soil sample EWA-7 (subsequently excavated) and the 1995 confirmation sample CS-01.

2.6.2.5 Summary Section for Soils. In general, analytical results do not indicate significant impact in the areas of soil sample collection. Concentrations of compounds detected in soils at OU-5/Site WP-1 include BNAs, pesticides, and metals. The VOC detected (acetone) has been traced to field decontamination of sampling equipment. Acetone has been widely detected in soil samples throughout Homestead ARB and has been identified as an artifact of the degradation of isopropyl alcohol used during field decontamination procedures. Field samples of the isopropanol alcohol were obtained for analysis which indicated up to 120,000 µg/L acetone content. Results of the acetone sampling are documented in the quality control summary report (QCSR) provided to the USACE, Omaha District.

BNAs, primarily PAHs, were detected in the one sample collected in 1993, the background sample collected in 1991, and the confirmation samples collected in 1995. BNA compounds were not detected in the 1994 samples due to elevated detection limits. The proximity of sample SP1-SL-0007 to the asphalt parking lot and the surficial location of this sample indicate the potential source of the PAH compounds may be run-off from the parking lot. The PAH compounds seen in the 1991 background samples were reported at higher concentrations than those detected in the 1993 samples. Only the background sample collected in 1991 had detectable quantities of PAHs with all results estimated at values less than the PQLs. The PAH concentrations were near the range of background concentrations reported for urban areas and those affected by anthropogenic influences.

Cyanide has not been detected in any of the soil samples collected at OU-5/Site WP-1. A comparison of the 1993, 1994, and 1995 metals analytical results indicate elevated concentrations above State of Florida Health-Based Soil Target Levels or CALs for arsenic, lead, and nickel in the 1995 excavation sample. Again, this may be indicative of their location within the swales which receive runoff from the surrounding area. Nickel was above the CALs in both 1993 and 1995 soil samples, while lead was above CAL in only the 1995 soil sample collected from the swale excavation. Arsenic exceeded the State of Florida Health-Based Soil Target Levels in the 1993 and 1995 soil samples.

2.6.3 Groundwater Investigations

The Electroplating Waste Disposal Area was identified during the initial IRP Phase I investigations. Groundwater samples have been collected at OU-5/Site WP- 1 in every phase of field investigations conducted at Homestead ARB since 1984 with the exception of the 1994 and 1995 Interim Action.

During the 1984 IRP Phase II investigation, three monitoring wells (I-01 to I-03) were installed (Figure 2-3) and groundwater samples were collected and analyzed for cyanide and total metals including cadmium, total chromium, hexavalent chromium, copper, lead, nickel, and zinc. A summary of the analytical data generated in 1984 is presented in Table 2-1. Low concentrations of cadmium (<0.2 to 0.4 µg/L), total chromium (<0.5 to 19.7 µg/L), hexavalent chromium (<0.1 to 1.7 µg/L), copper (4.2 to 7.0 µg/L), lead (5.7 to 9.0 µg/L), nickel (9.2 to 16.9 µg/L), and zinc (15.1 to 16.3 µg/L) were detected in the three groundwater samples. Cyanide was not detected in the groundwater samples. The highest concentration of total chromium was detected in sample I-01; the highest concentration of lead was detected in the duplicate of sample I-02; the highest concentrations of hexavalent chromium, cadmium, copper, and nickel were detected in sample I-03; and the highest concentrations of zinc was detected in samples I-02 and I-03. The concentrations of these constituents detected at OU-5/Site WP-1 were well below their applicable Florida Primary and Secondary

Drinking Water Standards and the Federal Maximum Contaminant Levels (MCLs) or Action Levels.

During the 1988 IRP Phase IV-A investigation, groundwater samples were collected from the three existing wells installed during the Phase II investigation (Figure 2-3). The groundwater samples were analyzed for total cyanide and total metals including arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, sodium (Table 2-3). Low concentrations of total metals included arsenic (8.1 to 24 µg/L), barium (5.7 to 7.6 µg/L), cadmium (<0.12 to 0.48 µg/L), chromium (8.9 to 9.4 µg/L), copper (<7.8 to 8.3 µg/L), lead (1.4 to 2.5 µg/L), mercury (<0.13 to 0. 16 µg/L), nickel (<11 to 14 µg/L), selenium (0.54 to 1.0 µg/L), and sodium (7,710 to 33,500 µg/L). All metals detected except for sodium and arsenic exhibited concentrations between the practical quantitation limit and the method detection limit. The highest concentrations of total arsenic, barium, nickel, selenium, and sodium were detected in sample I-01; the highest concentrations of cadmium, total chromium, and total lead were detected in sample I-02; and the highest concentrations of total copper and total mercury were detected in sample I-03. Concentrations of metals detected in groundwater were below applicable Florida Primary and Secondary Drinking Water Standards and Federal MCLs or Action Levels. Total cyanide, which was not detected in 1984, was detected in samples I-01 and I-03 at concentrations of 7.4 and 24 µg/L, respectively; however, these concentrations, are well below the Federal MCL of 200 µg/L.

Based on results from the previous investigations, G&M conducted a Remedial Investigation in 1991, during which additional groundwater samples were collected. Three existing wells I-01, I-02, and I-03 were sampled. One new monitoring well, SP1-MW-0001, was installed east of Building 164 in 1991 (Figure 2-3). This new well was also sampled. VOCs, BNAs, and TAL metals were included in the analyses.

The remedial investigation continued in 1993, with Montgomery Watson collecting samples from all four monitoring wells (SP1-MW-0001, I-01, I-02, and I-03) associated with OU5/Site WP-1 (Figure 2-4). All groundwater samples were analyzed for TCL pesticides/PCBs and cyanide. Additionally, groundwater sample SP1-I-02 was analyzed for TCL VOCs, TCL BNAs, and TAL metals (total and dissolved).

In 1996, OHM Corporation completed an additional round of groundwater sampling from the four OU-5/Site WP-1 monitoring wells SPl-MW-0001, I-01, I-02, and I-03. This groundwater sampling event was completed to supplement previous groundwater sampling events and provide a current characterization of site conditions. Groundwater samples collected by OHM Corporation were analyzed for TCL VOCs, TCL BNAs, TCL pesticides/PCBs, total metals and cyanide.

Groundwater results are compared to Florida Primary and Secondary Drinking Water Standards, Florida 62-770 Target Cleanup Levels, and Federal Primary and Secondary Drinking Water Standards (MCLs), presented in Table 2-12.

2.6.3.1 Volatile Organic Compounds. 1991 Investigation. In 1991, groundwater samples were collected from three existing monitoring wells (I-01, I-02, and I-03) and one newly installed monitoring well (SP1-MW-0001) (Figure 2-3). One VOC, methylene chloride, was detected in monitoring wells I-01 and I-02 at concentrations of 1.4 and 3.1 µg/L, respectively (Table 2-6). These reported concentrations are below the PQL for methylene chloride (5 µg/L) and also below the Florida Primary Drinking Water Standard, 5 µg/L. Methylene chloride is also a common laboratory contaminant and concentrations at these low levels are not necessarily indicative of site contamination.

1993 Investigation. Groundwater samples were collected for VOC analysis at only one monitoring well at OU-5/Site WP-1 during the 1993 field investigation. Monitoring well SP1-I-02 was sampled and a duplicate was collected. Chloroform (2.52 µg/L) and bromodichloromethane (1 and 2 µg/L) were detected at less than the CRQL of 10 µg/L. These values are also significantly below the Federal MCL of 100 µg/L for each compound.

Field QA/QC samples indicated the presence of 1,2-dichloropropane in the equipment blank associated with the collection of SP1-I-02 and SP1-I-902. The concentration (2 µg/L) is estimated below the CRQL. This compound has been detected in other equipment blanks and analyte-free water samples obtained during the 1993 investigation and is most likely associated with the use of the analyte-free water system. The QCSR discusses the full scope of quality assurance for the 1993 investigation and is submitted under separate cover. 1,2-dichloropropane was not detected in any of the groundwater samples collected. A summary of the 1993 groundwater analytical results for VOCs are presented in Table 2- 10.

1996 Investigation. Groundwater samples were analyzed for VOCs in the 1996 investigation from each of the four OU-5/Site WP-1 monitoring wells. Methylene chloride was the only compound detected and was reported in two samples and one duplicate, ranging in concentration from 1 µg/L to 7 µg/L. Methylene chloride was also present in an equipment blank at a concentration of 3 µg/L. Methylene chloride is a common laboratory contaminant and was also present in the equipment blank. Methylene chloride was detected

TABLE 2-12

GROUNDWATER QUALITY CRITERIA

Analyte	Florida Drinking Water Standards	Florida 62-770	EPA Drinking Water Standards	EPA Maximum Contaminant Level Goal
VOLATILE ORGANIC COMPOUNDS (ug/L):	NS	NS	100	0
Chloroform	NS	NS	100	0
Bromodichloromethane				
BASE/NEUTRAL AND ACID EXTRACTABLE				
ORGANIC COMPOUNDS (ug/L)	6	NS	6	0
bis(2-Ethylhexyl) phthalate	NS	NS	NS	NS
Di-n-octylphthalate	NS	d	NS	NS
2-Methylnaphthalene	NS	d	NS	NS
Naphthalene				
METALS (ug/L):				
Aluminum	200 l	NS	50 to 200 h	NS
Arsenic	50 k	NS	50g	NS
Barium	2000 k	NS	2000 i	2000 i
Beryllium	4	NS	4	4
Calcium	NS	NS	NS	NS
Chromium	100 k	NS	100 i	100 i
Cobalt	NS	NS	NS	NS
Copper	1000 l	NS	1000 h/1300 s	1000
Iron	300 l	NS	300 h	NS
Lead	15 k	50	15 s	0
Magnesium	NS	NS	NS	NS
Manganese	50 l	NS	50 h	NS
Mercury	2 k	NS	2 i	2 i
Nickel	100 k	NS	100 g	100
Potassium	NS	NS	NS	NS
Selenium	50 k	NS	50 i	50 i
Sodium	160000 k	NS	NS	NS
Thallium	2	NS	2	0.5
Vanadium	NS	NS	NS	NS
Zinc	5000 l	NS	NS	NS
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (mg/L)	NS	5	NS	NS
TOTAL DISSOLVED SOLIDS (mg/L)	500 l	NS	500 h	NS
BIOCHEMICAL OXYGEN DEMAND (mg/L)	NS	NS	NS	NS
TOTAL SUSPENDED SOLIDS (mg/L)	NS	NS	NS	NS
ALKALINITY (mg/L)	NS	NS	NS	NS
TOTAL ORGANIC CARBON (mg/L)	NS	NS	NS	NS
SULFATE (mg/L)	250	NS	250	400/500 g
SULFIDE (mg/L)	NS	NS	NS	NS
HARDNESS as CaCO3 (mg/L)	NS	NS	NS	NS

ug/L - micrograms per liter
mg/L - milligrams per liter
NS - No Standard
b - The total of volatile organic aromatics (benzene, toluene ethylbenzene and xylenes) must be <50 ug/L to meet FAC 62-770 guidelines.
c - The total of polynuclear aromatic hydrocarbons excluding naphthalenes must be <10 ug/L to meet FAC 62-770 guidelines.
d - The total of naphthalenes and methyl naphthalenes must be <100 ug/L to meet FAC 62-770 guidelines.
f - Numbers represent EPA's Proposed Primary MCL or Proposal MCLG, Federal Register, Vol. 55, No. 143, July 1990.
g - Numbers represent EPA's Primary MCL for Inorganics.
- Numbers represent EPA's Secondary MCL for Inorganics which are non-enforceable taste, odor or appearance guidelines.
Numbers represent EPA's Final MCL effective July 1992, Federal Register, January 30, 1991 and July 1, 1991.
- Florida Primary Drinking Water Standard.
l - Florida Secondary Drinking Water Standard.
s - Final Action Level -The final lead action level is exceeded if the level of lead/copper in more than 10 percent of the targeted tap samples is greater than the action level (90th percent).

in groundwater samples collected from the same two wells (I-01 and I-02) during the 1991 RI. However, methylene chloride was not reported above the method detection limit in the 1993 groundwater sample collected from monitoring well SP1-I-02. A summary of the 1996 VOC analytical results are provided in Table 2-10.

2.6.3.2 Base Neutral/Acid Extractable Compounds. 1991 Investigation. All four monitoring wells (I-01 through I-03, and SP1-MW-0001) were sampled and analyzed for BNAs during the 1991 investigation. Only one BNA, bis(2-ethylhexyl)phthalate, was detected in monitoring wells I-02, I-03, and SP1-MW-0001 at concentrations of 0.9,320, and 0.7 mg/L, respectively (Table 2-6). Concentrations of bis(2-ethylhexyl)phthalate were classified as qualitative because they were either detected below the PQL or were observed in an associated blank sample. Bis(2-ethylhexyl)phthalate is a common laboratory contaminant. This compound is a plasticizer and is also commonly encountered in samples which have been in contact with plastics (gloves, sample containers, etc.).

1993 Investigation. One well was sampled and analyzed for BNAs during the 1993 field investigation. The sample, SP1-I-02 and its duplicate, SP1-I-902, were collected from monitoring well I-02. Sample SP1-I-02 indicated 0.5 µg/L of di-n-butyl-phthalate and 0.3 µg/L of bis(2-ethylhexyl)phthalate (Table 2-10). Both concentrations are below the CRQL of 11 µg/L. Duplicate sample SP1-I-902 had reported concentrations of naphthalene (1 µg/L), 2-methylnaphthalene (2 µg/L), and di-n-butyl phthalate (0.5 µg/L). Concentrations reported for all BNA constituents are estimated since they are below the CRQLs (11 µg/L). The Florida Primary Drinking Water Standard for bis(2-ethylhexyl)phthalate is 6 µg/L and the Federal MCL is 6 µg/L. Groundwater concentrations of these compounds detected at OU-5/Site WP-1 were below these values. There is no established groundwater criteria for di-n-butylphthalate. As stated previously, phthalates are commonly encountered in samples exposed to plastics. The concentrations of naphthalene and 2-methylnaphthalene detected in the duplicate sample are below the Florida 62-770 guidelines of 100 µg/L with a total naphthalenes concentration of 3 µg/L.

1996 Investigation. Groundwater samples were collected and analyzed for BNAs from each of the OU-5/Site WP-1 wells in 1996. BNAs were not reported above the method detection limit in any of the groundwater samples. The 1996 groundwater analytical results for BNAs are presented in Table 2-10.

2.6.3.3 Organochlorine Pesticides/PCBs. 1991 Investigation. Groundwater samples collected in 1991 were not analyzed for pesticides and PCBs.

1993 Investigation. Groundwater samples were collected from all four monitoring wells at OU-5/Site WP-1 in March of 1993 and analyzed for TCL organochlorine pesticides and PCBs. Wells SP1-MW-0001, SP1-I-01, SP1-I-02, SP1-I-03, were sampled and submitted for analysis. Pesticides and PCBs were not detected above CRQLs in any of the four groundwater samples, and one duplicate sample collected. A summary of the 1993 groundwater analytical results for pesticides/PCB s is provided in Table 2-10.

1996 Investigation. Groundwater samples were collected from the four monitoring wells at OU-5/Site WP-1 during the 1996 investigation. Pesticides and PCBs were not reported above the detection limit in any of the samples collected. A summary of the 1996 groundwater analytical results for pesticides/PCBs is provided in Table 2-10.

2.6.3.4 Metals and Cyanide. **1991 Investigation.** Three existing monitoring wells (I-01 through I-03) and the one newly installed well (SP1-MW-0001) were sampled during the 1991 investigation. A duplicate of sample I-02 was also collected (I-9002). The following TAL metals were detected in groundwater samples collected at OU-5/Site WP-1: aluminum, barium, calcium, chromium, iron, magnesium, manganese, potassium, sodium, vanadium, zinc, arsenic, and lead (Table 2-6). Calcium, magnesium, and potassium were detected in the four wells sampled; however, no Florida Drinking Water Standards or Federal MCLs exist for these metals. Groundwater samples I-01, I-02 and I-9002 contained very high concentrations of total calcium, 3,100,000, 5,400,000, and 2,600,000 µg/L, respectively, in addition to significant concentrations of many other TAL metals. Review of the groundwater sampling logs for these samples indicated that all samples were turbid during sample collection. It is possible that the high TAL metal concentrations, particularly that of calcium, were a result of suspended sediments as artifacts of well construction and thereby overstated the actual concentrations of the analytes at the site. Calcium concentrations reported in groundwater samples I-02, I-9002, and I-03 were much higher than the range of dissolved calcium concentrations (55,000 to 140,000 µg/L) reported in the Biscayne Aquifer by Sonntag (1987).

Concentrations of barium detected in groundwater samples collected at OU-5/Site WP-1 were well below the Florida Primary Drinking Water Standard of 2,000 µg/L and the Federal PMCL of 2,000 µg/L. In addition, concentrations of sodium detected were well below the Florida Primary Drinking Water Standard of 160,000 µg/L. Estimated concentrations of arsenic detected in monitoring wells I-01 (92 µg/L) and I-02 (60 µg/L) exceeded the Florida Primary Drinking Water Standard and Federal MCL for arsenic of 50 µg/L. Concentrations of lead detected in samples I-02 and I-9002 (duplicate of I-02) exceeded both the Florida

Primary Drinking Water Standard and the Federal Action Level of 15 µg/L. Concentrations of chromium detected in sample I-02 exceeded the Florida Primary Drinking Water Standard and the Federal MCL of 100 µg/L. The high concentrations of calcium interfered with the ability to detect cadmium in samples I-01, I-02, and I-9002 resulting in detection limits for cadmium which exceed the Florida Primary Drinking Water Standard and the Federal MCL of 5 µg/L. Additionally, the high concentrations of calcium interfered with the ability to detect selenium resulting in detection limits for all samples of 50 µg/L.

Federal Secondary Drinking Water Standards establish recommended limits and deal with the aesthetic qualities of drinking water; however, the FDEP has adopted these standards as the Florida Secondary Drinking Water Standards and requires that potable groundwater shall meet these recommended limits. Concentrations of iron are naturally high and commonly exceed the Florida standard (Sonntag, 1987). Concentrations of iron detected in all groundwater samples collected in 1991 at OU-5/Site WP-1 exceeded the Florida Secondary Drinking Water Standard and Federal Secondary MCL of 300 µg/L. Concentrations of manganese detected in groundwater samples SP1-MW-0001, I-01, I-02, and I-9002 exceeded the Florida Secondary Drinking Water Standard and Federal Secondary MCL of 50 µg/L. Concentrations of aluminum detected in all groundwater, samples exceeded the Federal Secondary MCL for aluminum of 50-200 µg/L. However, concentrations of total dissolved solids and zinc did not exceed the Florida Secondary Drinking Water Standards and Federal Secondary MCLs in samples analyzed for these constituents.

The metal concentrations detected in the groundwater samples collected during the 1991 CERCLA investigation had the highest concentrations of metals of all sampling events. As discussed above, it is likely that the increase in metal concentrations is the result of suspended sediments in the groundwater samples collected.

Cyanide was not detected in any of the groundwater samples collected in 1991.

1993 Investigation. All four existing monitoring wells (SP1-MW-0001, SP-I-01, SP1-I-02, and SP1-I-03) were sampled in 1993 and analyzed for cyanide. Cyanide was not detected above the CRQL in any of the groundwater samples.

Only well SP1-I-02 was sampled and analyzed for TAL metals. Monitoring well SP1-I-02 was sampled in duplicate (SP1-I-902) and an equipment blank was collected. Due to high turbidity encountered in groundwater samples during the 1991 sampling events, both total (unfiltered) and dissolved (filtered) metals were analyzed (Table 2-10). Dissolved metals samples were filtered at the time of collection using a 0.45 micron disposable (single use) filter. The filtered sample was placed in the appropriate sample container and preserved with nitric acid to achieve a pH of <2. The pH was tested on all metals samples prior to shipment to the laboratoryto ensure that proper preservation (pH <2) had been achieved. Savannah Laboratories, Tallahassee, again checked the pH upon receipt at the laboratory. No report of inadequate preservation was noted in the analytical data.

Aluminum, arsenic, barium, calcium, copper, iron, lead, magnesium, manganese, potassium, sodium, vanadium, and zinc were detected in the unfiltered samples. Analysis of filtered samples showed lead, manganese, and vanadium had been removed to below detectable limits. Aluminum concentrations were reduced significantly (by as much as three orders of magnitude) in the filtered vs. unfiltered groundwater samples.

Evaluation of dissolved metals indicate that arsenic, copper, magnesium, potassium, sodium, and zinc are comparable to the total concentrations detected in groundwater. Total arsenic concentrations were 18.4 and 18.1 µg/L in SP1-I-02 and the duplicate, while dissolved arsenic concentrations were 16.1 and 16.7 µg/L. These values are well below the 60 µg/L reported during the 1991 sampling event. Total copper was reported at 3.1 and 3.7 µg/L and dissolved copper at 3.5 and <3.0 µg/L. Copper results were below the CRQL. Magnesium was detected in the unfiltered samples at 2,780 and 2,980 µg/L and at 2,230 and 2,290 µg/L in the filtered samples. Potassium was reported at 4,410 and 4,950 µg/L (total) and 3,250 and 3,750 µg/L (dissolved). Potassium results are below the CRQL. Sodium data indicated 14,300 and 14,500 µg/L (total) and 13,700 and 13,800 µg/L (dissolved).

Zinc was detected at 33.5 and 18.2 µg/L in the unfiltered samples and at 44.1 and 15.3 µg/L in the filtered samples. Zinc was also detected in the equipment blank at 36.1 µg/L and is a known contaminant at low levels in acids used for preservation and digestion of samples.

Arsenic, copper, magnesium, potassium, sodium, and zinc concentrations were all below the established regulatory guidance levels or fell within the range of concentrations reported in the Biscayne Aquifer, if no guideline for the metal in groundwater was available.

Aluminum, barium, calcium, iron, lead, manganese, and vanadium showed significant decreases in concentrations between total and dissolved metal results. Total aluminum was reported at 1,850 and 2,610 µg/L in SP1-I-02 and the duplicate SP1-I-902. The Florida Secondary Drinking Water Standard is 200 µg/L. The Federal Secondary MCL is 50-200 µg/L. The filtered samples indicated a significant decrease in aluminum concentrations to

<20 and 23.8 µg/L in SP1-I-02 and SP1-I-902, respectively. High concentrations of aluminum have been observed in background soil samples at HARB and in carbonate soils. Reported barium concentrations are below the Federal MCL of 2,000 µg/L in both total and dissolved analyses.

There are no Federal MCLs or Florida Drinking Water Standards for calcium. The dissolved calcium concentrations (78,800 and 82,200 µg/L) are within the range reported by Causaras, 1987, for concentrations of dissolved inorganic constituents in the Biscayne Aquifer. These high calcium concentrations contribute interference in analytical determinations for other metals.

Total iron detected at 1,560 and 1,950 µg/L is within or near the range detected as a dissolved constituent in the Biscayne Aquifer (<10 to 1,900 µg/L). These detected concentrations are higher than the Federal Secondary MCLs and Florida Secondary Drinking Water Standards of 300 µg/L. However, the filtered samples contained 40.5 and 50.0 µg/L dissolved iron for SP1-I-02 and SP1-I-902. The dissolved iron values are below the CRQL for the method and are also below the Federal Secondary MCL and the Florida Secondary Drinking Water Standard. As reported by Sonntag in 1997, concentrations of iron are naturally high and commonly exceed the Florida Secondary Drinking Water Standard.

Lead was detected in only the unfiltered groundwater metals analysis (9.3 and 9.1 µg/L. Total (unfiltered) lead levels were below the Federal MCL of 15 µg/L. Total manganese (26.7 and 28.5 µg/L) did not exceed the Florida Secondary Drinking Water Standard or the Federal Secondary MCL of 50 µg/L. Manganese was not detected in any of the filtered samples. No established guidelines for vanadium are available. Total vanadium values reported (5.5 and 6.5 µg/L) are below the CRQL. Vanadium was not detected above the CRQL in the filtered samples.

Thallium has a Florida Primary Drinking Water Standard of 2 µg/L, a Federal MCL of 2 µg/L, and a Federal MCLG of 0.5 µg/L. Thallium was not detected above the CRQL of 5 µg/L in any of the groundwater samples collected from SP1-I-02.

Though not detected at the attainable CRQLs, selenium and thallium results are qualified due to technical interferences caused by the high calcium typically observed in samples obtained in south Florida.

1996 Investigation. Groundwater samples were obtained from the four wells associated with OU-5/Site WP-1 (Figure 2-7) during the 1996 investigation and analyzed for total metals and cyanide. The groundwater analytical results obtained during this investigation are provided in Table 2-10. No filtered (dissolved) analyses were performed on the 1996 groundwater samples. Instead, care was taken during groundwater sampling to minimize the turbidity of the samples. The groundwater was sampled once the turbidity levels were below 10 NTU. Cyanide, aluminum, beryllium, cadmium, lead, mercury, selenium, silver, and thallium were not detected above the detection limit in the four groundwater samples collected in 1996.

Five metals, arsenic, barium, calcium, magnesium, and sodium, were detected in each of the four monitoring wells at OU-5/Site WP-1. Additionally, copper, iron, lead, manganese, potassium, vanadium, and zinc were detected in one or more of the groundwater samples. Concentrations of these metals were all below the Federal MCLs and Florida Drinking Water Standards. The metals, chromium, cobalt, copper, and nickel were only reported above detection limits in well SP1-I-03. Concentrations of these metals in well SP1-I-03 were reported below the Federal MCL and Florida Drinking Water Standards.

The calcium, magnesium, and sodium concentrations, which range from 83,900 µg/L to 114,000 µg/L to 2,740 µg/L, and 4,860 µg/L to 10,600 µg/L are within the range of values for dissolved inorganics detected in the Biscayne Aquifer.

Arsenic, which ranged in concentration from 3.9 µg/L to 15.3 µg/L, is above the range of <1.2 µg/L and the mean of 1.2 µg/L for dissolved organic constituents detected in the Biscayne Aquifer. Arsenic was detected at concentrations below the Federal MCL and Florida Primary Drinking Water Standard of 50 µg/L.

2.6.3.5 Summary Section for Groundwater.

Impacts to groundwater as a result of past operation do not indicate significant impacts as determined by groundwater samples obtained in 1991, 1993, and 1996. Comparison of the groundwater results collected in 1991 with those collected in 1993 and 1996 indicate elevated concentrations of constituents, primarily metals in the 1991 groundwater samples. This is likely due to the turbid conditions which were reported in the 1991 samples. Comparison of the range of the calcium concentrations in the 1991 groundwater samples, (130,000 µg/L to 5.4E+06 µg/L) with the 1993 (209,000 µg/L to 220,000 µg/L) and 1996

(83,400 µg/L to 114,000 µg/L) samples further substantiates the fact that turbid groundwater samples were collected.

The groundwater compounds detected in OU-5/Site WP-1 wells include VOCs (chloroform and bromodichloromethane), BNAs (naphthalene, 2-methylnaphthalene, di-n-butyl phthalate and bis(2-ethylhexyl)phthalate) and various naturally occurring metals. The organic contaminants are observed at very low levels. Methyle chloride was detected in monitoring wells I-10 and I-02 during the 1991 and 1996 groundwater sampling events. However, methylene chloride is a common laboratory contaminant and may not be indicative of groundwater impacts. Although arsenic exceeded Federal MCLs and Florida Primary Drinking Water Standards in one sample collected in 1991, this has been attributed to the significant turbidity reported in these samples. Aluminum and iron are the only compounds which exceed Federal MCLs and/or Florida Drinking Water Standards. Elevated concentrations of the metals are indicative of the Biscayne Aquifer in South Florida. Thallium was not detected, but the quantitation limit is above Federal MCLs and Florida Drinking Water Standards.

2.6.4 Sediment Investigations

This summary of sediment investigations is presented for the purpose of review only. Sediments have been fully evaluated in the investigation of OU-9, Boundary Canal.

Various sediment samples have been collected from the drainage swale south of Building 159, and the unlined drainage swale after it exits the underground culvert south of OU-5/Site WP-1 south and west of the equipment storage area (Figures 2-2, 2-3, 2-4, 2-5, and 2-6).

Because background sediment samples were not collected during the 1984 Phase II investigation and the 1991 CERCLA investigations at OU-5/Site WP-1, concentrations of constituents detected in the sediment samples collected during the OU-5/Site WP-1 investigations were compared with the background sediment sample, BC-SD-0010, from the 1991 Boundary Canal sampling event. The Boundary Canal background sample was obtained from a location upgradient of all industrial (PSCs) sites at Homestead ARB. Constituents detected in this sample are assumed to not be the result of the past or present industrial waste-handling activities/practices. Sediment sample BC-SD-0010 was analyzed for TCL BNAs, organochlorine pesticides, and TAL metals in 1991.

Two sediment samples were collected in 1984 from the drainage swale located south of Building 159 (Figure 2-2). These sediments were subsequently excavated during the 1995 Interim Action. The sediment samples were analyzed for cyanide and total metals including cadmium, total chromium, copper, lead, nickel, and zinc (Table 2-2). Low concentrations of these constituents were detected in the sediment samples as follows: cyanide concentrations ranged from 0.6 to 3.9 mg/kg, cadmium concentrations ranged from 0 to 0.01 mg/kg, total chromium concentrations ranged from 0.02 to 0.09 mg/kg, copper concentrations ranged from 0.01 to 0.04 mg/kg, lead concentrations ranged from 0.11 to 1.18 mg/kg, nickel concentrations ranged from 0 to 0.01 mg/kg, and zinc concentrations ranged from 0.8-0.13 mg/kg. Concentrations of total chromium, lead, zinc, and cyanide detected in the sediment samples were slightly higher than the concentrations detected in the surficial soil samplescollected during the Phase II investigation in 1984; however, concentrations of chromium, copper, lead and zinc detected in the OU-5/Site WP-1 sediment samples were well below the Boundary Canal background concentrations. Concentrations of cadmium, total chromium, copper, lead, nickel and zinc were well below their respective NOAA ER-L and ER-M values.

The 1991 CERCLA RI included the collection of two sediment and surface water samples in the unlined drainage swale approximately 400 ft south of Building 164 and just south of the equipment storage area (Figure 2-3).

The 1993 RI field activities included the collection of six sediment samples from the drainage areas: the grassy drainage swale east of Building 164, the grassy drainage swale south of Building 159, and the unlined drainage swale south of Building 164, which was also sampled in 1991. Samples SP1-SD-0007 and SP1-SD-0008 were collected from the same locations as SP1-SD-0005 and SP1-SD-0006 (1991). SP1-SD-0012 was collected at the south end of the north/south drainage swale east of Building 164 while SP1-SD-0009 through SP1-SD-0011 were collected from the east/west drainage swale south of Building 159. Sediment samples SP1-SD-0009 through SP1-SD-0012 were subsequently excavated during the 1995 Interim Action. All sediment samples collected in 1993 were analyzed for USEPA TCL organic compounds, TAL metals, andcyanide. Figures 2-3 and 2-4 illustrates the locations of the 1991 and 1993 sediment samples.

In 1994, IT Corporation completed a confirmation sampling program which included the collection of sediment samples from the east/west drainage swale south of Building 159 and the unlined drainage swale which extends south from Building 164. Twenty-one sediment samples were collected from the locations depicted on Figure 2-5. These samples were analyzed for BNAs, pesticides and TAL metals. Based on the results of the 1994 investigation, an Interim Action was performed by IT Corporation in 1995 to excavate affected sediments from the North Area drainages. After excavation, three confirmation samples were collected from the base of the excavation area. Two of the samples, CS-02 and SC-03, were considered to be sediments based on their locations in the drainage system (Figure 2-6).

Interim Action activities involved excavating the sediments to a depth of approximately 1 ft bls at each location. The excavation was extending out 3 ft from the centerline of the drainage swale. During the excavation activities, 12 sediments and 2 soil analytical sampling points from previous investigations were removed (Table 2-4). The results from samples collected at these locations are no longer considered representative of current site conditions.

2.6.4.1 Volatile Organic Compounds. 1991 Investigation. Two VOCs, tetrachloroethene, and trichloroethene, were detected in the 1991 sediment samples (Table 2-7). Tetrachloroethene and trichloroethene were detected in sample SP1-SD-0006 at concentrations of 29 and 12 µg/kg, respectively. These VOCs are not commonly used in the electroplating operations. A possible source for the tetrachloroethene and trichloroethene is the adjacent equipment storage area and motor pool. Tetrachloroethene and trichloroethene are solvents used during degreasing operations as well as other processes associated with automobile maintenance. These constituents may be present in waste oils in minor amounts because through historical waste oil handling practices solvent residue may have become incorporated into the waste oil. These compounds were not detected in the sample (SP1-SD-0008) collected from a similar location in 1993.

1993 Investigation. Six sediment samples plus one duplicate were collected and analyzed during the 1993 field investigations. The samples were identified as SP1-SD-0007 through SP1-SD-0012 plus duplicate sample SP1-SD-9012. Sediment sampling points SP1-SD-0008 through SP1-SD-00012 have been subsequently excavated. Two VOCs were detected: methylene chloride was detected in only one sample (SP1-SD-0010) while acetone was detected in two samples and the duplicate. Sample SP1-SD-0007 contained acetone outside the calibration range of the instrument in the initial analysis. The subsequent dilution showed <16,000 µg/L. The results are considered qualitative only for the positive presence of acetone although a quantity was not reported. Samples SP1-SD-0012 and SP1-SD-90012 reported acetone at 8 and 15 µg/L, respectively. These values are less than the CRQL. As previously discussed, acetone has been widely detected throughout Homestead ARB and has been identified as an artifact of the isopropyl alcohol used during field decontamination.

Acetone does not appear to be a soil/sediment contaminant at OU-5/Site WP-1. Additional discussion of the presence of acetone is provided in the QCSR provided to the USACE, Omaha-District.

The methylene chloride detected at 8 µg/L is below the CRQL. As previously discussed, this compound is a common contaminant in laboratories. Though not reported in an associated blank, it is unlikely, at the reported concentration, to be a site contaminant. Table 2-11 summarizes constituents detected during the 1993 investigation.

1994 and 1995 Interim Action. The sediment samples collected during the 1994 Confirmation Sampling and 1995 Interim Action were not analyzed for VOCs.

2.6.4.2 Base Neutral/Acid Extractable Compounds. 1991 Investigation. Several BNA compounds (mainly PAHs), including acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene, were detected in the two sediment samples collected south of the equipment storage area. For the most part, concentrations of PAHs detected in sediment samples SP1-SD-0005, SP1-SD-9005, and SP1-SD-0006 were above concentrations detected in background sample, BC-SD-0010 (Table 2-7).

The unlined drainage swale sampled contains surface-water intermittently, after rain storms, and it does not support aquatic life. To be consistent with other Homestead ARB site investigations, the PAH concentrations detected in these sediment samples were compared with National Oceanic and Atmospheric Administrative effects range-low and effects range-median (NOAA ER-L and ER-M) values and sediment quality criteria (SQC) values, which are indicators of risk to aquatic life. Concentrations of anthracene, benzo(a)pyrene, benzo(a)anthracene, chrysene, dibenzo(a,h)anthracene, fluoranthene, phenanthrene, and pyrene detected in sediment samples SP1-SD-0006 and SP1-SD-0005 (and/or its duplicate SP1-SD-9005) were above the NOAA ER-L and ER-M values for these constituents. The concentrations of acenaphthene and fluorene detected in sample SP1-SD-0005 were above both their respective NOAA ER-L and ER-M values and the concentrations detected in SP1-SD-0006 were above their respective NOAA ER-L value.

Based on USEPA guidance for sediment samples with an unknown organic carbon content, sediment quality criteria for sediment containing one percent organic carbon were compared to the unlined drainage swale sediment samples. SQC for benzo(a)anthracene and benzo(a)pyrene were exceeded in samples SP1-SD-0005 and SP1-SD-9005 and the SQC for fluoranthene, pyrene, and phenanthrene were exceeded in samples SP1-SD-0005, SP1-SD-9005, and SP1-SD-0006. PAHs are not commonly associated with electroplating operations. Possible sources for the PAHs are the adjacent equipment storage area and motor pool and road runoff. PAH compounds are commonly present in waste automotive oil and asphalt.

Additionally, two non-PAHs were detected in the sediment samples including bis(2-ethylhexyl)phthalate, which was detected in samples SP1-SD-0005 and SP1-SD-0006 at concentrations of 6100 and 1700 µg/kg, respectively, and dibenzofuran which was also detected in sample SP1-SD-0005 at a concentration of 2000 µg/kg. Concentrations of bis(2-ethylhexyl)phthalate detected in sediment samples SP1-SD-0005 and SP1-SD-0006 were above background concentrations detected in BC-SD-0010. Dibenzofuran was not detected in the background canal sediment.

1993 Investigation. Six sediments and one duplicate sample were collected and analyzed for TCL BNA compounds. Four of the 1993 sediment sampling locations have undergone excavation during the 1995 Interim Action. Sediments from SP1-SD-0009 through SP1-SD-0012 are no longer considered representative of site conditions. Eighteen PAHs were detected, as well as four phthalate compounds, dibenzofuran, carbazole, naphthalene, 2-methylnaphthalene, and 2,6-dinitrotoluene. The BNA compounds listed in Table 2-11 are similar to the compounds detected in 1991 (Table 2-7). Sample SP1-SD-0007 and SP1-SD-0008 collected in 1993 correspond to the same locations sampled in 1991 and identified as SP1-SD-0005 and SP1-SD-0006. The compounds detected in 1991 were reported at much lower concentrations in 1993 data. Concentrations of PAHs detected in sample SP1-SD-0007 were lower than the PQLs of the background sample (BC-SD-0100) used for comparison by G&M. With the exception of SP1-SD-0007 the PAH quantities reported are above the NOAA Median Effect Range for sediment quality. The concentrations of individual PAH compounds range from 5 µg/kg (2-methylnaphthalene) to in excess of 45,000 µg/kg of chrysene; 49,000 µg/kg fluoranthene; and 110,000 µg/kg pyrene in sample SP1-SD-0010.

The highest concentrations of PAHs occur in the east/west drainage swale located south of Building 159 in samples SP1-SD-0010 and SP1-SD-0011. These samples have been subsequently excavated. SP1-SD-0012 contained concentrations of PAHs at values comparable to SP1-SD-0011. Sample SP1-SD-0012 was collected from the southern end of the open drainage swale east of Building 164. Samples SP1-SD-0009 contained the same

PAHs as SP1-SD-0010 but in lower quantities. SP1-SD-0009 is downstream of the directional flow in the drainage swale from SP1-SD-0010. Samples SP1-SD-0007 and SP1-SD-0008 were collected further downstream of the directional flow of all the previously discussed samples. The two sediments, SP1-SD-0007 and SP1-SD-0008, contained the lowest quantity of detected PAHs for OU-5/Site WP-1.

Observations made during the March 1, 1993 investigation, indicated that a large diesel powered generator was operating approximately 20 ft northeast of monitor well I-03. An apparent fuel spill was observed during this event, which is believed to have occurred during fueling of the 250-gallon diesel fuel tank used to run the generator. Fuel was observed in the north-south drainage swale to the east of Building 164. This area corresponds with sample point SP1-SD-0012.

Dibenzofuran was detected in all the 1993 sediment samples at quantities ranging from 3 µg/kg to 1,100 µg/kg (SP1-SD-0010). All reported quantities were below the CRQL and therefore are estimated. Di-n-butyl phthalate was detected in two samples, SP1-SD-0007 (23 µg/kg) and SP1-SD-0011 (570 µg/kg). This compound was also reported in the associated lab blank. Both reported sample values are below the CRQL and are evaluated as non-detects in the QCSR. Two additional phthalates were detected: benzyl butyl phthalate and bis(2-ethylhexyl)phthalate, at levels ranging from 53 µg/kg to 4,000 µg/kg (SP1-SD-0012, bis(2-ethylhexyl)phthalate). Carbazole was detected in five of the six sediment locations ranging from 330 to 8,000 µg/kg (SP1-SD-0010). Only the 8,000 µg/kg result was above the CRQL.

Naphthalene was detected in two sediment samples SP1-SD-0009 and SP1-SD-0012 at 320 and 130 µg/kg, respectively. 2-methylnaphthalene was detected in all sediments except SP1-SD-0008 at ranging from 6 µg/kg to 79 µg/kg. All reported values are below the CRQL. Naphthalenes were not reported as detected in the background canal sediment. Naphthalenes have not previously been detected at OU-5/Site WP-1 and are not an anticipated by-product of electroplating operations.

The duplicate sample, SP1-SD-9012 contained 540 µg/kg of 2,6-dinitrotoluene. No other samples collected at this site had reported 2,6-dinitrotoluene at detectable quantities.

Concentrations in the sediments are higher than those detected in the soil samples collected at OU-5/Site WP-1 during any of the previous investigations. However, 1993 sediment results for samples collected from the drainage swale 400 ft south of OU-5/Site WP-1 were lower than at the same locations sampled in 1991.

1994 and 1995 Interim Action. Twenty-one sediment samples were collected and analyzed for BNAs during the 1994 confirmation sampling program (Figure 2-5). Nine PAH compounds were reported in most of the sediments collected during the 1994 sampling event. The PAHs include; phenathrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthtene, and benzo(a)pyrene. Addition BNAs detected in one or more of the samples include; acenapthene, acenaphylene, fluorene, bis(2-ethylhexyl)phthalate, indeno(1,2,3-c,d)pyrene, benzo(g,h,i)perylene, and dibenz(A,H)anthrancene.

The 1994 sediment sample concentrations in the east/west drainage ditch east of Building 164 and north of Building 153 include samples EWA-8 through EWA-17. Concentrations of PAHs in this drainage are highest in the EWA-9, EWA-11, and EWA-12 samples (Table 2-11). This is likely a result of their location immediately adjacent to areas which receive runoff from roadways and asphalt pavement. Concentrations of PAHs at these locations ranged from 3,100 µg/kg to 41,000 µg/kg. Sediments associated with the samples EWA-1 and EWA-12 have subsequently been excavated. The two 1995, post excavation samples, CS-02 and CS-03 have as much as one to two orders of magnitude lower concentrations of PAH compounds than the pre-excavation samples. Benzo(a)anthracene, fluoranthene, and pyrene in the post excavation sediment sample CS-02 are greater than 2 times the background sediment concentration.

Similarly, in the South Area, the PAH sediment concentrations are slightly elevated in samples EWA-18, EWA-19, EWA-20, and EWA-22. These points are the uppermost points in the South Area, just below the culvert (Figure 2-5). PAH concentrations may be slightly more elevated at these points due to runoff passing through the culvert and potentially dissipating quickly into the underlying formations. Concentrations of PAHs in the South Area range from 3,300 µg/kg to 55,000 µg/kg. There were no excavation activities in the South Area. Sediment concentration from the 1994 Confirmation Sampling and 1995 Interim Action have been summarized on Table 2-11.

2.6.4.3 Organochlorine Pesticides/PCBs. 1991 Investigation. Sediment samples were not analyzed for organochlorine pesticides/PCBs in the 1991 investigation.

1993 Investigation. Of the six sediments collected during the 1993 investigation only SP1-SD-0008 showed no pesticide presence. This sample did, however, contain a reported 870 µg/kg of PCB 1260 (Table 2-11). This is below any Toxic Substances Control Act (TSCA) PCB spill cleanup guidelines (40 CFR 761.120). Field observations of March 1,1993, noted a downed power line and pole east of well I-03. A transformer was not observed in the area.

The other five sediments plus the duplicate contained p'p'-DDT, p'p'-DDE, p'p'-DDD, and alpha- and beta-chlordane. The highest concentrations of DDT (1,200 µg/kg) and the chlordanes (2,400 and 2,800 µg/kg), were at SP1-SD-0012. The downstream samples showed lower concentrations of all pesticides detected. The full extent and source of pesticide contamination was not determined during this investigation. It is possible that local use of these pesticides has contributed to the concentration in sediments via surface run-off.

1994 and 1995 Interim Action. Organochlorine pesticides were analyzed for in the 1994 and 1995 sediment samples. However, PCBs were only analyzed for in the two 1995 post excavation sediment samples. The primary pesticides detected in the 1994 and 1995 sediment samples were DDT and its metabolites and chlordane. Concentrations of DDT and its metabolites ranged from 7.9 µg/kg to 620 µg/kg, while chlordane ranged from 82 µg/kg to 1,500 µg/kg. The highest reported concentrations of pesticide in the North Area were associated with sample EWA-11 and EWA-12. Pesticide concentrations in the 1995 post excavation samples are consistent with the pre-excavation concentrations in sample CS-02 and at reduced levels in sample CS-03.

In the South Area, higher concentrations were associated with sample EWA-18. As with the BNA compounds, pesticides levels appear to be concentrated at the exit point of the culvert which may be due to transport of contaminants through the culvert and then once it exits rapidly infiltrate into the underly formation. Pesticides have been used throughout the Homestead-ARB. The concentrations observed at the Base are indicative of these orthopogenic sources. A summary of pesticide results from the 1994 Confirmation Sampling and 1995 Interim Action are presented in Table 2-11.

2.6.4.4 Metals and Cyanide. 1991 Investigation. During the 1991 investigation, two sample points were collected from approximately 400 ft south of the defined area of OU-5/Site WP-1. TAL metals detected in the sediment samples included aluminum, barium, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, sodium, vanadium, zinc, mercury, arsenic, and lead. As previously discussed, these metals are commonly detected in limestone. Concentrations of most constituents detected in the sediment samples were below average carbonate concentrations except for the trace metals, barium, cadmium, chromium, cobalt, copper, zinc, arsenic, mercury, and lead, which were above concentrations given for the average carbonate composition (Hem, 1989). In addition, concentrations of aluminum, barium, cadmium, chromium, cobalt, copper, iron, magnesium, manganese, vanadium, zinc, mercury, arsenic, lead and cyanide detected in at least one of the sediment samples collected were above background soil concentrations detected for OU-5/Site WP-1.

Concentrations of barium, chromium, iron, lead, mercury, vanadium and zinc detected in sediment samples SP1-SD-0005, SP1-SD-9005, and SP1-SD-0006 were greater than the concentrations of these metals detected in the background sample, BC-SD-0010. In addition, concentrations of cadmium detected in samples SP1-SD-0006 and SP1-SD-9005, copper in sample SP1-SD-9005, and concentrations of arsenic detected in samples SP1-SD-0005 and SP1-SD-9005 were above background concentrations of these metals detected in sample BC-SD-0010. Concentrations of barium, lead, mercury, and zinc detected in samples SP1-SD-0005 and its duplicate, SP1-SD-9005, located closest to the equipment storage area contained the highest concentrations above background.

Concentrations of chromium detected in sample SP1-SD-0005 exceeded the NOAA ER-L and ER-M values. Concentrations of zinc in samples SP1-SD-0005, SP1-SD-9005 and SP1-SD-0006 exceeded the NOAA ER-L values and concentrations detected in SP1-SD-0005 and SP1-SD-90005 exceeded the NOAA ER-M value. Sediment samples SP1-SD-0005, SP1-SD-9005 and SP1-SD-0006 contained mercury concentrations which exceeded the NOAA ER-L value, and additionally, the concentration of mercury detected in sample SP1-SD-0005 exceeded the NOAA ER-M value. Lead concentrations detected in samples SP1-SD-0005 and SP1-SD-9005 exceeded the NOAA ER-M and ER-L values and sample SP1-SD-0006 exceeded the NOAA ER-L value. Table 2-7 summarizes metals detected in the 1991 sediment samples.

Cyanide was detected in sample SP1-SD-9005 at a concentration of 2.2 mg/kg. Because of the distance from OU-5/Site WP-1 and the time elapsed since the Electroplating Facility was in operation, OU-5/Site WP-1 is an unlikely source for the cyanide. Additional sources of cyanide include herbicides, rodenticides, insecticides, and fungicides.

1993 Investigation. Metals analyses were performed on the six sediment samples collected in 1993 (Figure 2-4). Four of the sampling point were subsequently excavated during the 1995 Interim Action. The metals detected during the 1993 sampling activities are the same metals detected in 1991 with the addition of antimony and potassium. However, the antimony values reported in 1993 are all below the PQLs reported for the 1991 samples. The sampling in 1993 was more extensive and include drainage swales within the OU-5/Site WP-1. Table 2-11 summarizes the 1993 investigation results for sediments.

Aluminum, calcium, cobalt, magnesium, and sodium values are similar to background concentrations in the Boundary Canal. The iron, manganese, nickel, potassium, and vanadium concentrations reported are less than the average carbonate compositions for those analytes.

Barium is below the carbonate composition (30 mg/kg) at SP1-SD-0012 and SP1-SD-0010, but considerably above the average at SP1-SD-0007 (635 mg/kg), and SP1-SD-0009 (201 mg/kg). Cadmium was detected at all points in the range of 1.6 to 4.6 mg/kg with the highest concentration at SP1-SD-0011. Chromium was detected in all samples (15-810 mg/kg) with the highest concentration at SP1-SD-0009). All values for chromium were above background and average carbonate concentrations. Copper was detected in all samples (14.6 to 61.1 mg/kg) with only 1 sample result below the Boundary Canal background value.

Lead values ranged from 87.6 to 1,180 mg/kg. Mercury was detected at five of the six sampling locations. Sample SP1-SD-0008 contained <0.11 mg/kg mercury. Concentrations at the other sampling points ranged from 0.25 to 4.4 mg/kg mercury with SP1-SD-0009 the highest reading. Zinc concentrations ranged from 58.9 to 612 mg/kg.

The reported values for antimony, arsenic, barium, chromium, iron, lead, and zinc are qualified as qualitative data due to technical difficulties encountered during analysis. The primary source of these technical interferences is the high calcium inherent in these samples from south Florida. Additional discussion of these technical interferences and the qualification of this data is presented in the associated QCSR.

The concentration reported for cobalt, potassium, sodium, and most of the nickel values are below the CRQL.

In summary, the highest metals concentrations generally occur in the grassy east/west drainage swale south of Building 159. The elevated lead concentration (1,180 mg/kg) is considered to be representative of a limited area within the swale and is considered an isolated detection. This sample point has been subsequently excavated. Sample point SP1-SD-0007 also shows higher concentrations of metals than downstream sample SP1-SD-0008.

Cyanide was not detected in any of the sediment samples collected during the 1993 investigation.

There were no significant differences in the sediment analytical results for samples collected in 1991 from samples collected in 1993 at sites SP1-SD-0005 and SP1-SD-0006, and SP1-SD-0007 and SP1-SD-0008.

1994 and 1995 Interim Action. Twenty-one sediment samples were collected and analyzed for TAL metals in 1994 and two sediments in 1995 from the locations depicted in Figures 2-5 and 2-6, respectively. Metal analytical results for the 1994 sediment samples indicated concentration above the method detection limit for each of the TAL metals except for cadmium, cobalt, nickel potassium, thallium, and vanadium. The metals arsenic, barium, chromium, lead, mercury, and zinc were detected at higher concentrations in sediment samples than soil samples. Arsenic concentrations ranged from 2 mg/kg: to 34 mg/kg. Six of the 1994 sediment samples exceed the soil CAL of 10 mg/kg established for Homestead ARB. Of those 6 sediments, 5 sample locations were subsequently excavated. Arsenic concentrations from the two post excavation samples are 25 mg/kg (CS-02) and 22 mg/kg (CS-03). -

The ranges of concentrations for the remaining elevated metal compounds were 20.9 mg/kg to 5,290 mg/kg for barium; 44.3 mg/kg to 116 mg/kg for chromium; 157 mg/kg to 1210 mg/kg for lead; 0.13 mg/kg to 4.2 mg/kg for mercury; and 152 mg/kg to 954 mg/kg for zinc. Sediment concentrations exceeded CAL in only one sample for barium and all samples for lead. However, only one sample exceeded the State of Florida Health-Based Soil Target Level for lead. This sample (EWA-10) was subsequently excavated. With the exception of arsenic and lead, 1995 post excavation sediments were below the CAL and State of Florida Health-Based Soil Target Levels. Sediments analytical results for the 1994 Confirmation Sampling and 1995 Interim Action are summarized in Table 2-11.

2.6.4.5 Summary for Sediment. The two chlorinated VOCs detected at low concentrations in 1991 were probably associated with an adjacent equipment storage area. They were not detected in 1993. However, acetone and methylene chloride were detected, but are related to the field decontamination solvent and laboratory contamination, respectively.

Phthalates were detected in 1991 and 1993. These compounds are commonly observed when water has come in contact with plastics. No criteria are proposed for phthalates in sediment.

PAHs were detected in sediments. The most likely source of PAHs detected in the 1991 through 1995 sediment samples is run-off from the roadways and asphalt parking lots which are part of OU-5/Site WP-1. Also, in 1993 a leak from a diesel generator was observed following into one of the drainage swabs. PAHs and phthalates are not associated with electroplating wastes.

The metals detected in 1991 were comparable to the Boundary Canal background sample with the exception of mercury and zinc. Metals detected in 1993 were significantly higher then in 1991. Similarly, the metals arsenic, barium, chromium, lead, mercury, and zinc were detected at higher concentrations in 1994 and 1995 than in 1993. Arsenic and lead were the only metals detected which exceed CAL or State of Florida Health-Based Soil Target Levels. Cyanide was not detected in any of the sediment samples collected in 1991, 1993, or 1995.

Pesticides and PCBs were analyzed during the 1993 investigation only. PCB 1260 was detected at very low levels at one location. DDT, DDT metabolites, and chlordane were detected in sediment samples collected from 1994 through 1995. Pesticides have been observed in soil and sediment samples throughout Homestead ARB.

The significant and potential human health and environmental impacts of occurrences of constituents detected in drainage ditch sediments and surface water have been fully evaluated in the *Final OU-9 Remedial Investigation Report* (Woodward - Clyde, November 1995).

2.6.4 Surface Water Investigation

Due to the presence of surface water in the OU-5/Site WP-1 drainage ditches observed only during periods of heavy rain, surface water samples were only collected during the 1991 Investigation. In addition, surface water impacts of the Base ditches and canals have been evaluated further in the OU-9 Boundary Canal RI/RA. During the 1991 investigation, two surface-water samples were collected at the same locations as the sediment samples (Figure 2-3). Table 2-8 provides a summary of the compounds detected in the surface waters collected in 1991.

1991 Investigation. Two VOCs, acetone and methylene chloride, were detected in surface-water samples below the CRQL.

Several BNAs, mainly PAHs, were detected in the surface-water samples. Benzo(b)fluoranthene was detected in samples SP1-SW-0006 and SP1-SW-9005 at concentrations of 22 and 2.0 µg/L, respectively. Pyrene was detected in samples SP1-SW-0005, SP1-SW-90005, and SP1-SW-0006 at concentrations of 1.8, 2.4, and 27 µg/L. Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, and phenanthrene were detected in sample SP1-SW-0006 at concentrations of 0.96, 15, 14, 17, 26, and 6.8 µg/l, respectively. Fluoranthene was detected in samples SP1-SW-0005, SP1-SW-90005, and SP1-SW-0006 at concentrations of 3.6, 3.6, and 41 µg/L. PAHs are not commonly associated with electroplating operations but are present in waste automobile oils and fuels. The runoff from the equipment storage area and motor pool area or from the road would be a likely source of these contaminants.

Although the unlined drainage swale contains surface water intermittently, only during and after rain storms, the Class III Florida Surface-water Quality Standards for recreation and fish and wildlife were used to be consistent with investigations conducted at other Homestead ARB sites. TAL metals detected in the surface-water samples includes aluminum, barium, cadmium, calcium, chromium, copper, iron, magnesium, manganese, potassium, silver, sodium, vanadium, zinc, mercury, and lead. Aluminum, barium, calcium, magnesium, manganese, potassium, sodium, and vanadium are nutrients and there are no surface-water quality standards available for these constituents. The cadmium, copper, iron, silver, and mercury concentrations detected in sample SP1-SW-0006 exceeded their respective Florida Surface-water Quality Standards and the Federal Water Quality Criterion for these constituents. The concentrations of lead and zinc detected in samples SP1-SW-0005, SP1-SW-9005, and SP1-SW-0006 exceeded the Florida Surface-water Quality Standard and Federal Water Quality Criterion. Additionally, the detection limit for cyanide exceeded the Florida Surface-water Quality Standard and the Federal Water Quality Criterion of 5 and 5.2 µg/L, respectively.

2.6.4.1 Summary for Surface Water. Several PAHs were detected at low levels in surface water during the 1991 investigations. These concentrations are most likely the result of dissolution from the sediment when surface water is present primarily during the wet season or from surface runoff during frequent rainfall. The VOCs detected at very low levels are most probably laboratory or field contaminants.

Zinc, lead and cyanide were the only inorganics detected which exceeded water quality standards and/or criterion. The source of these constituents is most likely local runoff associated with frequent rainfall.

The significant and potential human health and environmental impacts of occurrences of constituents detected in drainage ditch sediments and surface water will be fully evaluated in the *Final OU-9 Remedial Investigation Report* (Woodward - Clyde, November 1995).

2.6.6 Potential Routes of Migration

Contaminants may migrate from a source area through a variety of processes. Volatile contaminants may be released into air and migrate in the vapor phase. Liquid or aqueous-phase contaminants may migrate to both soils and groundwater through direct infiltration. Erosion related to surface runoff or wind may transport contaminants sorbed to surface soils. Infiltrating precipitation may dissolve contaminants and carry them into deeper soils where they can be adsorbed, or into groundwater in the dissolved phase. Dissolved phase contaminants may be carried in the down gradient direction by groundwater flow in an aquifer.

Although other contaminated media are present at OU-5/Site WP-1, the principal route of migration of contaminants is through shallow groundwater. The impacts associated with the surface water and sediment samples have been further evaluated in the OU-9, Boundary Canal RI/RA. Past activities allowed contaminants to enter soil and surface water, which eventually migrated to shallow groundwater. Migration of contaminants via surface water occurs intermittently, during storm events.

OU-5/Site WP-1 and its drainages are situated on a developed portion of the Base which includes buildings, roads, and parking areas. The cycle of water through the site begins with precipitation. During rainfall events, water percolates rapidly through the limestone and weathered limestone bedrock underlying the site. Surface water runoff is over land to one of the drainage swales or ditches located in the immediate area of the site. The drainage swales and canals provide adequate surface water drainage for this site and are typically dry during non-storm events. Given the highly transmissive underlying formation, rainwater and surface water will typically infiltrate rapidly into the shallow aquifer system. It is estimated that horizontal groundwater movement can be on the order of tens of feet during a single rainfall event. Once the rainfall ceases, the water table returns to near static conditions and groundwater movement decreases dramatically.

Between rainfall events, evaporation from the surface soils returns water from the aquifer to the atmosphere. The rate of loss is greatest with open water bodies and decreases with increasing distance from the water table.

The natural concentrations of chemicals in the soil, rock, and water have a controlling effect on the fate and transport mechanisms. Soils at the site exist primarily as a veneer on the bedrock surface. A considerable amount of the OU-5/Site WP-1 area is covered by asphalt, roads, or buildings. The soil has both organic and iron precipitants. Nevertheless the calcium carbonate from the underlying oölite is the primary mineral present. The site drainage swales also receive runoff from the asphalted parking area located east of Building 164.

2.6.7 Exposure Assessment

This section of the risk assessment identifies and describes potential human receptors, reviews possible pathways of exposure for compounds of concern at OU-5/Site WP-1, and presents estimates of exposure doses resulting from identified pathways at OU-5/Site WP-1. An exposure assessment is conducted to identify potential sources and mechanisms of release, transport pathways (e.g., groundwater, surface water, soil, and air), routes of exposures (ingestion, inhalation, dermal contact), and potential on-site and off-site receptor populations (current users of the site, as well as adjacent populations which may be exposed to chemicals that have been transported off-site). This information provides the basis for constructing site-specific exposure scenarios.

Two environmental media were considered in this document - groundwater and surface soil. It should be noted that guidance on what depth range should be used for surface soil differs between the USEPA (0 to 12 inches) and the Florida DEP (0 to 24 inches). Samples taken between 0 and 24 inches below land surface (bls) were considered surface soil samples, so receptor exposure during gardening or landscaping activities could be evaluated in this assessment. This choice seems reasonable for south Florida, as the year-round, mild climate would permit possible residential gardening and frequent landscaping activities on base. No subsurface soil sampling was conducted because most soil layers at OU-5/Site WP-1 are only one to two inches deep and the underlying layers are composed of limestone and bedrock. Furthermore, the sediment and surface water samples collected at OU-5/Site WP-1 from the area canals and drainage ditches are not evaluated in this document. The potential human health effects due to exposures associated with the canal system are addressed in the BRA for OU-9, Boundary Canal Evaluation, which will be submitted as a separate report.

Other information considered in the development of present and future exposure scenarios includes: physical characteristics of the site and surrounding area such as climatology, groundwater hydrology, location and description of surface water and surrounding land use and available state-specific guidelines relevant to exposure and risk assessments.

A critical step in assessing the potential risk to public health is to identify the pathways through which exposure could occur. A typical transport pathway consists of four necessary elements: 1) a source and mechanism of chemical release, 2) an environmental transport medium, 3) a point of potential contact with the contaminated medium, and 4) an exposure route (inhalation of vapors, ingestion of groundwater, etc.). All four of these elements must be present for a pathway to be complete.

Exposure Point Concentration. In accordance with USEPA methodology (1989a), the medium-specific 95 percent UCL on the arithmetic mean concentrations for the COPCs will be used as exposure point concentrations (EPCs) to estimate reasonable maximum exposure (RME). The RME approach is suggested by the USEPA (1989a) to provide an estimate of the maximum exposure (and therefore risk) that might occur. The RME corresponds to a duration and frequency of exposure greater than is expected to occur on an average basis. In those instances where the calculated 95 percent UCL exceeds the maximum detected concentration, the maximum detected concentration was used as the EPC for a more accurate estimate of RME concentration (USEPA, 1999a).

The total number of samples collected, as well as the sources of the data used in the risk assessment and included in the database for the calculation of each COPC exposure point concentration, varied by medium.

Once the database for each medium was developed, the 95 percent UCL concentration on the arithmetic mean concentration (one-tailed test, assuming a lognormal distribution) was calculated and compared to the maximum COPC concentration to determine the EPC for each COPC. The results of these analyses for the sampled media are presented in Tables 2-13 and 2-14. The information presented in these tables is discussed in the following subsections. An example of the data reduction used to calculate the arithmetic mean and UCL for each COPC is shown in Table 2-15.

Exposure Scenarios. Exposure pathways identified at OU-5/Site WP-1 are shown in Table 2-16 and are associated with soils or groundwater. With the exception of the VOCs, the chemicals detected at the site have low environmental mobility.

TABLE 2-13

EXPOSURE POINT CONCENTRATIONS FOR GROUNDWATER
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida

Constituent	Number of Samples in Groundwater Database[1]				UCL Concentration[2] (Fg/l)	Maximum Detected Concentration (Fg/l)	Mean Concentration (Fg/l)	Value Used in Risk Calculation s[3]
	Geraghty & Miller 1991	Mongomery Watson 1993	OHM 1996	Total Number Samples Averaged 1991-93				
VOCs								
Bromodichloromethane	4	1	4	9	4.8	2	3.6	3.6
Chloroform	4	1	4	9	4.8	2	3.6	3.6
Methylene Chloride	4	1	4	9	5.5	7	3.3	3.3
BNAs								
Bis(2-Ethylhexyl)phthalate	4	1	4	9	1500	320	38.5	38.5
METALs								
Aluminum	4	1	4	9	202,228,118	24000	4266.3	4266.3
Arsenic	4	1	4	9	83.2	92	26.3	26.3
Barium	4	1	4	9	203.7	150	37.2	37.2
Chromium	4	1	4	9	486.7	130	29.2	29.2
Lead	4	1	4	9	259.8	30	7.3	7.3
Manganese	4	1	4	9	170133.5	200	44	44
Nickel	4	1	4	9	42.3	8	10.8	10.8
Vanadium	4	1	4	9	151.7	82	16.4	16.4

Fg/L micrograms per Liter

[1] Count does not include duplicates; a duplicate sample was collected atone well (SP1-1-02) for each sampling program.

[2] The UCL concentration was calculated assuming a lognormal distribution of the data.

[3] As per Region IV Guidance, the arithmetic mean of the wells in the plume (assumed to be the entire site) was used as the exposure point concentration.

TABLE 2-14

EXPOSURE POINT CONCENTRATIONS IN SURFACE SOIL SAMPLES
SITE WP-1/OUT-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida

Chemical	Geraghty & Miller 1991[1]	Montgomery Watson 1993[2]	IT Corp 1994[3]	IT Corp 1995[4]	Total No. of Samples	UCL Concentration[5]	Maximum Detected Concentration	Value Used in Risk Calculations[6]
BNAs (Fg/kg)								
Benzo(a)pyrene	4	1	5	1	11	2.05E+06	460	460
Pesticides (Fg/kg)								
4,4'-DDD	0	4	3	1	8	87989	1,400	1,400
Chlordane Isomers	0	4	3	1	8	1.47E+06	1,400	1,400
TRPS (TICs) (mg/kg)	0	1	0	0	1	----	3,322	3,322
Metals (mg/kg)								
Aluminum	4	1	5	1	11	6,453	9,270	6,453
Arsenic	4	1	5	1	11	7.8	9.7	7.8
Cadmium	4	1	5	1	11	26.4	1.4	1.4
Chromium	4	1	5	1	11	18	23.4	18.0
Copper	4	1	5	1	11	226	160	160
Lead	4	1	5	1	11	543	120	120
Manganese	4	1	5	1	11	184	230	184
Mercury	4	1	5	1	11	0.15	0.4	0.2
Nickel	4	1	5	1	11	509	300	300
Vanadium	4	1	5	1	11	12.4	14.7	12

Fg/kg	Micropams per kilogram
mg/kg	Miligram per kilograrn
--	Not calculated due to low number of samples.

When a location was sampled in duplicate, the data is combined for risk assessment and is reported as one sample collected.

(1) Geraghty & Miller, 1991 Data Points: SP1-SL-0001, SP1-SL-0002, SP1-SL-0003, SP1-MW-0001-S.
(2) Montgomery Watson 1993 Data Points: SP1-SL-0004, SP1-SL-0005, SP1-SL-0007.
(3) IT Corporation 1994 Data Points; EWA1, EWA2, EWA3, EWA4, EWA5.
(4) IT corporation 1995 Data Points: CS-01.
(5) The UCL concentration was calculated assuming a lognormal distribution of the data.
(6) The UCL concentration is used as the exposure point concentration unless it is greater than the maximum detected concentration, in which case the maximum detected concentration is used.
(7) A UCL concentration was determined for lead in surface soil for use in the IEUBK model which was necessary since lead is a COPC in groundwater. In the dataset, 11 samples were collected, the maximum concentration is 120 mg/kg, and the UCL is 543 mg/kg. Therefore the maximum concentration was used as the exposure point concentration (120 mg/kg).

TABLE 2-15

EXAMPLE DATA REDUCTION CALCULATION FOR ARSENIC IN SURFACE SOIL SAMPLES AT SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida

Sample Designation	Analytical Result (mg/kg)	Value Used (1) (mg/kg)	Log Transformed Data
EWA1 (1 ft), 1994	0.43B	0.43	-0.844
EWA2 (1 ft), 1994	<0.45	0.23	-1.492
EWA3 (1 ft), 1994	<1.5	0.75	-0.288
EWA4 (1 ft), 1994	0.56B	0.56	-0.580
EWA5 (1 ft), 1994	<0.41	0.21	-1.585
CS-01 (1 ft), 1995	6.9	6.9	1.932
SP1-SL-0007 (0-1 ft), 1993	9.7N	9.7	2.272
SP1-SL-0001 (0-1 ft), 1991	0.26	0.26	-1.347
SP1-SL-0002 (0-1 ft), 1991	0.61	0.61	-0.494
SP1-SL-0003 (0-1 ft), 1991	1.5	1.5	0.405
SP1-SL-MW-0001A (0-1 ft), 1991	0.83	0.83	-0.186

$$\text{UCL} = e^{\bar{x} + \left(0.5s^2 + \frac{sH}{\sqrt{n-1}}\right)}$$

where:

Arithmetic mean of transformed data	$\bar{\chi} = -0.201$
Total number of samples	$n = 11$
Degrees of freedom	$n - 1 = 10$
Standard Deviation	$s = 1.287$
H-statistic of transformed data (∝=0.05)	$H = 3.5$
Upper Confidence Limit (in mg/kg)	UCL = 7.79

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(1) All statistics were calculated using one-half the detection limit for non-detects, where applicable.

TABLE 2-16

POTENTIAL PATHWAYS OF EXPOSURE TO CHEMICALS PRESENT IN SITE SAMPLES AT SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

Medium	Pathway/Route	Potentially-Exposed Population	Comments
Groundwater (potable use)	Ingestion, dermal contact, and inhalation of constituents in groundwater.	None currently identified. Hypothetical future on-site residents unlikely due to nature and history of site.	No potable wells are located between Site WP-1 and the groundwater discharge point (drainage ditches or Boundary Canal). No active potable wells are located within a 1-mile radius of the site. Future potable use of groundwater is unlikely due to high total dissolved solids associated with salt-water intrusion.
Surface Soil	Incidental ingestion of and dermal contact with affected surface soils/dust and inhalation of affected dust.	Current base workers accessing site to cut the grass. Future construction workers excavating soils.	Most of the site is covered with sparse grass or gravel, so contact with soil, dust, or volatilized constituents is possible.
Surface Soil	Incidental ingestion of and dermal contact with affected surface soils/dust and inhalation of affected dust.	Hypothetical future residents could be exposed to constituents in soils.	The potential for future development of the site is limited due to the surrounding land use.

Under present conditions, access to the site is limited primarily to base workers performing duties that might require site access, such as cutting the grass. COPCs detected in the surface soils include one BNA, two pesticides, nine metals, and TRPH. Base workers cutting the grass at the site could be exposed to the soils via direct contact with exposed arms and face, incidental ingestion of soils that might adhere to the hands, and inhalation of dusts or vapors generated while cutting the grass. The site is sparsely vegetated, therefore, potential exposure rates will not be reduced by a vegetation factor.

If the operation of Homestead ARB is to continue in the future, exposure pathways at the site are unlikely to change. Given the location of OU-5/Site WP-1 in the midst of base administration activity, future development of this area for intensive base operations is unlikely. Foreseeable future use conditions at the site would result in potential exposure pathways similar to those discussed for present site conditions. However, it should be noted, that damage from the hurricane would necessitate construction activities regardless of future land use.

Under current reuse plans, OU-5/Site WP- 1 will be under cantonment of the US Air Force Reserve. Therefore, reuse of OU-5/Site WP-1 for residential purposes is unlikely in the foreseeable future. However, for risk characterization, hypothetical future residents were considered as receptors. Exposure pathways for hypothetical future residents would include direct contact with the surface soils, incidental ingestion of the surface soils, and inhalation of fugitive dust or vapors.

Hypothetical future construction workers were included in the risk characterization. Exposure pathways for future hypothetical construction workers would include ingestion and inhalation of soil. This receptor is evaluated for only surface soils (less than two feet) as no subsurface soil (greater than two feet) is expected at the site since most soil layers are usually one to two inches deep and the underlying layers are composed of limestone and bedrock.

Although it is unlikely that potable wells would be installed in the vicinity of the site, a conservative assumption made in this risk assessment is that a potable well is installed in the groundwater plume, downgradient of the site. Exposure of hypothetical future residents to affected groundwater via ingestion, inhalation, and dermal contact are considered potential exposure pathways.

In summary, workers cutting the grass on the site w ill be used to represent current exposure to the on-site soils. In the unforeseen event that the site is no longer under cantonment of the

US Air Force Reserve, hypothetical future exposure pathways considered included residential development of the site. Table 2-16 and Figure 2-9 summarize the potential exposure pathways for OU-5/Site WP-1.

2.7 SUMMARY OF SITE RISKS

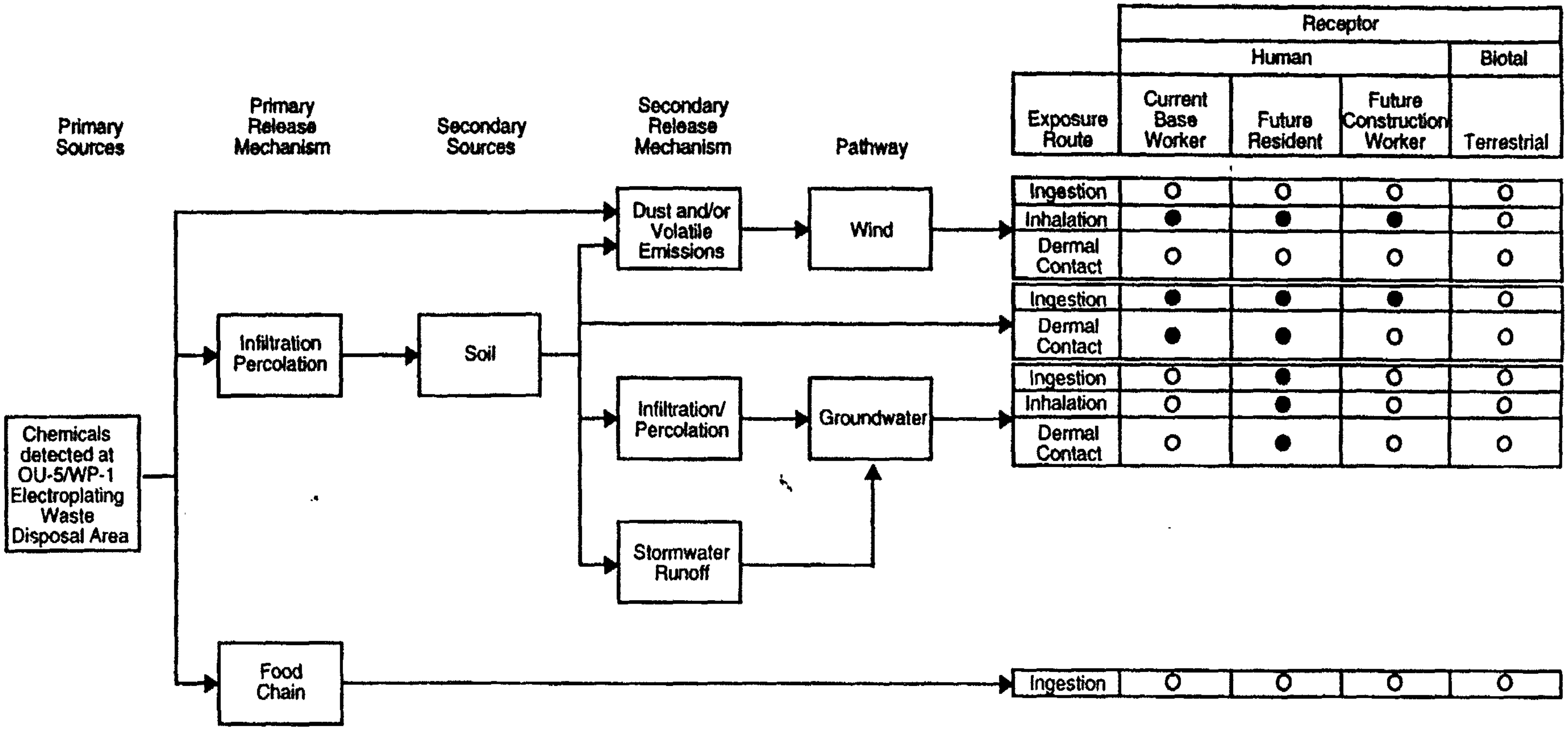
In order to evaluate whether existing or future exposure to contaminated media at OU-5/Site WP-1 could pose a risk to people or the environment, USAF completed a Baseline Risk Assessment (BRA) in October 1996 with USEPA oversight of this process. This evaluation then served as a baseline for determining whether cleanup of each site media was necessary. In the BRA, USAF evaluated site risks for several environmental media. This ROD addresses the risks attributable to chemicals in the soil and groundwater at OU-5/Site WP-1. Sediment and surface water will be addressed as part of OU-9, Boundary and Military Canal investigation. The risk assessment included the following major components: selection of chemicals of potential concern, exposure assessment, toxicity assessment, risk characterization, development of remedial goal options, ecological risk, and uncertainties. The USAF estimated potential site risk in the absence of any future remediation.

2.7.1 Selection of Chemicals of Potential Concern

This section presents an analysis of the site data to determine which chemicals present in site samples are potentially responsible for the greatest risks at the site. These chemicals are designated chemicals of potential concern (COPCs). The selection of COPCs allows the risk assessment to focus on a manageable list of the most important chemicals, which in turn permits concise analysis and presentation of information during the remainder of the risk assessment.

2.7.1.1 Criteria For Selection. The process of selecting the COPCs involves four criteria. These criteria are outlined in Figure 2-10. The first criterion involves determining whether a chemical is present within its range of natural background concentrations. Chemicals present at background levels are not selected as COPCs. Tables 2-17 and 2-18 present groundwater and soil background data, respectively.

The second criterion is whether a chemical represents at least one percent of the risk in a given media, based on a screening method that involves the concentration and toxicity of the chemical. Factors other than concentration and toxicity are considered to potentially modify this criterion to include additional chemicals that account for less than one percent of the risk.



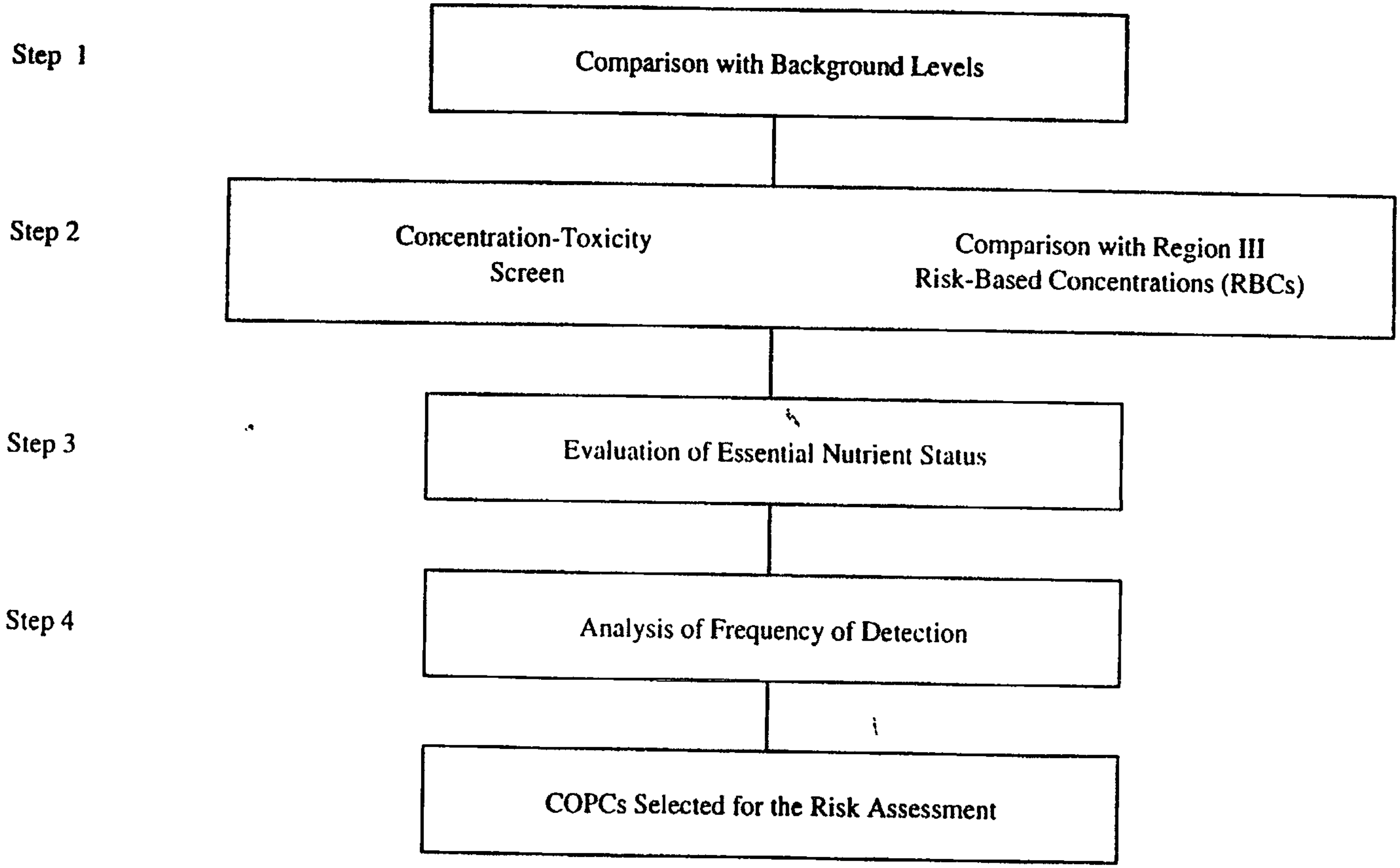
	Receptor			
	Human			Biotal
Exposure Route	Current Base Worker	Future Resident	Future Construction Worker	Terrestrial
Ingestion	○	○	○	○
Inhalation	●	●	●	○
Dermal Contact	○	○	○	○
Ingestion	●	●	●	○
Dermal Contact	●	●	○	○
Ingestion	○	●	○	○
Inhalation	○	●	○	○
Dermal Contact	○	●	○	○
Ingestion	○	○	○	○

● = Pathway complete, further evaluation recommended

○ = Pathway evaluated and found incomplete, no further evaluation recommended

Footnote: (1) Based on the non-volatile nature of the COPCs, it was considered that the potential for exposure to particulant, but not volatile emissions exists.

Conceptual Model for OU-5/Site WP-1, Electroplating Waste Disposal Area
Figure 2-9



Identification of Chemicals of Potential Concern (COPCs): Criteria for Section

Figure 2-10

TABLE 2-17

CONCENTRATIONS OF DISSOLVED INORGANIC CHEMICALS DETECTED IN THE BISCAYNE AQUIFER IN DADE COUNTY, FLORIDA

Homestead Air Reserve Base, Florida

Constituent	Range (Fg/l)	Mean (Fg/l)
Calcium	55,000 - 140,000	90,000
Magnesium	1,700 - 19,000	5,600
Sodium	7,400 - 77,000	26,600
Potassium	200 - 6,500	2,400
Chloride	13,000 - 110,000	42,000
Fluoride	100 - 500	200
Sulfate	100 - 45,000	14,600
Alkalinity (as CaCO3)	157,000 - 624,000	263,000
Arsenic	<1 - 2	1.2
Barium	<100 - 100	100
Cadmium	<1 - 3	1.0
Chromium [a]	<10 - 10	--
Iron	<10 - 1,900	560
Lead	<1 - 6	1.9
Manganese	<10 - 30	9.7
Mercury	<0.1 - 0.3	0.10
Zinc	<10 - 30	7.5
TDS [b]	196 - 478	333
Hardness (as CaCO3) [b]	150 - 370	249

Source: Causaras, C.R., 1987, Geology of the Surficial Aquifer System, Dade County, Florida. U.S. Geological Survey Water Resources Investigation Report 86-4126.

Notes:

[a] All detected observations had the same value.

[b] In milligrams per liter

TABLE 2-18

BACKGROUND SOIL CHEMICAL CONCENTRATIONS
Homestead Air Reserve Base, Florida

Compound	Average Carbonate Composition Hem (1989)	Homestead ARB Background Soil(a) 0-2 ft bls	Homestead ARB Background Soil(b) 4-6 ft bls	Typical Values for Uncontaminated Soils(c) (mg/kg)	Common Range(d) (mg/kg)	Average(d) (mg/kg)
Volatile Organic Compounds (µg/kg)						
Acetone		119.2	--	--	--	--
Chlorobenzene		3.8	--	--	--	--
Methylene Chloride		4	--	--	--	--
Total PAHs (ug/kg)		738.55	--	0.01 - 1.3 forest(e) 0.01 - 1.01 rural 0.06 - 5.8 urban 8 - 336 road dust	--	--
Base/Neutral and Acid Extractable Organic Compounds (µg/kg/dw)						
Acenaphthene		ND	--	--	--	--
Benzo(a)anthracene		67	--	--	--	--
Benzo(a)pyrene		66	--	--	--	--
Benzo(b)fluoranthene		69	--	--	--	--
Benzo(g,h,i)perylene		44	--	--	--	--
Benzo(k)fluoranthene		66	--	--	--	--
bis(2-Ethylhexyl)phthalate		100	--	--	--	--
Chrysene		79	--	--	--	--
Dibenzofuran		ND	--	--	--	--
Fluoranthene		52.4	--	--	--	--
Fluorene		ND	--	--	--	--
2-Methylnaphthalene		84	--	--	--	--
Naphthalene		50	--	--	--	--
Phenanthrene		50	--	--	--	--
Pyrene		49.15	--	--	--	--
1,2-Dichlorobenzene		ND	--	--	--	--
1,4-Dichlorobenzene		ND	--	--	--	--
Total Phthalates (µg/kg)		126	515	--	--	--
Metals (mg/kg)						
Aluminum	8970	2400	425	--	700 ->10,000	57000
Antimony	--	<28 - 30	<7.4 - <160	0 - 30	2 - 10(f)	--(g)
Arsenic	1.8	1.6	<1.4 - <2.9	0 - 30	<0.1 - 73	7.4
Barium	30	42.9	5	0 - 500	10 - 1,500	420
Beryllium	--	<2.8 - 2.9	<0.63 - <0.74	0 - 5	<1 - 7	0.85
Cadmium	0.048	<2.8 - 3.0	<0.74 - <16	0 - 1	0.01 - 0.1(f)	0.06(f)
Calcium	272,000	345,000	400,000	--	10 - 28,000	630
Chromium	>0.1	11.5	3.9	0 - 100	1 - 1,000	52
Cobalt	0.12	<1.1 - 1.2	<1.3 - <1.5	7	<0.3 - 70	9.2
Copper	4.4	<2.7 - 3.0	<3.2 - <3.7	30	<1 - 700	22
Iron	8,190	1650	260	--	10 - 10,000	2,500
Lead	16	4.05	1.4	0 - 500	<10 - 300	17
Magnesium	45,300	1050	875	0 - 500	5 - 5,000	460
Manganese	842	23	5.4	0 - 500	<2 - 7,000	640
Mercury	0.046	0.014	<0.013 - <0.014	0 - 1	<0.01 - 3.4	0.12
Nickel	13	<4.5 - 4.7	<5.1 - <5.9	15	<5 - 700	18
Potassium	2,390	<110 - 120	<130 - <150	--	5 - 3,700	--(g)
Selenium	--	<5.6 - 5.7	<2.9 - <7.1	0 - 1	<0.01 - 3.9	0.45
Silver	--	<1.1 - 1.2	<1.3 - <1.5	0.15	0.01 - 5.0(f)	0.05(f)
Sodium	398	555	910	--	<500 - 50,000	7,800
Thallium	--	<1.1 - 5.6	<1.3 - <6.8	--	2.2 - 23	8.6
Vanadium	13	<5.7 - 5.9	2.3	0 - 100	<7 - 300	66
Zinc	16	20	<2.9 - 63	60	<5 - 2,900	5.2

(a) Source: Based on 5 background samples as reported in Geraghty & Miller, 1992.

(b) Source: Based on 2 background samples as reported in Geraghty & Miller, 1992.

(c) Source: Gas Research Institute, 1987.

(d) U.S. Geological Survey Professional Paper 1270, Element Concentrations in Soils and Other Surficial Material of the Conterminous United States Page 4, Table 1 (unless indicated otherwise).

(e) Source: Menzie, et al., 1992.

(f) Data for these metals were not included in the USGS Paper. Concentrations were obtained from the USEPA Office of Solid Waste and Emergency Response, Hazardous Waste Land Treatment, SW-874, April 1983, Page 273, Table 6.45

(g) Average not established.

These factors include physical and chemical properties of a given chemical, environmental persistence, medium-specific mobility, the potential to bioaccumulate, potential routes of exposure, the spatial extent of the chemical, and the range and magnitude of concentrations detected. This screening method is consistent with toxicity screening guidance available during the preparation of previous drafts of this document.

Changes in COPC screening guidance have occurred. At the request of regulators, this change in guidance was incorporated into this document by screening chemicals detected in site samples using an additional method based on USEPA Region III Risk-Based Concentrations (RBCs). This additional screening is further discussed in Section 2.7.1.4.

The third criterion is whether a chemical is an essential human nutrient that is only toxic at very high doses (i.e., at doses that are both much higher than beneficial levels and much higher than could be associated with contact at the site). Chemicals typically considered under this criterion include calcium, iron, magnesium, potassium, and sodium.

The fourth criterion is to determine frequency of detection in a given medium. When chemicals are detected in less than five percent of the site samples for a given medium, they are not selected as a chemical of potential concern. This criterion was only used when at least 20 site samples had been collected: for a particular medium. The following paragraphs discuss the four criteria above in greater detail.

Background levels have been estimated for groundwater, surface soil, and subsurface soil. As per Region IV risk assessment guidance (USEPA, 1992b), inorganic chemicals which have maximum detected concentrations less than twice the background concentration are considered to be present at background levels. Exceptions to this rule have been made for known human carcinogens such as arsenic and chromium (assumed to present in the hexavalent state, or Cr(VI)). For these metals, the maximum detected concentration has been required to be less than background to assume that the metal is present at background levels.

The results of COPC screening groundwater and surface soil are summarized in Tables 2-19, and 2-20, respectively.

Groundwater. For groundwater, United States Geological Survey (USGS) data on the Biscayne Aquifer have been used for comparison with site groundwater samples (Causarus, 1987). The USGS data are summarized in Table 2-17. While it is generally considered preferable to determine background concentrations with wells immediately upgradient of the

TABLE 2-19

SUMMARY OF CHEMICALS PRESENT IN SITE SAMPLES - GROUNDWATER
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida
(Page 1 of 2)

Constituent	Minimum Detected Concentration (µg/l)	Maximum Detected Concentration (µg/l)	No. of Samples With Detects/ Total No. Samples	Preliminary Screening Summary
VOCs (µg/l)				
Bromodichloromethane	2	2	1/9	**Included [1]**
Chloroform	2	2	1/9	**Included [1]**
Methylene chloride	1	7	5/9	**Included [1]**
BNAs (µg/l)				
bis-(2-Ethylhexyl)phthalate	0.3	320	4/9	**Included**
Di-n-butyl phthalate	0.5	0.5	1/9	Excluded, low score [2]
2-Methylnaphthalene	2	2	1/9	Excluded, low score [2]
Naphthalene	1	1	1/9	Excluded, low score [2]
Metals (µg/l)				
Aluminum	2610	24,000	5/9	**Included**
Arsenic	3.9	92	9/9	**Included**
Barium	4.5	150	9/9	**Included**
Calcium	10,100	5,400,000	9/9	**Included, qualitative, high conc essential nutrient**
Chromium	4.1	130	7/9	**Included**
Cabalt	3.5	3.5	1/9	Excluded, low score [2]
Copper	3.7	11.9	3/9	Excluded, low score [2]
Iron	4.9	18,000	7/9	**Included, qualitative, high conc essential nutrient**
Lead	5.4	30	5/9	**Included**

TABLE 2-19

SUMMARY OFCHEMICALS PRESENT IN SITE SAMPLES - GROUNDWATER
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida
(Page 2 of 2)

Constituent	Minimum Detected Concentration (µg/l)	Maximum Detected Concentration (µg/l)	No. of Samples With Detects/ Total No. Samples	Preliminary Screening Summary
Metals (µg/l) (continued)				
Magnesium	1490	14,000	9/9	Excluded, essential nutrient, below site background
Manganese	0.81	200	7/9	**Included**
Nickel	8	8	1/9	**Included**
Potassium	642	4,950	9/9	Excluded, essential nutrient, below site background
Sodium	3,870	26,000	9/9	Excluded, essential nutrient, below site background
Vanadium	2.9	82	6/9	**Included**
Zinc	6.7	33.5	5/9	Excluded, low score [2]

[1] Chemical was included as a COPC based on additional screening using benchmarks based on USEPA Region III Risk-Based Concentrations (See Section 2.6).

[2] Low score indicates <1% result for concentration-toxicity screen (USEPA, 1989) for the RfD and/or SF calculation (see Table 2-5).

TABLE 2-20

SUMMARY OF CHEMICALS PRESENT IN SITE SAMPLES - SURFACE SOIL
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida
(Page 1 of 3)

Constituent	Minimum Detected Concentration	Maximum Detected Concentration	No. of Samples With Detects/ Total No. Samples	Preliminary Screening Summary
Volatile Organics (μg/kg)				
Acetone	1268	27,000	3/5	Excluded, low score [1]
BNAs (μg/kg)				
Acenaphthene	17	17	1/11	Excluded, low score [1]
Anthracene	39	39	1/11	Excluded, low score [1]
Benzo(a)Anthracene	25	691	3/11	Excluded, low score [1]
Benzo(a)Pyrene	30	460	3/11	**Included [2]**
Benzo(b)Fluoranthene	37	540	3/11	Excluded, low score [1]
Benzo(g,h,i)Perylene	8.1	240	3/11	Excluded, low score [1]
Benzo(k)Fluoranthene	44	460	3/11	Excluded, low score [1]
Bis(2-Ethylhexyl)Phthalate	93	110	2/11	Excluded, low score [1]
Butyl Benzyl Phthalate	24	24	1/11	Excluded, low score [1]
Carbazole	62	62	1/5	Excluded, low score [1]
Chrysene	46	540	3/11	Excluded, low score [1]
Di-n-Butyl Phthalate	17	460	2/11	Excluded, low score [1]
Di-n-Octyl Phthalate	7	7	1/11	Excluded, low score [1]
Dibenz(a,h)Anthracene	87	87	1/11	Excluded, low score [1]
Dibenzofuran	11	11	1/11	Excluded, low score [1]
Fluoranthene	55	1,200	3/11	Excluded, low score [1]
Fluorene	20	20	1/11	Excluded, low score [1]
Indeno(1,2,3-c,d)Pyrene	230	230	1/11	Excluded, low score [1]
Phenanthrene	10	490	3/11	Excluded, low score [1]
Pyrene	58	810	3/11	Excluded, low score [1]
TRPHs (TICs) (mg/kg)	3322	3322	1/1	**Included**

TABLE 2-20

SUMMARY OF CHEMICALS PRESENT IN SITE SAMPLES - SURFACE SOIL
SITE 2–1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida
(Page 2 of 3)

Constituent	Minimum Detected Concentration	Maximum Detected Concentration	No. of Samples With Detects/ Total No. Samples	Preliminary Screening Summary
Pesticides/PCBs (μg/kg)				
4,4'-DDD	1.4	1,400	5/8	**Included**
4,4'-DDE	3.9	240	7/8	Excluded, low score 1
4,4'-DDT	0.83	34	5/8	Excluded, low score 1
Chlordane	4.2	1,400	4/8	**Included**
Endosulfan sulfate	0.77	8.8	2/8	Excluded, low score 1
Metals (mg/kg)				
Aluminum	728	9,270	11/11	**Included**
Arsenic	0.26	9.7	8/11	**Included**
Barium	43.6	21.2	11/11	Excluded, low score 1
Beryllium	0.31	0.31	1/11	Excluded, low score 1.4
Cadmium	0.42	1.4	2/11	**Included**
Calcium	30,600	646,716	11/11	Excluded, essential nutrient, below site background
Chromium	7.2	23.4	6/11	**Included**
Cobalt	0.34	1.4	4/11	Excluded, low score[1]
Copper	1.7	160	7/11	**Included**
Iron	302	5,800	1/11	**Included, qualitative, high cone essential nutrient**
Lead	2.4	120	10/11	Exluded, USEPA [5]
IEUBK Magnesium	970	1,500	11/11	Excluded, essential nutrient, below site background
Manganese	5.1	230	11/11	**Included**
Mercury	0.011	0.4	2/11	**Included**
Nickel	8.87	300	6/11	**Included**
Potassium	28	2,160	7/11	**Included, qualitative, high cone essential nutrient**
Sodium	212	513	9/11	Excluded, essential nutrient, below site background

TABLE 2-20

SUMMARY OF CHEMICALS PRESENT IN SITE SAMPLES - SURFACE SOIL
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida
(Page 3 of 3)

Constituent	Minimum Detected Concentration	Maximum Detected Concentration	No. of Samples With Detects/ Total No. Samples	Preliminary Screening Summary
Meatal (mg/kg) (continued)				
Vanadium	8.2	14.7	6/11	**Included**
Zinc	2.2	300	9/11	Excluded, low score [1]

[1] Low score indicates <1% result for toxicity-concentration screen (USEPA, 1989) for the RfD and/or SF calculation (Refer to Table 2-6).

[2] Chemical was included as a COPC, despite low score, because the maximum detected concentration exceeded the benchmark based on USEPA Region III Risk-Based Concentration (RBC) (see Section 2.6).

[3] Included as a COPC, despite low score, because there is no Region III RBC available for n-nonane (see Section 2.6).

[4] Beryllium exceeded benchmark based on USEPA Region III RBCs (see Section 2.6), but did not exceed site background.

[5] This concentration of lead in soil has been shown by the USEPA IEUBK model to result in no significant additional uptake of lead in blood for children or adults.

site, the monitoring well SP1-I-01 designated by Geraghty & Miller as a background well in 1991 had concentrations of several metals which indicate it is not representative of background conditions. Therefore, this well has subsequently been included in the risk assessment dataset for groundwater. The USGS data for the Biscayne Aquifer are more likely to represent undisturbed groundwater conditions and have been used to place the site data in perspective.

Soil. For surface soil, five Base-wide background samples were collected by Geraghty & Miller in 1991. These samples include SP1-SL-0028-2, P3-SL-0023, P2-SL-0023-2, SP3-SL-0004-1, and SP3-SL-0004-2. For subsurface soil, two background samples (SP11-SL-0028-6 and SP7-SL-0002) were collected. Soil background values are summarized in Table 2-18. In addition, data concerning typical chemical concentration ranges in soil arc used to place the site data in perspective (Shacklette and Boerngen, 1984).

2.7.1.2 Concentration-Toxicity Screen. The concentration-toxicity screen is used to calculate indices that rank the chemicals according to their relative potentials to create health risks at the site. One index is used to rank chemicals according to their potential for initiating or promoting cancers, and a second index ranks chemicals-according to their potential for chronic non-cancer effects. The first index applies only to carcinogens, while the latter index applies to noncarcinogens. These indices used for ranking purposes only, and do not represent actual risk values.

The index used for ranking carcinogens involves the use of a cancer slope factor (CSF). Studies of carcinogenicity tend to focus on identifying the slope of the linear portion of a curve of dose versus response. A plausible upper-bound value of the slope is called the slope factor.

The index used to rank chemicals according to their potential to cause noncarcinogenic effects involves the use of a reference dose (RfD). A chronic RfD is an estimate of a daily exposure level for which people, including sensitive populations, do not have an appreciable risk of suffering significant adverse health effects. Most CSFs and RfDs were obtained from the *Integrated Risk Information System* (IRIS), or, if not available there, from the *Health Effects Assessment Summary Tables* (HEAST).

The index for carcinogenic effects is calculated by taking the maximum detected concentration of each contaminant and multiplying by the oral slope factor. The inhalation CSF is used for chemicals that are only carcinogenic by inhalation (chromium and cadmium).

The index for noncarcinogenic effects is calculated by taking the maximum detected concentration of each contaminant and dividing by the oral RfD. Chemicals making up at least one percent of the total index for all chemicals have been selected as COPCs (unless the chemical has been eliminated based on background or essential nutrient considerations). Concentration toxicity screening results for groundwater and surface soils are presented in Tables 2-21 and 2-22, respectively.

Due to changes in guidance during the development of this document, an additional toxicity-screening method, based on USEPA Region III RBCs, was also used to screen for COPCs. This method is described in Section 2.7.1.4.

2.7.1.3 Data Analysis. This subsection is organized according to media (groundwater and surface soil). Within each medium, the data are presented in the order of volatile organic compounds (VOCs), semi-volatile organic compounds, pesticides/polychlorinated biphenyls (PCBs), and inorganics. Comparisons are made to the four criteria listed in Section 2.7.1.1, and then COPCs are selected. The summary Tables 2-19 and 2-20 present chemical concentration ranges, frequencies of detection, and whether a chemical has been selected as a COPC.

The analytical data for this risk assessment were collected by Geraghty & Miller during an investigation in 1991, Montgomery Watson during 1993, IT Corporation in 1994 and 1995 (soil sampling only), and OHM in 1996 (groundwater sampling only). An in-depth discussion of the sample collection and analytical methodology is presented in Section 2.0 of the *Final Remedial Investigation Report for Operable Unit 5/Site WP-1, Electroplating Waste Disposal Area (Former Site SP-1)* (Montgomery Watson, 1996).

The soil and groundwater analytical data were reduced and analyzed for use in the risk assessment according to guidelines provided by USEPA (1989a, 1991a). Geraghty & Miller, IT Corporation, and OHM performed laboratory analyses and data validation for their field samples; Montgomery Watson performed its own data validation, which is reported in a *Draft Quality Control Summary Report*, while Savannah Laboratories performed the laboratory analyses. All data collected by Geraghty & Miller in 1991, Montgomery Watson in 1993, IT Corporation in 1994 and 1995, and OHM in 1996 were reviewed for this risk evaluation, This includes a review of detects, detection limits for non-detects, and estimated (J-qualified) data. Detection limits reported for Montgomery Watson samples were in compliance with CLP SOW contract required quantitation limits (CRQL). However, sample

TABLE 2-21

TOXICITY - CONCENTRATION SCREEN FOR CHEMICALS PRESENT IN SITE SAMPLES - GROUNDWATER
WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homstead Air Reserve Base, Florida

Constituent	Maximum Concentration mg/l	RfD mg/kg/day	Slope Factor (mg/kg/day)$^{-1}$	Non-Carcinogen Index (conc/RfD)	Carcinogen Index (conc x SF)	% RfD	% SF
VOCs							
Bromodichloromethane	0.002	2.0E-02 (a)	6.2E-02 (a)	1.0E-01	1.2E-04	0.03%	0.00%
Chloroform	0.002	1.0E-02 (a)	6.1E-03 (a)	2.0E-01	1.2E-05	0.05%	0.00%
Methylene chloride	0.007	6.0E-02 (e)	7.5E-03 (e)	1.2E-01	5.3E-05	0.03%	0.00%
BNAs							
Bis(2-Ethylhexyl)phthalate	0.32	2.0E-02 (a)	1.4E-02 (a)	1.6E+01	4.5E-03	**4.04%**	0.08%
Di-n-Butyl Phthalate	0.0005	1.0E-01 (a)	NA	5.0E-03	NC	0.00%	NC
2-Methylnaphthalene (1)	0.002	4.0E-02 (c)	NA	5.0E-02	NC	0.01%	NC
Naphthalene	0.001	4.0E-02 (c)	NA	2.5E-02	NC	0.01%	NC
Metals							
Aluminum	24	1.0E+00 (c)	NA	2.4E+01	NC	**6.06%**	NC
Arsenic	0.092	3.0E-04 (a)	1.5E+00 (a)	3.1E+02	1.4E-01	**77.39%**	**2.46%**
Barium	0.15	7.0E-02 (a)	NA	2.1E+00	NC	**0.54%**	NC
Calcium	5400	NA	NA	NC	NC	NC	NC
Chromium (2)	0.13	5.0E-03 (a)	4.2E+01 (a)	2.6E+01	5.5E+00	**6.56%**	**97.34%**
Cabalt	0.0035	6.0E-02 (c)	NA	5.8E-02	NC	0.01%	NC
Copper	0.0119	3.7E-02 (h)	NA	3.2E-01	NC	0.08%	NC
Iron	18	NA	NA	NC	NC	NC	NC
Lead	0.03	NA	NA	NC	NC	NC	NC
Magnesium	14	NA	NA	NC	NC	NC	NC
Manganese (3)	0.2	2.4E-02 (a)	NA	8.3E+00	NC	**2.10%**	NC
Nickel (4)	0.008	2.0E-02 (e)	8.4E-01 (a)	4.0E-01	6.7E-03	**0.10%**	**0.12%**
Potassium	4.95	NA	NA	NC	NC	NC	NC
Sodium	26	NA	NA	NC	NC	NC	NC
Vanadium	0.082	7.0E-03 (h)	NA	1.2E+01	NC	**2.96%**	NC
Zinc	0.0335	3.0E-01 (a)	NA	1.1E-01	NC	0.03%	NC

Notes:

Toxicity values quoted in this table are for the oral pathway unless otherwise noted
conc = concentration
NA = Not Available
NC = Non-Carcinogenic
RfD = Reference Dose
SF = Slope Factor
(a) IRIS, 1995
(b) HEAST, 1995
(c) ECAO

(1) Naphthalene RfD used as surrogate for 2-Methylnaphthalene, RfD
(2) Slope factor is for inhalation pathway
(3) RfD for manganese is calculated based on the NOAEL of 10 mg/day in food, using a modifying factor of 3 for non-dietary intake.
(4) Nickel refinery dust inhalation slope factor used as surrogate for Nickel slope factor

TABLE 2-22

TOXICITY - CONCENTRATION SCREEN FOR CHEMICALS PRESENT IN SITE SAMPLES - SURFACE SOIL (0-2 FT)
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida
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Constituent	Maximum Concentration mg/kg	RfD mg/kg/day	Slope Factor mg/kg/day	Non-Carcinogen Index (conc/RfD)	Carcinogen Index (conc x SF)	% RfD	% SF
VOCs							
Acetone	27	1.0E-01 (a)	NA	2.7E+02	NC	0.24%	NC
BNAs							
Acenaphthene	0.017	6.0E-02 (a)	NA	2.8E-01	NC	0.00%	NC
Anthracene	0.039	3.0E-01 (a)	NA	1.3E-01	NC	0.00%	NC
Benzo(a)anthracene (1)	0.691	3.0E-02 (a)	7.3E-01 (8) (a)	2.3E+01	5.0E-01	0.02%	0.04%
Benzo(a)pyrene (1)	0.46	3.0E-02 (a)	7.3E+00 (a)	1.5E+01	3.4E+00	0.01%	0.27%
Benzo(b)fluoranthene	0.54	3.0E-02 (a)	7.3E-01 (8) (a)	1.8E+01	3.9E-01	0.02%	0.03%
Benzo(g,h,i)perylene (1)	0.24	3.0E-02 (a)	NA	8.0E+00	NC	0.01%	NC
Benzo(k)fluoranthene (1)	0.46	3.0E-02 (a)	7.3E-02 (8) (a)	1.5E+01	3.4E-02	0.01%	0.00%
bis(2-Ethylhexyl)phthalate	0.11	2.0E-02 (a)	1.4E-02 (a)	5.5E+00	1.5E-03	0.00%	0.00%
Butylbenzyohthalate	0.024	2.0E-01 (a)	NA	1.2E-01	NC	0.00%	NC
Carbazole (1)	0.062	3.0E-02 (a)	2.0E-02 (b)	NC	1.2E-03	NC	0.00%
Chrysene (1)	0.54	3.0E-02 (a)	7.3E-03 (8) (a)	1.8E-01	3.9E-03	0.02%	0.00%
Di-n-Butyl Phthalate	0.46	1.0E-01 (a)	NA	4.6E+00	NC	0.00%	NC
Di-n-octyl phthalate	0.007	2.0E-02 (a)	NA	3.5E-01	NC	0.00%	NC
Dibenzo(a,h)anthracene (1)	0.087	3.0E-02 (a)	7.3E+00 (8) (a)	2.9E+00	6.4E-01	0.00%	0.05%
Dibenzofuran	0.011	4.0E-03 (a)	NA	2.8E+00	NC	0.00%	NC
Fluoranthene	1.2	4.0E-02 (a)	NA	3.0E+01	NC	0.03%	NC
Fluorene	0.02	4.0E-02 (a)	NA	5.0E-01	NC	0.00%	NC
Indeno(1,2,3-c,d)pyrene (1)	0.23	3.0E-02 (a)	7.3E-01 (8) (a)	7.7E+00	1.7E-01	0.01%	0.01%
Phenathrene (1)	0.49	3.0E-02 (a)	NA	1.6E+01	NC	0.01%	NC
Pyrene	0.81	3.0E-02 (a)	NA	2.7E+01	NC	0.02%	CN
TRPHs (TICs) (as n-Nonane) (2)	3322	6.0E-01 (d)	NA	5.5E+03	NC	**4.85%**	NC
Pesticides/PCPs							
4,4'-DDD (3)	1.4	5.0E-04 (a)	2.4E-01 (a)	2.8E+03	3.4E-01	**2.44%**	**0.03%**
4,4'-DDE (3)	0.24	5.0E-04 (a)	3.4E-01 (a)	4.8E+02	8.2E-02	0.42%	0.01%
4,4'-DDT	0.034	5.0E-04 (a)	3.4E-01 (a)	6.7E+01	1.2E-02	0.06%	0.00%
Chlordane	1.4	6.0E-05 (a)	1.3E+00 (a)	2.3E+04	1.8E+00	**20.46**	**0.15%**
Endosulfan Sulfate (4)	0.0088	6.0E-03 (a)	NA	1.5E+00	NC	**%**	NC
						0.00%	
Metals							
Aluminum	9270	1.0E+00 (C)	NA	9.3E+03	NC	**8.13%**	NC
Arsenic	9.7	3.0E-04 (a)	1.5E+00 (a)	3.2E+04	1.5E+01	**28.34**	**1.17%**
Barium	21.2	7.0E-02 (a)	NA	3.0E+02	NC	**%**	NC
Beryllium	0.31	5.0E-03 (a)	4.3E+00 (a)	6.2E+01	1.3E+00	0.27%	0.11%
Cadmium (food) (5)	1.4	1.0E-03 (a)	6.3E+00 (a)	1.4E+03	8.8E+00	0.05%	**0.71%**
Calcium	646716	NA	NA	NC	NC	**1.23%**	NC
						NC	

TABLE 2-22

TOXICITY - CONCENTRATION SCREEN FOR CHEMICALS PRESENT IN SITE SAMPLES - SURFACE SOIL (0-2 FT) SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

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Constituent	Maximum Concentration mg/kg	RfD mg/kg/day		Slope Factor mg/kg/day		Non-Carcinogen Index (conc/RfD)	Carcinogen Index (conc x SF)	% RfD	% SF
Metals (continued)									
Chromium [5]	2.34	5.0E-03	[a]	4.1E+01	[b]	4.7E+03	9.6E+02	**4.10%**	**77.16%**
Cobalt	1.4	6.0E-02	[c]	NA		2.3E+01	NC	0.02%	NC
Copper	160	3.7E-02	[c]	NA		4.3E+03	NC	**3.79%**	NC
Iron	5800	NA		NA		NC	NC	NC	NC
Lead	120	NA		NA		NC	NC	NC	NC
Magnesium	1500	NA		NA		NC	NC	NC	NC
Manganese [6]	230	2.4E-02	[a]	NA		9.6E+03	NC	**8.40%**	NC
Mercury	0.4	3.0E-04	[b]	NA		1.3E+03	NC	**1.17%**	NC
Nickel [7]	300	2.0E-02	[a]	8.4E-01	[a]	1.5E+04	2.5E+02	**13.15%**	**20.27%**
Potassium	2,160	NA		NA		NC	NC	NC	NC
Sodium	513	NA		NA		NC	NC	NC	NC
Vanadioum	14.7	7.0E-03	[b]	NA		2.1E+03	NC	**1.84%**	NC
Zinc	300	3.0E-01	[a]	NA		1.0E+03	NC	0.88%	NC

NOTES:

Toxicity values quoted in this table are for the oral pathway unless otherwise noted

NA = Not Available
NC = Not calculated
RfD = Reference Dose
SF = Slope Factor

[a] IRIS, 1996
[b] HEAST, 1995
[c] ECAO
[d] Massachusetts DEP, October 1994
[1] Pyrene RfD used as a surrogate for RfD of various PAHs
[2] n-Nonane RfD used as surrogate for TRPHs RfD
[3] DDT RfD used as surrogate for DDD and DDE RfDs
[4] Endosulfan RfD used as surrogate for endosulfan sulfate RfD
[5] Slope factor is for inhalation pathway
[6] RfD for manganese is calculated based on the NOAEL of 10 mg/day in food, using a modifying factor of 3 for non-dietary intake.
[7] Nickel refinery dust inhalation slope factor used as surrogate for Nickel slope factor
[8] Toxicity equivalence factor (TEF) was applied to the benzo(a)pyrene slope factor, based on the relative potency of this chemical to be

quantitation limits (SQL) at levels suitably low for risk assessment use were not consistently achieved.

2.7.1.4 Screening Using Risk-Based Concentrations. Guidance on COPC selection changed during the development of this document. Therefore, a Risk-Based Concentration (RBC)-based benchmark screening method was added after input from regulators. Note that the use of both the toxicity-concentration screening method described in Section 2.7.1.2 and the RBC method described below results in a greater number of COPCs than use of each method singly. Therefore, selection of COPCs in this document is more conservative.

Risk-Based Concentrations. Current USEPA Region IV guidance recommends using the USEPA Region III RBCs as guidance for screening. RBCs are published periodically by USEPA Region III to act as guidance in risk management, risk assessment, and remediation decisions. RBCs are generated using default exposure parameters for chemicals in a specific media. Concentrations quoted in the USEPA Region III RBC Table that represent risk levels of 1E-06 (for carcinogens) or a hazard quotient of 1 (for non-carcinogens). USEPA Region IV suggests that screening values for non-carcinogenic chemicals be adjusted to represent a hazard quotient of 0.1.

Maximum concentration values of all chemicals detected in a particular environmental medium are compared to the appropriate RBCs in Tables 2-23 and 2-24. Chemicals whose maximum concentration exceeded the benchmark value were added as COPCs. The results of this process are summarized below.

Groundwater. Chemicals detected in groundwater were compared to the Tap Water RBCs. The results of this comparison are shown in Table 2-23. The comparison resulted in bromodichloromethane, chloroform, and methylene chloride being added to the list of COPCs for groundwater. All other chemicals that exceeded the RBCs had been already selected as COPCs, based on previous screening described in Sections 2.7.1.2 and 2.7.1.3, and Table 2-21.

Surface soil. Chemicals detected in surface soil were compared to RBCs for residential soil. The results of this comparison are shown in Table 2-24. The comparison resulted in benzo(a)pyrene being added to the list of COPCs for surface soils. Although the maximum concentration of beryllium in surface soil exceeded its RBCs, the concentrations detected were within background, so beryllium was not considered a COPC in surface soil.

TABLE 2-23

RBC-BASED BENCHMARK SCREENING FOR CHEMICALS
PRESENT IN SITE SAMPLES - GROUNDWATER
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida

Constituent	COPC from previous screening? [b] (yes = +)	Maximum Concentration mg/l	Toxicity Values				RCBs (Region III Tap Water) mg/l	RBC-based Benchmark mg/l	Exceeds Benchmark (yes = +)	COPC
			RfD mg/kg/day		Slope Factor (mg/kg/day) $^{-4}$					
VOCs										
Bromodichloromethane	-	0.002	2.0E-02	(a)	6.2E-02	(a)	0.00017	0.00017	+	+
Chloroform	-	0.002	1.0E-02	(a)	6.1E-03	(a)	0.00015	0.00015	+	+
Methylene Chloride	-	0.007	6.0E-02	(a)	7.5E-03	(a)	0.0041	0.0041	+	+
BNAs										
Bis(2-Ethylhexyl)phthalate	+	0.32	2.00E-02	(a)	1.40E-02	(a)	0.0048	0.0048	+	+
Di-n-Butyl Phthalate	-	0.0005	1.00E-01	(a)	NA		3.7	0.37	-	-
2-Methylnaphthlene (2)	-	0.002	4.00E-02	(c)	NA		1.5	0.15	-	-
Naphthalene	-	0.001	4.00E-02	(c)	NA		1.5	0.15	-	-
Metals										
Aluminum	+	24	1.00E+00	(c)	NA		37	3.7	+	+
Arsenic	+	0.092	3.00E-04	(a)	1.50E+00	(a)	0.000045	0.000045	+	+
Barium	+	0.15	7.00E-02	(a)	NA		2.6	0.26	-	+
Chromium (3)	+	0.13	5.00E-03	(c)	4.20E+01	(a)	0.18	0.18	-	+
Cobalt	-	0.0035	6.00E-02	(c)	NA		2.2	0.22	-	-
Copper	-	0.0119	3.70E-02	(b)	NA		1.5	0.15	-	-
Lead	+	0.03	NA		NA		NA	NA	NA	+
Manganese	+	0.2	2.40E-02	(a)	NA		0.18	0.018	+	+
Nickel (4)	+	0.008	2.00E-02	(a)	8.40E-01	(a)	0.73	0.073	-	+
Vanadium	+	0.082	7.00E-03	(b)	NA		0.26	0.026	+	+
Zinc	-	0.0335	3.00E-01	(a)	NA		11	1.1	-	-

Notes:

table are for the oral pathway unless otherwise noted.

Essential nutrients (calcium, iron, magnesium, potassium and sodium) are not considered in this table. See Sections 2.4 and 2.5 for full discussion of essential nutrients.

Chemicals which did not have RBC values were carried as COPCs in the risk assessment.

NA = Not Available

RfD = Reference Dose

(a) IRIS, 1996

(b) HEAST, 1995

(c) ECAO

(1) Based on screening carried out in Table 2-5 and Section 2.5

(2) N2phthalene RID used as surrogate for 2-Methylnaphthalent RfD

(3) Slope factor is for inhalation pathway

(4) Nickel refinery dust inhalation slope factor used as surrogate for Nickel slope factor

TABLE 2-24

RBC-BASED BENCHMARK SCREENING FOR CHEMICALS
PRESENT IN SITE SAMPLES - SURFACE SOIL (0-2 FT)
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida
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Constituent	COPC from previous screening? (1) (yes = +)	Maximum Concentration mg/l	Toxicity Values		RCBs (Region III Resid Soil) mg/kg	RBC-based Benchmark mg/kg	Exceeds Benchmark (yes = +)	COPC
			RfD mg/kg/day	Slope Factor (mg/kg/day)				
VOCs								
Acetone	-	27	1.0E-01 (a)	NA	7,800	780	-	-
BNAs								
Acenaphthene	-	0.017	6.0E-02 (a)	NA	4,700	470	-	-
Anthracene	-	0.039	3.0E-01 (a)	NA	23,000	2,300	-	-
Benzo(a)anthracene (2)	-	0.691	3.0E-02 (a)	7.3E-01 (9) (a)	0.88	0.88	-	-
Benzo(a)pyrene (2)	-	0.46	3.0E-02 (a)	7.3E+00 (a)	0.088	0.088	+	+
Benzo(b)fluoranthene	-	.54	3.0E-02 (a)	7.3E-01 (9) (a)	0.88	0.88	-	-
Benzo(g,h,i)perylene (2)	-	0.24	3.0E-02 (a)	NA	2,300	230	-	-
Benzo(k)fluoranthene (2)	-	0.46	3.0E-02 (a)	7.3E-02 (9) (a)	8.8	8.8	-	-
bis(2-Ethylhexyl)phthalate	-	0.11	2.0E-02 (a)	1.4E-02 (a)	46	46	-	-
Butylbenzyohthalate	-	0.024	2.0E-01 (a)	NA	73	0.73	-	-
Carbazole (2)	-	0.062	3.0E-02 (a)	2.0E-02 (b)	32	32	-	-
Chrysene (2)	-	0.54	3.0E-02 (a)	7.3E-03 (9) (a)	88	88	-	-
Di-n-Butyl Phthalate	-	0.46	1.0E-01 (a)	NA	7,800	780	-	-
Di-n-octyl phthalate	-	0.007	2.0E-02 (a)	NA	1,600	160	-	-
Dibenzo(a,h)anthracene (2)	-	0.087	3.0E-02 (a)	7.3E+00 (9) (a)	0.088	0.088	-	-
Dibenzofuran	-	0.011	4.0E-03 (a)	NA	310	31	-	-
Fluoranthene	-	1.2	4.0E-02 (a)	NA	3,100	310	-	-
Fluorene	-	0.02	4.0E-02 (a)	NA	3,100	310	-	-
Indeno(1,2,3-c,d)pyrene (2)	-	0.23	3.0E-02 (a)	7.3E-01 (9) (a)	0.88	0.88	-	-
Phenathrene (2)	-	0.49	3.0E-02 (a)	NA	2,300	230	-	-
Pyrene	-	0.81	3.0E-02 (a)	NA	2,300	230	-	-
TRPHs (TICs) (as n-Nonane) (3)		3322	6.0E-01 (a)	NA	NA	NA	NA	
Pesticides/PCPs								
4,4'-DDD (4)	+	1.4	5.0E-04 (a)	2.4E-01 (a)	2.7	2.7	-	+
4,4'-DDE (4)	-	0.24	5.0E-04 (a)	3.4E-01 (a)	1.9	1.9	-	-
4,4'-DDT	-	0.034	5.0E-04 (a)	3.4E-01 (a)	1.9	1.9	-	-
Chlordane	+	1.4	6.0E-05 (a)	1.3E+00 (a)	0.49	0.49	+	+
Endosulfan Sulfate (5)	-	0.0088	6.0E-03 (a)	NA	47	47	-	-
Metals								
Aluminum	+	9270	1.0E+00 (c)	NA	78,000	7,800	+	+
Arsenic	+	9.7	3.0E-04 (a)	1.5E+00 (a)	0.43	0.43	+	+
Barium	-	21.2	7.0E-02 (a)	NA	550	550	-	-
Beryllium (6)	-	0.31	5.0E-03 (a)	4.3E+00 (a)	0.15	0.15	+	+
Cadmium (food) (7)	+	1.4	1.0E-03 (a)	6.3E+00 (a)	3.9	3.9	-	+
Chromium (7)	+	23.4	5.0E-03 (a)	4.1E+01 (a)	39	39	-	+
Cobalt	-	1.4	6.0E-02 (c)	NA	470	470	-	-
Copper	+	160	3.7E-02 (b)	NA	310	310	-	+

TABLE 2-24

RBC-BASED BENCHMARK SCREENING FOR CHEMICALS PRESENT IN SITE SAMPLES - SURFACE SOIL (0-2 FT) SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

(Page 2 of 2)

Constituent	COPC from previous screening? (1) (yes = +)	Maximum Concentration mg/kg	Toxicity Values		RCBs (Region III Resid Soil) mg/kg	RBC-based Benchmark mg/kg	Exceeds Benchmark (yes = +)	COPC
			RfD mg/kg/day	Slope Factor (mg/kg/day)				
Metals (continued)				NA	NA	NA	NA	-
Lead	-	120	NA (a)	NA	390	39	+	+
Manganese	+	230	2.4E-02 (a)	NA	23	2.3	-	+
Mercury	+	0.4	3.0E-04 (a)	8.4E-01 (a)	1,600	160	+	+
Nickel (8)	+	300	2.0E-02 (a)	NA	550	55	-	+
Vanadium	+	14.7	7.0E-03 (a)	NA	23,000	2,300	-	-
Zinc	-	300	3.0E-01 (a)					

NOTES:

Toxicity values quoted in this table are for the oral pathway unless otherwise noted.

Essential nutrients (calcium, iron, magnesium, potassium and sodium) are not considered in this table. See Sections 2.4 and 2.5 for full discussion of essential nutrients.

NA = Not Available
NC = Not calculated
RFD = Reference Dose
SF = Slope Factor

(a) IRIS, 1995

(b) HEAST, 1995

(c) ECAO

(d) Massachusetts DEP, October 1994.

(1) Based on screening carried out in Table 2-6 and Section 2.5.

(2) Pyrenc RfD and RBC used as a surrogate for RfD and RBC of various PAHs.

(3) n-Nonane RfD used as surrogate for TICs RfD. As no RBC is available for n-nonane. TRPH was carried as a COPC.

(4) DDT RID used as surrogate for DDD and DDE RfDs

(5) Endosulfan RFD and RBC used as surrogates for endosulfan sulfate RID and REC, respectively.

(6) Although beryllium exceeds RBC-based benchmarks, the maximum concentration does not exceed background, so it is not considered a COPC.

(7) Slope factor is for inhalation pathway.

(8) Nickel refinery dust inhalation slope factor used as surrogate for Nickel slope factor.

(9) Toxicity equivalence factor (TEF) was applied to the benzo(a)pyrene slope factor, based on the relative potency of this chemical to benzo(a)pyr

At the suggestion of USEPA Region IV, toxicity values for n-nonane were used as surrogates for TRPH. As no RBC was available for n-nonane, TRPH was added to the list of COPCs for surface soil. All other chemicals detected in surface soil whose maximum concentrations exceeded the RBCs had been already selected as COPCs based on previous screening described in Sections 2.7.1.2 and 2.7.1.3, and Table 2-22.

2.7.1.5 Chemicals of Potential Concern Selection Process. The chemicals of potential concern (COPCs) selection process determines those chemicals that are the most toxic and that are anticipated to create the greatest potential risk. As stated previously, Figure 2-10 illustrates the criteria used to select COPCs in this risk assessment

Identification of the COPCs for the risk assessment was accomplished in accordance with USEPA (1989a) guidance. All detected constituents were included as COPCs for the risk assessment with the following exceptions:

- As per USEPA Region IV risk assessment guidance (USEPA, 1992b), inorganic constituents present at concentrations less than twice background concentrations were excluded from the list of COPCs. Only those constituents for which the maximum detected concentration was greater than twice the background concentration were retained as COPCs.

- Chemicals detected in less than 5% of the samples analyzed per media.

- Chemicals represented in less than 1% of the potential overall risk via the concentration-toxicity screen (USEPA, 1989a), and whose maximum concentration detected did not exceed a benchmark based on USEPA Region III RBCs (USEPA, 1995a).

Based on the above evaluation, a group of COPCs was carried through the quantitative risk assessment for each of the environmental media, groundwater and soil. This selection is summarized in Table 2-25.

Tentatively Identified Compounds (TICs) and TRPH. Where it was appropriate, TICs were included within the quantitative risk analysis as COPCs for soil and groundwater. Tentatively identified chemicals in the Montgomery Watson 1993 dataset associated with petroleum products were summed for quantification. Categories of TICs included in this evaluation were: alkanes, unknown hydrocarbons, substituted benzenes, PAHs,

TABLE 2-25

CHEMICALS OF POTENTIAL CONCERN IN ENVIRONMENTAL MEDIA AT SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

Constituents	Affected Media	
	Groundwater	Surface Soil (0.2 ft.)
VOCs		
Bromodichloromethane	X	--
Chloroform	X	--
Methylene chloride	X	--
BNAs		
Bis(2-ethylhexyl)phthalate	X	--
Benzo(a)pyrene	--	X
TRPHs (TICs)	--	X
Pesticides/PCBs		
4,4'-DDD	--	X
Chlordane	--	X
Metals		
Aluminum	X	X
Arsenic	X	X
Barium	X	--
Cadmium	--	X
Calcium	X	--
Chronium	X	X
Copper	--	X
Iron	X	X
Lead	X	--
Manganese	X	X
Mercury	--	X
Nickel	X	X
Potassium	--	X
Vanadium	X	X

BNAs	Base/neutral and acid extractable compounds
PCBs	Polychlorinated biphenyls
TRPHs	Total recoverable petroleum hydrocarbons.
VOCs	Volatile organic compounds.

cycloalkanes, and aromatics. The summed petroleum-related TICs were treated as TPH in screening and the risk characterization

Unknown and other partially identified TICs were not included for further analysis due to the lack of information on these chemicals. Organic acids detected in soil and groundwater were not included in the quantitative risk assessment as these chemicals are the result of natural processes by biological organisms (bacteria) in the breaking down or "weathering" of petroleum product at the site.

USEPA Region IV has adopted an approach to TPH developed by the State of Massachusetts DEP (Massachusetts DEP, 1994). This approach uses the toxicity values of certain hydrocarbon compounds (e.g. n-hexane, n-nonane, eicosane) for fractions of TPH. The toxicity of hydrocarbons tends to decrease with increasing carbon chain length, n-Hexane has an RfD of 0.06, n-nonane an RfD of 0.6, and eicosane an RfD of 6.

After review and discussion with USEPA Region IV, toxicity values for n-nonane (C9) were used as surrogate values for TPH/TRPH and fuel-associated TICs. Use of n-nonane as a surrogate was felt to be more representative of the TPH present at the site than use of n-hexane, as volatile fractions of TPH (C4-C7) would be expected to attenuate by weathering more rapidly than heavier components. Also, certain of the soil samples (such as those taken by Geraghty and Miller) were analyzed for hydrocarbons solely in the C8-C20 carbon range.

2.7.2 Potential Routes of Migration

Contaminants may migrate from a source area through a variety of processes. Volatile contaminants may be released into air and migrate in the vapor phase. Liquid or aqueous-phase contaminants may migrate to both soils and groundwater through direct infiltration. Erosion related to surface runoff or wind may transport contaminants sorbed to surface soils. Infiltrating precipitation may dissolve contaminants and carry them into deeper soils where they can be adsorbed, or into groundwater in the dissolved phase. Dissolved phase contaminants may be carried in the down gradient direction by groundwater flow in an aquifer.

Although other contaminated media are present at OU-5/Site WP-1, the principal route of migration of contaminants is through shallow groundwater. The impacts associated with the surface water and sediment samples have been further evaluated in the OU-9, Boundary Canal RI/RA. Past activities allowed contaminants to enter soil and surface water, which eventually migrated to shallow groundwater. Migration of contaminants via surface water occurs intermittently, during storm events.

OU-5/Site WP-1 and its drainages are situated on a developed portion of the Base which includes buildings, roads, and parking areas. The cycle of water through the site begins with precipitation. During rainfall events, water percolates rapidly through the limestone and weathered limestone bedrock underlying the site. Surface water runoff is over land to one of the drainage swales or ditches located in the immediate area of the site. The drainage swales and canals provide adequate surface water drainage for this site and are typically dry during non-storm events. Given the highly transmissive underlying formation, rainwater and surface water will typically infiltrate rapidly into the shallow aquifer system. It is estimated that horizontal groundwater movement can be on the order of tens of feet during a single rainfall event. Once the rainfall ceases, the water table returns to near static conditions and groundwater movement decreases dramatically.

Between rainfall events, evaporation from the surface soils returns water from the aquifer to the atmosphere. The rate of loss is greatest with open water bodies and decreases with increasing distance from the water table.

The natural concentrations of chemicals in the soil, rock, and water have a controlling effect on the fate and transport mechanisms. Soils at the site exist primarily as a veneer on the bedrock surface. A considerable amount of the OU-5/Site WP-1 area is covered by asphalt, roads. or buildings. The soil has both organic and iron precipitants. Nevertheless the calcium carbonate from the underlying oolite is the primary mineral present. The site drainage swales also receive runoff from the asphalted parking area located cast of Building 164.

2.7.3 Exposure Assessment

This section of the risk assessment identifies and describes potential human receptors, reviews possible pathways of exposure for compounds of concern at OU-5/Site WP-1, and presents estimates of exposure doses resulting from identified pathways at OU-5/Site WP-1. An exposure assessment is conducted to identify potential sources and mechanisms of release, transport pathways (e.g., groundwater, surface water, soil, and air), routes of exposures (ingestion, inhalation, dermal contact), and potential on-site and off-site receptor populations (current users of the site, as well as adjacent populations which may be exposed to chemicals that have been transported off-site). This information provides the basis for constructing site-specific exposure scenarios.

Two environmental media were considered in this document - groundwater and surface soil. It should be noted that guidance on what depth range should be used for surface soil differs between the USEPA (0 to 12 inches) and the Florida DEP (0 to 24 inches). Samples taken between 0 and 24 inches below land surface (bls) were considered surface soil samples, so receptor exposure during gardening or landscaping activities could be evaluated in this assessment. This choice seems reasonable for south Florida, as the year-round, mild climate would permit possible residential gardening and frequent landscaping activities on base. No subsurface soil sampling was conducted because most soil layers at OU-5/Site WP-1 are only one to two inches deep and the underlying layers are composed of limestone and bedrock. Furthermore, the sediment and surface water samples collected at OU-5/Site WP-1 from the area canals and drainage ditches are not evaluated in this document. The potential human health effects due to exposures associated with the canal system are addressed in the BRA for OU-9, Boundary Canal Evaluation, which will be submitted as a separate report.

Other information considered in the development of present and future exposure scenarios includes: physical characteristics of the site and surrounding area such as climatology, groundwater hydrology, location and description of surface water and surrounding land use and available state-specific guidelines relevant to exposure and risk assessments.

A critical step in assessing the potential risk to public health is to identify the pathways through which exposure could occur. A typical transport pathway consists of four necessary elements: 1) a source and mechanism of chemical release, 2) an environmental transport medium, 3) a point of potential contact with the contaminated medium, and 4) an exposure route (inhalation of vapors, ingestion of groundwater, etc,). All four of these elements must be present for a pathway to be complete.

Exposure Point Concentration. In accordance with USEPA methodology (1989a), the medium-specific 95 percent UCL on the arithmetic mean concentrations for the COPCs will be used as exposure point concentrations (EPCs) to estimate reasonable maximum exposure (RME). The RME approach is suggested by the USEPA (1989a) to provide an estimate of the maximum exposure (and therefore risk) that might occur. The RME. corresponds to a duration and frequency of exposure greater than is expected to occur on an average basis. In those instances where the calculated 95 percent UCL exceeds the maximum detected concentration, the maximum detected concentration was used as the EPC for a more accurate estimate of RME concentration (USEPA, 1989a).

The total number of samples collected, as well as the sources of the data used in the risk assessment and included in the database for the calculation of each COPC exposure point concentration, varied by medium.

Once the database for each medium was developed, the 95 percent UCL concentration on the arithmetic mean concentration (one-tailed test, assuming a lognormal distribution) was calculated and compared to the maximum COPC concentration to determine the EPC for each COPC. The results of these analyses for the sampled media are presented in Tables 2-13 and 2-14. The information presented in these tables is discussed in the following subsections. An example of the data reduction used to calculate the arithmetic mean and UCL for each COPC is shown in Table 2-15.

Exposure Scenarios. Exposure pathways identified at OU-5/Site WP-1 are shown in Table 2-16 and are associated with soils or groundwater. With the exception of the VOCs, the chemicals detected at the site have low environmental mobility.

Under present conditions, access to the site is limited primarily to base workers performing duties that might require site access, such as cutting the grass. COPCs detected in the surface soils include one BNA, two pesticides, nine metals, and TRPH. Base workers cutting the grass at the site could be exposed to the soils via direct contact with exposed arms and face, incidental ingestion of soils that might adhere to the hands, and inhalation of dusts or vapors generated while cutting the grass. The site is sparsely vegetated, therefore, potential exposure rates will not be reduced by a vegetation factor.

If the operation of Homestead ARB is to continue in the future, exposure pathways at the site are unlikely to change. Given the location of OU-5/Site WP-1 in the midst of base administration activity, future development of this area for intensive base operations is unlikely. Foreseeable future use conditions at the site would result in potential exposure pathways similar to those discussed for present site conditions. However, it should be noted, that damage from the hurricane would necessitate construction activities regardless of future land use.

Under current reuse plans, OU-5/Site WP-1 will be under cantonment of the US Air Force Reserve. Therefore, reuse of OU-5/Site WP-1 for residential purposes is unlikely in the foreseeable future. However, for risk characterization, hypothetical future residents were considered as receptors. Exposure pathways for hypothetical future residents would include direct contact with the surface soils, incidental ingestion of the surface soils, and inhalation of fugitive dust or vapors.

Hypothetical future construction workers were included in the risk characterization. Exposure pathways for future hypothetical construction workers would include ingestion and inhalation of soil. This receptor is evaluated for only surface soils (less than two feet) as no subsurface soil (greater than two feet) is expected at the site since most soil layers are usually one to two inches deep and the underlying layers are composed of limestone and bedrock.

Although it is unlikely that potable wells would be installed in the vicinity of the site, a conservative assumption made in this risk assessment is that a potable well is installed in the groundwater plume, downgradient of the site. Exposure of hypothetical future residents to affected groundwater via ingestion, inhalation, and dermal contact are considered potential exposure pathways.

In summary, workers cutting the grass on the site will be used to represent current exposure to the on-site soils. In the unforeseen event that the site is no longer under cantonment of the US Air Force Reserve, hypothetical future exposure pathways considered included residential development of the site. Table 2-16 and Figure 2-9 summarize the potential exposure pathways for OU-5/Site WP-1.

2.7.4 Toxicity Assessment

This section of the baseline risk assessment provides information on the human health effects of site-specific COPCs. The information presented in this section provides a basis for the dose-response assessment carried out in the quantitative risk assessment.

Evaluation of the toxic potential of a chemical involves the examination of available data that relate observed toxic effects to doses. Generally, there are two categories of information that are considered in this part of a quantitative risk assessment:

- Information on the potential acute or chronic non-cancer effects of chemicals, and
- Information on the potential for chemicals to initiate or promote cancers.

A wide variety of factors must be considered in using health effects data in qualitative or quantitative assessments. As discussed in the following subsections, there may be a variety of relationships between dose and effects. Also, the fact that some chemicals display thresholds (i.e., there are doses below which the chemical does not cause an effect) must be considered.

Non-Carcinogenic Effects. In general, non-carcinogenic (acute or chronic systemic) effects are considered to have threshold values, while carcinogenic effects are considered to not have thresholds. Toxicity studies for the former focus on identifying where this threshold occurs. The threshold can be related to a reference dose (RfD). A chronic RfD is an estimate of a daily exposure level for which people, including sensitive individuals, do not have an appreciable risk of suffering significant adverse health effects. Exposure doses above an RfD could possibly cause health effects.

Carcinogenic Effects. Studies of carcinogenicity tend to focus on identifying the slope of the linear portion of a curve of dose versus response. A plausible upper-bound value of the slope is called the cancer slope factor (CSF) or cancer potency factor (CPF). The product of the CSF and the exposure dose is an estimate of the risk of developing cancer. In accordance with current scientific policy concerning carcinogens, it is assumed that any dose, no matter how small, has some associated response. This is called a non-threshold effect. In this assessment, the non-threshold effect was applied to all probable carcinogens.

Toxicological Properties. The risks associated with exposure to COPCs at OU-5/Site WP-1 are a function of the inherent toxicity (hazard) of each chemical and the exposure dose. This section addresses the inherent toxicological properties of the COPCs. The exposure doses are estimated in the Exposure Assessment section which follows.

A distinction is made between carcinogenic and non-carcinogenic effects, and two general criteria are used to describe these effects: excess lifetime cancer risk for constituents which are thought to be potential human carcinogens and the hazard quotient (HQ) for constituents that cause non-carcinogenic effects. For potential carcinogens. the current regulatory guidelines (USEPA, 1989a) use an extremely conservative approach in which it is assumed that any level of exposure to a carcinogen could hypothetically cause cancer. This is contrary to the traditional toxicological approach to toxic chemicals, in which finite thresholds are identified, below which toxic effects are not expected to occur. This traditional approach still is applied to non-carcinogenic chemicals.

Toxicity Values. In general, CSFs, cancer classifications, RfDs, and RfCs are taken from IRIS (1996) or, in the absence of IRIS data, the USEPA Health Effects Assessment Summary Tables (HEAST) (USEPA, 1995). Because toxicity values for dermal exposure are rarely available, several adjustments were made to toxicity values for use in calculating dermal dose as per Region IV supplemental guidance to RAGS issued in March of 1994. The PAH CSFs were not adjusted to assess dermal exposure since the portal of entry differs in the outcome of tumors from oral and dermal exposure (USEPA, 1989a). Additionally, oral toxicity constants (RfDs and CSFs) were adjusted for dermal use via the application of oral absorption efficiency values obtained from Region IV supplemental guidance to RAGS issued in March of 1994. The factors used to correct both exposure dose calculations for dermal absorption from soil and the factors used to adjust oral toxicity constants (RfDs and CSFs) for use in calculating risks and hazard indices via dermal exposure are provided in Table 2-26. Unadjusted oral and inhalation RfDs are provided in Table 2-27. CSFs, cancer type or tumor sites, and carcinogen classifications for the COPCs at the site are presented in Table 2-28. Derivation of the adjusted RfDs and CSFs is shown in Table 2-29.

There are no USEPA-verified acceptable doses (i.e., RfDs) for lead. Considerable controversy currently exists concerning the appropriate acceptable doses for lead. The best method for evaluating exposure to lead is through the measurement of lead in blood or blood lead levels. Lead was evaluated in this risk assessment based on acceptable blood lead levels for young children using the USEPA (1994a) IEUBK model (LEAD 0.99d).

USEPA Region IV has adopted an approach to TPH developed by the State of Massachusetts DEP (Massachusetts DEP, 1994). This approach uses the toxicity values of certain hydrocarbon compounds (e.g. n-hexane, n-nonane, eicosane) as surrogate toxicity values for fractions of TPH (Andrews and Snyder, 1991). The toxicity of hydrocarbons tends to decrease with increasing carbon chain length. n-Hexane has an RfD of 0.06, n-nonane an RfD of 0.6, and eicosane an RfD of 6.

After review and discussion with USEPA Region IV, n-nonane was used to calculate non-cancer risks associated with exposure to Total Recoverable Petroleum Hydrocarbons (TRPHs) and tentatively identified compounds (TICs) shown to be petroleum related. The toxicity of hydrocarbons generally decreases as chain length increases (Andrews and Snyder, 1991). The light-end hydrocarbons (e.g., n-hexane) present in TPH tend to attenuate by weathering faster than heavier components, leaving the long-chain, less toxic components of TPH. Thus, use of n-nonane as a toxicity surrogate for the TPH represents a conservative (protective) approach.

TABLE 2-26

DERMAL AND ORAL ABSORPTION EFFICIENCIES FOR COMPOUNDS OF CONCERN AT SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

Constituents	Absorption Efficiencies	
	Dermal (a)	Oral (b)
VOCs		
Bromodichloromethane	0.01	0.80
Chloroform	0.01	0.80
Methylene chloride	0.01	0.80
BNAs		
Benzo(a)pyrene	0.01	0.50
Bis(2-ethylhexyl)phthalate	0.01	0.50
TRPHs (as n-nonane)	0.01	0.50
Pesticides		
Chlordane	0.01	0.50
4,4'-DDD	0.01	0.50
Metals		
Aluminum	0.001	0.20
Arsenic	0.001	0.95
Barium	0.001	0.20
Cadmium	0.001	0.20
Chromium	0.001	0.20
Copper	0.001	0.20
Lead	0.001	0.20
Manganese	0.001	0.20
Mercury	0.001	0.20
Nickel	0.001	0.20
Vanadium	0.001	0.20

(a) Used to adjust dermal dose calculation for absorption from soil as per Region IV Supplemental Guidance to RAGS Bulletin, Vol. 1 No. 1, USEPA, Atlanta, Georgia, March 1994.

(b) Used to adjust oral toxicity constants (RfDs and CPFs) to estimate effects via dermal exposure. Values as per Region IV Supplemental Guidance to RAGS Bulletin, Vol. 1 No. 1. USEPA. Atlanta, Georgia, March 1994.

TABLE 2-27

REFERENCE DOSES FOR COMPOUNDS OF CONCERN AT SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

stituent	Chronic Oral RfD (mg/kg/day)		Subchronic Oral RfD (mg/kg/day)		Chronic Inhalation RfC (mg/kg/day)		Subchronic Inhalation RfC (mg/kg/day)	
VOCs								
Bromodichloromethane	2.00E-02	a	2.00E-02	b	NA		NA	
Chloroform	1.00E-02	a	1.00E-02	b	NA		NA	
Methylene chloride	6.00E-02	a	6.00E-02	b	8.57E-01	b	8.57E-01	b
BNAs								
Benzo(a)pyrene(1)	3.00E-02	a	3.00E-01	b	NA		NA	
Bis(2-ethylhexyl)phthalate	2.00E-02	a	NA		NA		NA	
TRPHs (as n-nonane)(2)	6.00E-01	c	NA		NA		NA	
Pesticides								
Chlordane	6.00E-05	a	6.00E-05	b	NA		NA	
4,4'-DDD(3)	5.04E-04	a	5.04E-04	b	NA		NA	
Metals								
Aluminum	1.00E+00	d	NA		NA		NA	
Arsenic	3.00E-04	a	3.00E-04	b	NA		NA	
Barium	7.00E-02	a	7.00E-02	b	1.00E-04	b	1.00E-03	b
Cadmium (water)	5.00E-04	a	NA		NA		NA	
Cadmium (food)	1.00E-03	a	NA		NA		NA	
Chromium VI	5.00E-03	a	2.00E-02	b	NA		NA	
Copper	3.70E-02	a	3.70E-02	a	NA		NA	
Lead	NA		NA		NA		NA	
Manganese	2.40E-02	a	NA		1.43E-05	a	NA	
Mercury	3.00E-04	b	3.00E-04	b	8.60E-05	a	8.60E-05	b
Nickel	2.00E-02	a	2.00E-02	b	NA		NA	
Vanadium	7.00E-03	b	7.00E-03	b	NA		NA	

a IRIS, 1996
b USEPA, 1995
c Massachusetts DEP, 1994
d ECAO
(1) The pyrene RfD was used as a surrogate for the benzo(a)pyrene RfD
(2) The n-nonane RfD was used as a surrogate for TRPHs RfD
(3) The DDT RfD was used as a surrogate for the DDD RfD

TABLE 2-28

CANCER SLOPE FACTORS, TUMOR SITES, AND USEPA CANCER CLASSIFICATIONS FOR COMPOUNDS OF CONCERN AT SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

Constituent	CSF (mg/kg/day)-1				Tumor Site		USEPA Classification
	Oral		Inhalation		Oral	Inhalation	
VOCs							
Bromodichloromethane	6.20E-02	a	NA		kidney	NA	B2
Chloroform	6.10E-03	a	8.10E-02	b	kidney	liver	B2
Methylene chloride	7.50E-03	a	1.65E-03	a	liver	liver and lung	B2
BNAs							
Benzo(a)pyrene	7.30E+00	a	6.10E+00	c	stomach	respiratory tract	B2
Bis(2-ethylhexyl)phthalate	1.40E-02	a	NA		liver	NA	B2
Pesticides							
Chlordane	1.30E+00	a	1.30E+00	a	liver	liver	B2
4,4'-DDD	2.40E-01	a	NA		liver	NA	B2
Metals							
Arsenic	1.50E+00	a	1.50E+01	a	skin	respiratory tract	A
Cadmium	NAP		6.30E+00	a	NAP	respiratory tract	B1
Chromium VI	NAP		4.10E+01		NAP	lung	A
Lead	NA		NA		NA	NA	B2
Nickel(1)	NAP		8.40E-01	a	NA	NA	a

mg/kg/day	milligrams per kilogram per day
NA	Not available
NAP	Not applicable since it is considered carcinogenic via inhalation only

a	IRIS, 1996
b	USEPA, 1995
c	ECAO
(1)	Nickel refinery dust inhalation slope factor used as surrogate for nickel slope factor

TABLE 2-29

ADJUSTED TOXICITY VALUES USED TO ASSESS DERMAL EXPOSURE AT SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

Constituent	Oral Toxicity Values				Oral Absorption Efficiency	Source	Dermal Toxicity Value (Adjusted Oral)		
	RfDo	Source	CSFo	Source			RfDa	CSFa	
VOCs									
Bromodichloromethane	2.00E-02	a	6.20E-02	a	0.80	e	1.6E-02	7.8E-02	
Chloroform	1.00E-02	a	6.10E-03	a	0.80	e	8.0E-03	7.6E-03	
Methylene chloride	6.00E-02	a	7.50E-03	a	0.80	e	4.8E-02	9.4E-03	
BNAs									
Benzo(a)pyrene[f]	3.00E-02	a	7.30E+00	a	0.50	e	NA	NA	j
Bis(2-ethylhexyl)phthalate	2.00E-02	a	1.40E-01	a	0.50	e	1.0E-02	2.8E-02	
TRPHs (as n-nonane)[g]	6.00E-01	d	NA		0.50	e	3.0E-01	NA	
Pesticides									
Chlordane	6.00E-05	a	1.30E+00	a	0.50	e	3.0E-05	2.6E+00	
4,4'-DDD[h]	5.04E-04	a	2.40E-01	a	0.50		2.5E-04	4.8E-01	
Metals									
Aluminum	1.00E+00	c	NA		0.20	e	2.0E-01	NA	
Arsenic	3.00E-04	a	1.50E+00	a	0.95	i	2.9E-04	1.6E+00	
Barium	7.00E-02	a	NA		0.20	e	1.4E-02	NA	
Cadmium (water)	5.00E-04	a	NAP		0.20	e	1.0E-04	NA	
Cadmium (food)	1.00E-03	a	NAP		0.20	e	2.0E-04	NA	
Chromium	5.00E-03	a	NAP		0.20	e	1.0E-03	NA	
Copper	3.70E-02	a	NA		0.20	e	7.4E-03	NA	
Lead	NA	a	NA		0.20	e	NA	NA	
Manganese	2.40E-02	a	NA		0.20	e	4.8E-03	NA	
Mercury	3.00E-04	b	NA		0.20	e	6.0E-05	NA	
Nickel	2.00E-02	a	NAP		0.20	e	4.0E-03	NA	
Vanadium	7.00E-03	b	NA		0.20	e	1.4E-03	NA	

CSFa	Adjusted cancer slope factor $(mg/kg/day)^{-1}$.
CSFo	Oral cancer slope factor $(mg/kg/day)^{-1}$.
NA	Not available.
NAP	Not applicable, carcinogenic only by inhalation route.
RfDa	Adjusted reference dose (mg/kg/day).
RfDo	Oral reference dose (mg/kg/day).

a	IRIS, 1996
b	USEPA, 1995
c	ECAO
d	Massachusetts DEP, 1994
e	Default value as per Region IV Supplemental Guidance to RAGS Bulletin, Vol. 1, No. 1, USEPA, Atlanta, Georgia, March 1994.
f	Pyrene RfD used as surrogate for benzo(a)pyrene RfD
g	The n-nonane RfD was used as a surrogate for TRPHs RfD
h	DDT RfD used as surrogate for DDD RfD
i	National Research Council, 1982
j	PAH slope factors were not adjusted to assess dermal exposure since the portal of entry differs in the outcome of tumors from oral and dermal exposure (USEPA, 1989a).

The CSFs for benzo(a)pyrene were used to calculate cancer risks associated with exposure to all carcinogenic PAHs at the site. In accordance with USEPA Region IV guidance (USEPA, 1992b), the oral CSF and inhalation CSF for benzo(a)pyrene were converted using toxicity equivalency factors (TEFs) for each individual carcinogenic PAH. This approach is based on the relative potency of each compound to the potency of benzo(a)pyrene (USEPA, 1992b). There are a limited number of RfDs available for the PAHs detected at the site. The following PAHs have USEPA-verified RfDs: fluoranthene and pyrene. The RfD for pyrene was used to calculate non-cancer risks associated with exposure to detected non-carcinogenic PAHs not having individual RfDs.

2.7.5 Risk Characterization

This section of the baseline risk assessment describes how calculated exposure doses are converted into health risks. This section characterizes risks as part of a quantitative risk assessment for the site. Risk characterization involves the integration of health effects information developed as part of the dose-response assessment with exposure estimates developed as part of the exposure assessment. The result is a quantitative estimate of chronic and non-carcinogenic risks based on the presumption that a threshold dose is required to elicit a response, as well as a quantitative estimate of carcinogenic risks presumed to exist regardless of the dose. These estimates are usually presented in either probabilistic terms (e.g., one-in-one-million), or with reference to specific benchmark or threshold levels. Because risk estimates are based on a combination of measurements and assumptions, it is important to provide information on sources of uncertainty in risk characterization. The key elements of risk characterization included in this section are: an estimation of human dose, an estimation of risk, a presentation of risk, and an uncertainty analysis.

2.7.5.1 Carcinogenic Risks. Public health risks are evaluated separately for carcinogenic and non-carcinogenic effects. The excess lifetime cancer risk is an estimate of the increasedrisk of cancer which results from lifetime exposure, at specified average daily dosages, to chemicals detected in media at the site. Excess lifetime cancer risk, equal to the product of the exposure dose and the slope factor, is estimated for each known, probable, or possible carcinogenic chemical in each medium. The risk values provided in this report are an indication of the increased risk, above that applying to the general population, which may result from the exposure scenarios described in the Exposure Assessment Section 2.7.3. The risk estimate is considered to be an upperbound estimate; therefore, it is likely that the true risk is less than that predicted by the model. Current regulatory methodology assumes that excess lifetime cancer risks can be summed across routes of exposure and constituents to derive a "Total Site Risk" (USEPA, 1989a). The USEPA, OSWER Directive 9355.0-30, Role of the Risk Assessment in Superfund Remedy Selection Decisions (1991e) has stated that sites with an excess lifetime cancer risk less than 10^{4} (1 in 10,000) generally do not warrant remedial action. However, the state of Florida's target cancer risk is 10^{-6}.

The incremental risk is calculated for each exposure scenario based on the following basic equation:

$$\text{Cancer Risk} = \text{Exposure Dose x Slope Factor}$$

where the slope factor (SF) is in units of $(\text{mg/kg/day})^{-1}$ based on a compound specific cancer bioassay dose response curve.

The exposure dose is adjusted over a 70-year lifetime. The summation of dose is in keeping with the concept that for genotoxic agents there exists no threshold dose and implies that total, lifetime exposure is of greater importance than the actual dose during the exposure event(s). Ingestion and inhalation risks are calculated separately since chemicals often have differentSFs for differing routes of exposure. The different SFs relate to the pharmacokinetics inherent in each chemical/organ and the specific routes of uptake.

Slope factors are derived by USEPA in an intentionally conservative way, that is, the actual risk is not expected to exceed the predicted risk, and could be considerably lower. Cancer risks calculated using these conservative slope factors and reasonable maximum exposure estimates are upper bound estimates of excess cancer risk potentially arising from exposure to the chemicals in question. A number of assumptions have been made in the derivation of these values, many of which are likely to overestimate exposure and toxicity. The actual incidence of excess cancers is likely to be lower than these estimates and may be zero.

Lifetime daily intakes, using an averaging time of up to 70 years, effectively prorates the total cumulative dose over a lifetime. This approach is based on the assumption for carcinogens that a high dose received over a short period of time at any age is equivalent to a corresponding low dose received over a lifetime (USEPA, 1989a). This assumption is unlikely to be true for all carcinogens, and introduces uncertainty into the assessment of potential risk. This assumption may also lead to an overestimate or underestimate of potential risk, depending upon the actual timing of exposure and the mechanism of action of individual carcinogens.

The magnitude of cancer risk relative to Superfund site remediation goals in the National Contingency Plan ranges from 10^{-4} (one-in-ten-thousand) to 10^{-6} (one-in-one-million) depending on the site, proposed usage, and chemicals of concern (USEPA, 1989a). Within this range, the level of risk which is considered to be acceptable at a specific site is a risk management decision and is decided on a case-specific basis. It is generally accepted that risks above this range require attention. The one-in-a-million level of risk (expressed as 1E-06) is often referred to as the de minimis level of risk; risks calculated below this range would not require attention. The 1E-06 risk level does not equate to an actual cancer incidence of one-in-a-million. For substances that may cause cancer, the risk assessment process uses animal data to predict the probability of humans developing cancer over a 70-year lifetime. The numbers are given as upper bounds; the real risk is expected to be less. The one-in-a-million risk level is a theoretical prediction that no more than one person out of a million lifetimes would contract cancer due to an environmental exposure. By the way of comparison, the average person in the U.S. incurs a background risk of cancer (from all causes) of about one chance in four (0.25). Adding a risk of 0.000001 to a background risk of 0.25 is of little significance to any single individual. These small risk levels may be of concern only if the exposed population includes many millions of people.

2.7.5.2 Chronic Health Risks. The HQ is the ratio of the estimated exposure dose to the RfD. This ratio is used to evaluate non-carcinogenic health effects due to exposure to a chemical. An HQ greater than 1 indicates that the estimated exposure dose for that chemical exceeds acceptable levels for protection against non-carcinogenic effects. Although an HQ of less than 1 suggests that non-carcinogenic health effects should not occur, an HQ of slightly greater than 1 is not necessarily an indication that adverse effects will occur. The sum of the HQs is termed the hazard index (HI). Current regulatory methodology assumes that HIs can be summed across exposure routes for all media at the site to derive a "Total Site Risk" (USEPA, 1989a). The USEPA, OSWER Directive 9355.0-30, Role of Risk Assessment in Superfund Remedy Selection Decisions (1991e) has stated that sites with a non-carcinogenic HQ less than 1 generally do not warrant remedial action.

The USEPA has developed a set of health based benchmark numbers, called reference doses, or RfDs, as guideposts in a risk assessment. Reference doses are an adaptation of the earlier toxicological measure of "acceptable daily dose" or ADI. The unit of a reference dose is mg contaminant/kg body weight/day. The potential for adverse effects on human health (other than cancer) is evaluated by comparing an intake over a specific time period with a reference dose derived for a similar exposure period.

The hazard index is the ratio (unitless) of the estimated exposure dose (D) of a compound to a reference dose (RfD) judged to be without adverse effects given long-term exposure. Thus, the index is used as a measure of potential noncarcinogenic health risks. Due to the margin of safety built into the RfD value, exceedence of the number has no immediate meaning with regard to specific health effects, the frequency of effects, or the magnitude of effects. However, exceedence of the number should serve as an indicator that the potential for unacceptable exposure does exist and further evaluation needs to be considered. The effects of noncarcinogens in the body vary greatly with regard to potential target organs, threshold dose, and "severity" of effect. Therefore, the individual toxicity for each compound needs to be assessed.

If the hazard index is less than 1.0, then no chronic health effects are expected to occur. If the hazard index is greater than 1.0, then adverse health risks are possible. In the case of noncarcinogenic effects, chronic exposure below a threshold dose results in a non-response or a diminished response.

2.7.5.3 Risks Associated With Exposure to Groundwater. Risks for a hypothetical future adult resident exposed to groundwater are shown in Table 2-30. The excess lifetime cancer risk and HI are 5E-04 and 3, respectively. The excess lifetime cancer risk level associated with hypothetical future resident conditions at the site is above the USEPA remediation-based risk benchmarks for carcinogens (10^{-4} to 10^{-6}) and above the state of Florida's criterion of 1E-06. The hazard index also exceeds the risk benchmark of one.

In accordance with current USEPA Region IV guidance (USEPA, 1995d), the inhalation and dermal exposure to VOCs during showering are assumed to be equivalent to the ingestion dose. This is based on a growing body of evidence that risk estimates from ingestion of VOCs in potable water, inhalation of volatiles from showering, and dermal exposure to volatiles during showering or bathing are similar (Andelman, 1985; Andelman, et.al., 1986, 1987; McKone, 1987, and Jo, et.al., 1990). Given this assumption, risks via the inhalation and dermal routes for groundwater contact can be calculated using the oral dose (mg/kg/day-1) and multiplying by the inhalation slope factor for carcinogens and dividing by the RfD for noncarcinogens. No inhalation RfCs were available for bromodichloromethane and chloroform, thus, oral RfDs are used for these compounds. Therefore, the total risk via groundwater contact including oral, dermal and inhalation exposures is 5E-04 for cancer risk and 3 for noncancer risk. Inorganics, including arsenic are not expected to volatilize from the water droplet, thus, the primary exposure routes via groundwater use would be ingestion

TABLE 2-30

GROUNDWATER INGESTION EXPOSURE DOSES AND RISK CALCULATIONS FOR A HYPOTHETICAL FUTURE ADULT RESIDENT AT SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

Constituent	Cgw (mg/L)	GWExD (mg/kg-day)	Toxicity Values	Calculated Risk
CANCER EFFECTS			**CSFo**	
VOCs				
Bromodichloromethane	0.004	4.2E-05	6.20E-02	2.6E-06
Chloroform	0.004	4.2E-05	6.10E-03	2.6E-07
Methylene Chloride	0.003	3.9E-05	7.5E-03	2.9E-07
BNAs				
Bis(2-Ethylhexyl)phthalate	0.04	4.5E-04	1.4E-02	6.3E-06
Metals				
Arsenic	0.026	3.1E-04	1.50E+00	4.6E-04
Chromium	0.0292	3.4E-04	NAP	NAP
Lead	0.0073	8.6E-05	-	-
Nickel	0.0108	1.3E-04	NAP	NAP
			ELCR =	5E-04
NON-CANCER EFFECTS			**RfDo**	
VOCs				
Bromodichloromethane	0.004	9.9E-05	2.0E-02	4.9E-03
Chloroform	0.004	9.9E-05	1.0E-02	9.9E-03
Methylene chloride	0.003	9.0E-05	6.0E-02	1.5E-03
BNAs				
Bis(2-Ethylhexyl)phthalate	0.0385	1.1E-03	2.0E-02	5.3E-02
Metals				
Aluminum	4.266	1.2E-01	1.0E+00	1.2E-01
Arsenic	0.026	7.2E-04	3.0E-04	2.4E+00
Barium	0.0372	1.0E-03	7.0E-02	1.5E-02
Chromium (VI)	0.0292	8.0E-04	5.0E-03	1.6E-01
Lead	0.0073	2.0E-04	-	-
Manganese	0.044	1.2E-03	2.40E-02	5.0E-02
Nickel	0.0108	3.0E-04	2.00E-02	1.5E-02
Vanadium	0.0164	4.5E-04	7.00E-03	6.4E-02
			HI =	3E+00

S	Insufficient data; USEPA-verified toxicity value not available.
NAP	Cancer slope factor and/or reference dose applies to inhalation pathway only, not to ingestion.
Cgw	Constituent exposure point concentration in groundwater in milligrams per liter (mg/L) (see Table 4-2).
GWExD	Ground-water exposure dose in milligrams per kilogram per day (mg/kg/day).
CSFo	Cancer Slope Factor, Oral
RfDo	Reference Dose, Oral
ELCR	Excess lifetime cancer risk.
HI	Hazard index (sum of the hazard quotients).

and to a small degree dermal. The dermal dose is expected to be two to three orders of magnitude less than oral dose.

The primary contributor to the carcinogenic risk estimate is arsenic (98% of the calculated risk). This compound was detected in nine of nine samples at concentrations ranging from 3.9 µg/l to 92 µg/l. Two of the nine samples had arsenic concentrations (60 and 92 µg/l) higher than the state and federal drinking water standard of 50 µg/l. The arsenic risk level is based on unfiltered samples which exhibited high turbidity during the 1991 G&M sampling program. Therefore, this level probably overestimates concentrations in a hypothetical potable well. Further, the presence of arsenic in groundwater in southeast Florida is common and future use as a potable supply is unlikely due to high levels of dissolved solids associated with the salt-water intrusion.

The definition of an EPC representing the groundwater plume area for this site is difficult and is complicated by the turbid sampling conditions noted in 1991. Although, all four wells were re-sampled in 1996, no removal actions affecting groundwater has occurred at the site. Therefore, the selection of data points best representing the arsenic concentrations in groundwater may need additional examination.

As previously stated in Section 2.7.1 of this document, the total unfiltered groundwater sampling results for arsenic at OU 5/Site WP-1 are as follows:

(1) Four samples were collected by G&M in 1991 from wells SP1-I-01 (92 ug/L), SPl-I-02 (60 ug/L), SP1-I-03 (19 ug/L) and SP1-MW-0001 (11 ug/L). All of the water sampling logs from the 1991 G&M data indicated turbid conditions;

(2) One sample was collected by MW in 1993 from SP1-I-02 (18.4 ug/L, 18.1 ug/L in the duplicate). MW also collected a filtered sample and duplicate from SP1-I-02 and detected concentrations of 16.1 ug/l and 16.7 ug/l, respectively; and

(3) Four samples were collected from all of the wells by OHM in 1996, SP1-I-01 (9.6 ug/L), SP1-I-02 (15.3 ug/L, 14.8 ug/L in the duplicate), SP1-I-03 (3.9 ug/L), and SP1-MW-0001 (7.8 ug/L).

Although the 1991 G&M data is not considered to represent actual groundwater conditions, in order to be conservative, a groundwater EPC of 26 ug/L was used in the risk calculations. This represents the arithmetic average of the four wells which are assumed to constitute the concentrated area of the plume. Therefore, this EPC is considered a reasonably conservative number.

However, if the construction of the groundwater EPCs was changed based on the apparent sampling method discrepancies in 1991, risk estimates would be changed as well. The following information shows the range of risk estimates via exposure to groundwater for different EPCs:

<u>If all data points (G&M, 1991; MW, 1993: and OHM, 1996) are considered -</u>
For the maximum concentration of 92ug/L, the ELCR = 2E-03 and the HI = 9E+00
For the average concentration of 26 ug/L, the ELCR = 2E-04 and the HI = 3E+00
(26 ug/L represents the EPC used in the risk calculations presented in this assessment)

<u>If only the MW, 1993, and OHM, 1996 data are considered -</u>
For the maximum concentration of 18 ug/L, the ELCR = 3E-04 and the HI = 2E+00
For the average concentration of 11 ug/L, the ELCR = 2E-04 and the HI = 1E+00

<u>If only the most recent sampling (OHM, 1996) is considered -</u>
For the maximum concentration of 15 ug/L, the ELCR = 3E-04 and the HI = 2E+00
For the average concentration of 9 ug/L, the ELCR = 2E-04 and the HI = 1E+00

Therefore the potential risks associated with groundwater exposures could range from 2E-03 to 2E-04 for cancer and from 9E+00 to 1E+00 for noncancer risks. These values are above the USEPA remediation-based risk benchmarks for carcinogens (10^{-4} to 10^{-6}) and above the state of Florida's criterion of 1E-06. The hazard indices also exceed the risk benchmark of one.

A lesser, secondary contributor to the carcinogenic risk estimate is bis(2-ethylbexyl)phthalate (1.4% of the calculated risk). Bis(2-ethylhexyl)phthalate was detected in four of nine samples at concentrations ranging from 0.3 µg/L to 320 µg/L. The maximum value for this chemical was used as the exposure point concentration in the risk calculations. The cancer risk (6E-06) is within the US EPA remediation-based risk benchmark, but above the state criteria.

However, these exceedances are of limited significance due to the unlikely use of this groundwater as a potable supply. The use of potable wells on-base has been replaced with the use of off-base wells because of high dissolved solids due to salt-water intrusion. Finally, the future military land reuse of the site makes potable uses of groundwater even more remote.

2.7.5.4 Risks Associated With Exposure to Soils. Base Worker. Risks for a potential current base worker who regularly accesses OU-5/Site WP-1 are calculated in Table 2-31. The ELCR and HI are 2E-07 and 4E-03, respectively. These risk levels are below the USEPA remediation-based risk benchmarks.

Hypothetical Future Residents. The risks for hypothetical future residents exposed to onsite soils are calculated in Tables 2-32 (adult, 24-year exposure period) and 2-33 (young child, 6-year exposure period). For an adult, the ELCR and HI are 9E-06 and 2E-01, respectively. The ELCR and HI for the child are 2E-05 and 1E+00, respectively. Both the adult and child cancer risk estimates and the adult hazard index are below the USEPA remediation-based risk benchmarks. The hazard index for the child is equal to the benchmark of 1.0.

Hypothetical Future Construction Worker. Risks for future construction workers who would access OU-5/Site WP-1 are calculated in Table 2-34. The risks are estimated for construction worker exposure to surface soils via inhalation and ingestion routes of exposure. The ELCR and HI are 1E-06 and 5E-01, respectively. The cancer risk estimate is equal to the USEPA remediation-based risk benchmarks of IE-06, and HI is below the benchmarks of 1.

2.7.5.5 Lead. The USEPA has identified a 10 to 15 µg/dL blood lead level as a range of potential concern for health effects in children (Federal Register, 1988b). The results from the IEUBK model using soil and groundwater data are listed in Table 2-35. The model predicted that 94% of children exposed to lead at concentrations at OU-5/Site WP-1 would have blood lead concentration below the 10 µg/dL acceptable blood lead level. For this site, the model assumes the child is exposed to a concentration of 120 mg/kg of lead (represents the maximum concentration) in surface soil and 30 µg/l of lead (represents the maximum concentration) in groundwater. The model used USEPA default exposure assumptions and used the EPCs calculated from the site data, conservatively assuming a lognormal distribution.

Although the maximum concentration of lead detected in unfiltered groundwater samples (30 µg/l) is greater than the federal treatment technique level in drinking water (15 µg/1), this concentration is not anticipated to be the delivered concentration in drinking water, as water

TABLE 2-31

SOIL EXPOSURE DOSES AND RISK CALCULATIONS
FOR A POTENTIAL CURRENT BASE WORKER AT
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida

Constituent	Cs (mg/kg)	SexDo (mg/kg-day)	SexDd (mg/kg-day)	SExDi (mg/kg-day)	Toxicity Values			Calculated Risk/HI
CANCER EFFECTS					CSFo	CSFd	CSFi	
BNAs								
Benzo(a)pyrene	0.46	1.7E-08	1.1E-08	2.3E-13	7.3E+00	7.3E+00	6.1E+00	2.0E-07
Pesticides/PCBs								
Chlordane Isomers	1.4	5.1E-08	3.2E-08	7.0E-13	1.3E+00	2.6E+00	1.3E+00	1.5E-07
4,4'-DDD	1.4	5.1E-08	3.2E-08	7.0E-13	2.4E-01	4.8E-01	2.4E-01	2.8E-08
Metals								
Arsenic	7.8	2.8E-07	1.8E-08	3.9E-12	1.5E+00	1.6E+00	1.5E+01	4.5E-07
Cadmium	1.4	5.1E-08	3.2E-09	7.0E-13	NAP	NAP	6.3E+00	4.4E-12
Chromium (VI)	18	6.5E-07	4.1E-08	9.0E-12	NAP	NAP	4.1E+01	3.7E-10
Nickel	300	1.1E-05	6.9E-07	1.5E-10	NAP	NAP	8.4E-01	1.3E-10
						ELCR		8E-07
NON-CANCER EFFECTS								
					RfDo	RfDd	RfDi	
BNAs								
Benzo(a)pyrene	0.46	4.7E-08	3.0E-08	6.4E-13	3.0E-02	1.5E-02	3.0E-02	3.5E-06
TRPHs (as n-nonane)	3322	3.4E-04	2.1E-04	4.7E-09	6.0E-01	3.0E-01	6.0E-01	1.3E-03
Pesticides/PCBs								
Chlordane Isomers	1.4	1.4E-07	9.0E-08	2.0E-12	6.0E-05	3.0E-05	6.0E-05	5.4E-03
4,4'-DDD	1.4	1.4E-07	9.0E-08	2.0E-12	5.05-04	2.5E-04	5.0E-04	6.5E-04
Metals								
Aluminum	6453	6.6E-04	4.2E-05	9.0E-09	1.0E+00	2.0E-01	1.0E+00	8.6E-04
Arsenic	7.8	7.9E-07	5.0E-08	1.1E-11	3.0E-04	2.9E-04	3.0E-04	2.8E-03
Cadmium	1.4	1.4E-07	9.0E-09	2.0E-12	1.0E-03	2.0E-04	1.0E-03	1.9E-04
Chromium (VI)	18	1.8E-06	1.2E-07	2.5E-11	5.0E-03	1.0E-03	5.0E-03	4.8E-04
Copper	160	1.6E-05	1.0E-06	2.2E-10	3.7E-02	7.4E-03	3.7E-02	5.8E-04
Manganese	184	1.9E-05	1.2E-06	2.6E-10	2.4E-02	4.8E-03	1.4E-05	1.0E-03
Mercury	0.2	2.0E-08	1.3E-09	2.8E-43	3.0E-04	6.0E-05	8.6E-05	8.9E-05
Nickel	300	3.1E-05	1.9E-06	4.2E-10	2.0E-02	4.0E-03	2.0E-02	2.0E-03
Vanadium	12	1.2E-06	7.7E-08	1.7E-11	7.0E-03	1.4E-03	7.0E-03	2.3E-04
						HI		2E-02

ELCR	Excess lifetime cancer risk.	CSFO	Cancer Slope Factor. Oral
HI	Hazard index (sum of the hazard quotients)	CSFd	Cancer Slope Factor. Dermal
Cs	Concentration of chemical in soil (mg/kg)	CSFi	Cancer Slope Factor. Inhalation
SExDo	Soil exposure does, oral route	RfDo	Reference Dose, Oral
SExDd	Soil exposure does, dermal route	RfDd	Reference Dose, Dermal
SExDo	Soil exposure dose, inhalation route	RfDi	Reference Does, Inhalation
NAP	Not applicable, carcinogenic via inhalation pathway only		

TABLE 2-32

SOIL EXPOSURE DOSES AND RISK CALCULATIONS
FOR A HYPOTHETICAL FUTURE ADULT RESIDENT AT
SITE WP-1/OU-S, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida

Constituent	Cs (mg/kg)	SexDo (mg/kg-day)	SexDd (mg/kg-day)	SExDi (mg/kg-day)	Toxicity Values			Calculated Risk/HI
CANCER EFFECTS					CSFo	CSFd	CSFi	
BNAs								
Benzo(a)pyrene	0.46	2.2E-07	6.8E-08	1.2E-11	7.3E+00	7.3E+00	6.1E+00	2.1E-06
Pesticides/PCBs								
Chlordane Isomers	1.4	6.6E-07	2.1E-07	3.6E-11	1.3E+00	2.6E+00	1.3E+00	1.4E-06
4,4'-DDD	1.4	6.6E-07	2.1E-07	3.6E-11	2.4E-01	4.8E-01	2.4E-01	2.6E-07
Metals								
Arsenic	7.8	3.7E-06	1.2E-07	2.0E-10	1.5E+00	1.6E+00	1.5E+01	5.7E-06
Cadmium	1.4	6.6E-07	2.1E-08	3.6E-11	NAP	NAP	6.3E+00	2.3E-10
Chromium (VI)	18	8.5E-06	2.7E-07	4.6E-10	NAP	NAP	4.1E+01	1.9E-08
Nickel	300	1.4E-04	4.5E-06	7.7E-09	NAP	NAP	8.4E-01	6.5E-09
						ELCR		9E-06
NON-CANCER EFFECTS								
					RfDo	RfDd	RfDi	
BNAs								
Benzo(a)pyrene	0.46	6.3E-07	2.0E-07	3.5E-11	3.0E-02	1.5E-02	3.0E-02	3.4E-05
TRPHs (as n-nonane)	3322	4.6E-03	1.4E-03	2.5E-07	6.0E-01	3.0E-01	6.0E-01	1.2E-02
Pesticides/PCBs								
Chlordane Isomers	1.4	1.9E-06	6.1E-07	1.1E-10	6.0E-05	3.0E-05	6.0E-05	5.2E-02
4,4'-DDD	1.4	1.9E-06	6.1E-07	1.1E-10	5.0E-04	2.5E-04	5.0E-04	6.3E-03
Metals								
Aluminum	6453	8.8E-03	2.8E-04	4.8E-07	1.0E+00	2.0E-01	1.0E+00	1.0E-02
Arsenic	7.8	1.1E-05	3.4E-07	5.9E-10	3.0E-04	2.9E-04	3.0E-04	3.7E-02
Cadmium	1.4	1.9E-06	6.1E-08	1.1E-10	1.0E-03	2.0E-04	1.0E-03	2.2E-03
Chromium (VI)	18	2.5E-05	7.8E-07	1.4E-09	5.0E-03	1.0E-03	5.0E-03	5.7E-03
Copper	160	2.2E-04	6.9E-06	1.2E-08	3.7E-02	7.4E-03	3.7E-02	6.9E-03
Manganese	184	2.5E-04	8.0E-06	1.4E-08	2.4E-02	4.8E-03	1.4E-05	1.3E-02
Mercury	0.2	2.7E-07	8.7E-09	1.5E-11	3.0E-04	6.0E-05	8.6E-05	1.1E-03
Nickel	300	4.1E-04	1.3E-05	2.3E-08	2.0E-02	4.0E-03	2.0E-02	2.4E-02
Vanadium	12	1.6E-05	5.2E-07	9.0E-10	7.0E-03	1.4E-03	7.0E-03	2.7E-03
						HI		2E-01

ELCR	Excess lifetime cancer risk.	CSFo	Cancer Slope Factor, Oral
HI	Hazard index (sum of the hazard quotients)	CSFd	Cancer Slope Factor Dermal
Cs	Concentration of chemical in soil (mg/kg)	CSFi	Cancer Slope Factor, Inhalation
SExDo	Soil exposure dose, Oral route	RfDo	Reference Dose, Oral
SExDd	Soil exposure dose, dermal route	RfDd	Reference Dose, Dermal
SExDi	Soil exposure dose, inhalation route	RfDi	Reference Dose, inhalation
NAP	Not applicable, carcinogenic via inhalation pathway only		

TABLE 2-33

SOIL EXPOSURE DOSES AND RISK CALCULATIONS FOR A HYPOTHETICAL FUTURE CHILD RESIDENT AT SITE WP-1/OU-S, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Best, Florida

Constituent	Cs (mg/kg)	SexDo (mg/kg-day)	SexDd (mg/kg-day)	SExDi (mg/kg-day)	Toxicity Values			Calculated Risk/HI
CANCER EFFECTS					CSFo	CSFd	CSFi	
BNAs								
Benzo(a)pyrene	0.46	5.0E-07	9.2E-08	1.4E-11	7.3E+00	7.3E+00	6.1E+00	4.4E-06
Pesticides/PCBs								
Chlordane Isomers	1.4	1.5E-07	2.8E-07	4.2E-11	1.3E+00	2.6E+00	1.3E+00	2.7E-06
4,4'-DDD	1.4	1.5E-07	2.8E-07	4.2E-11	2.4E-01	4.8E-01	2.4E-01	5.0E-07
Metals								
Arsenic	7.8	8.5E-06	1.6E-07	2.0E-10	1.5E+00	1.6E+00	1.5E+01	1.3E-05
Cadmium	1.4	1.5E-06	2.8E-08	4.2E-11	NAP	NAP	6.3E+00	2.7E-10
Chromium (VI)	18	2.0E-05	3.6E-07	5.4E-10	NAP	NAP	4.1E+01	2.2E-08
Nickel	300	3.3E-04	6.0E-06	9.0E-09	NAP	NAP	8.4E-01	7.6E-09
						ELCR		2E-05
NON-CANCER EFFECTS								
					RfDo	RfDd	RfDi	
BNAs								
Benzo(a)pyrene	0.46	5.9E-06	1.1E-06	1.6E-10	3.0E-02	1.5E-02	3.0E-02	2.7E-04
TRPHs (as n-nonane)	3322	4.2E-02	7.8E-03	1.2E-06	6.0E-01	3.0E-01	6.0E-01	9.7E-02
Pesticides/PCBs								
Chlordane Isomers	1.4	1.8E-05	3.3E-06	4.9E-10	6.0E-05	3.0E-05	6.0E-05	4.1E-01
4,4'-DDD	1.4	1.8E-05	3.3E-06	4.9E-10	5.0E-04	2.5E-04	5.0E-04	4.9E-02
Metals								
Aluminum	6453	8.3E-02	1.5E-03	2.3E-06	1.0E+00	2.0E-01	1.0E+00	9.0E-02
Arsenic	7.8	1.0E-04	1.8E-06	2.7E-09	3.0E-04	2.9E-04	3.0E-04	3.4E-01
Cadmium	1.4	1.8E-05	3.3E-07	4.9E-10	1.0E-03	2.0E-04	1.0E-03	2.0E-02
Chromium (VI)	18	2.3E-04	4.2E-06	6.3E-09	5.0E-03	1.0E-03	5.0E-03	5.0E-02
Copper	160	2.0E-03	3.7E-05	5.6E-08	3.7E-02	7.4E-03	3.7E-02	6.0E-02
Manganese	184	2.4E-03	4.3E-05	6.5E-08	2.4E-02	4.8E-03	1.4E-05	1.1E-01
Mercury	0.2	2.6E-06	4.7E-08	7.0E-11	3.0E-04	6.0E-05	8.6E-05	9.3E-03
Nickel	300	3.8E-03	7.0E-05	1.1E-07	2.0E-02	4.0E-03	2.0E-02	2.1E-02
Vanadium	12	1.5E-04	2.8E-06	4.2E-09	7.0E-03	1.4E-03	7.0E-03	2.7E-03
						HI		1E+00

ELCR	Excess lifetime cancer risk	CSFo	Cancer Slope Factor. Oral
HI	Hazard index (sum of the hazard quotients)	CSFd	Cancer Slope Factor, Dermal
Cs	Concentration of chemical in soil (mg/kg)	CSFi	Cancer Slope Factor, Inhalation
SExDo	Soil exposure does, Oral route	RfDo	Reference Dose, Oral
SExDd	Soil exposure dom dermal route	RfDd	Reference Dose, Dermal
SExDi	Soil exposure dose, inhalation route	RfDi	Reference Dose, Inhalation
NAP	Not applicable, carcinogenic via inhalation pathway only		

TABLE 2-34

SOIL EXPOSURE DOSES AND RISK CALCULATIONS FOR A HYPOTHETICAL FUTURE CONSTRUCTION WORKER AT SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA

Homestead Air Reserve Base, Florida

Contstituent	Cs Surface (mg/kg-day)	Surface Soil SExDo (mg/kg-day)	Surface Soil SExDi (mg/kg-day)	Toxicity Values		Surface Soil Calculated Risk/HI
CANCER EFFECTS				CSFo	CSFi	
BNAs						
Benzo(a)pyrene	0.46	3.1E-08	3.5E-13	7.3E+00	6.1E+00	2.3E-07
Pesticides/PCBs						
Chlordane Isomers	1.4	9.4E-08	1.1E-12	1.3E+00	1.3E+00	1.2E-07
4,4'-DDD	1.4	9.4E-08	1.1E-12	2.4E-01	2.4E-01	2.3E-08
Metals						
Arsenic	7.8	5.2E-07	6.0E-12	1.5E+00	1.5E+01	7.9E-07
Cadmium	1.4	9.4E-08	1.1E-12	NAP	6.3E+00	6.8E-12
Chromium (VI)	18	1.2E-06	1.4E-11	NAP	4.1E+01	5.7E-10
Nickel	300	2.0E-05	2.3E-10	NAP	8.4E-01	1.9E-10
				ELCR (Surface Soil Exposure)		1E-06
NON-CANCER EFFECTS						
				RfDo	RfDi	
BNAs						
Benzo(a)pyrene	0.46	2.2E-06	2.5E-11	3.0E-01	3.0E-01	7.2E-06
TRPHs (as n-nonane)	3322	1.6E-02	1.8E-07	6.0E-01	6.0E-01	2.6E-02
Pesticides/PCBs						
Chlordane Isomers	1.4	6.6E-06	7.5E-11	6.0E-05	6.0E-05	1.1E-01
4,4'-DDD	1.4	6.6E-06	7.5E-11	5.0E-04	5.0E-04	1.3E-02
Metals						
Aluminum	6453	3.0E-02	3.5E-07	1.0E+00	1.0E+00	3.0E-02
Arsenic	7.8	3.7E-05	4.2E-10	3.0E-04	3.0E-04	1.2E-01
Cadmium	1.4	6.6E-06	7.5E-11	1.0E-03	1.0E-03	6.6E-03
Chromium (VI)	18	8.5E-05	9.7E-10	2.0E-02	2.0E-02	4.2E-03
Copper	160	7.5E-04	8.6E-09	3.7E-02	3.7E-02	2.0E-02
Maganese	184	8.6E-04	9.9E-09	2.4E-02	1.4E-02	3.7E-02
Mercury	0.2	9.4E-07	1.1E-11	3.0E-04	8.6E-04	3.1E-03
Nickel	300	1.4E-03	1.6E-08	2.0E-02	2.0E-02	7.0E-02
Vanadium	12	5.6E-05	6.5E-10	7.0E-03	7.0E-03	8.1E-03
				HI (Surface Soil Exposure)		5E-01

ELCR	Excess lifetime cancer risk.	CSFo	Cancer Slope Factor, Oral
HI	Hazard index (sum of the hazard quotients)	CSFd	Cancer Slope factor, Dermal
Cs	Concentration of chemical in soil (mg/kg)	CSFi	Cancer Slope Factor, Inhalation
SExDo	Soil exposure dose, oral route	RfDo	Reference Dose Oral
SExDd	Soil exposure dose, dermal route	RfDd	Reference Dose. Dermal
SExDi	Soil exposure dose, inhalation route	RfDi	Reference Dose, Inhalation
NAP	Not applicable, carcinogenic via inhalation pathway only		

TABLE 2-35

MODELED BLOOD LEAD LEVELS IN HYPOTHETICAL CHILDREN (AGED 0 TO 6), SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
Homestead Air Reserve Base, Florida

			Blood Lead Level[b]		
Study Site	**Medium**	**Concentration[a]**	**Geometric Mean µg/dL**	**Percent Below 10 µg/dL**	**Percent Below 15 µg/dL**
WP-1/OU-5	Soil Air[c] Groundwater	120 mg/kg negligible 30 µg/L	4.8	94.3	99.2

[a] Lesser of 95 percent UCL on the mean or maximum detected concentration.

[b] Calculated using the USEPA model (version 0.99d) (USEPA, 1994a).

[c] Air concentration = SPM x Cs x UC1 x UC2.
where:

Cs	Soil concentration (mg/kg).
dL	Deciliter.
Kg	Kilogram.
m^3	Cubic meter.
mg	Milligram.
µg	Microgram.
SPM	Suspended particulate matter (0.075 mg/m^3) (Federal Register, 1988a).
UCI	Unit conversion 1 (10^{-6} kg/mg).
UC2	Unit conversion 2 (10^3 µg/mg).

treatment prior to use would be expected to remove the metal in particulate form from water. Lead was detected in five of nine groundwater samples in concentrations ranging from 5.4 to 30 µg/l. At present, the shallow groundwater is not used as a drinking water supply. Further, the use of the shallow groundwater in the future as a potable supply is highly improbable. Saltwater intrusion under the base has caused the replacement of on-base supply wells with off-base supply wells. So it is likely that saltwater intrusion would preclude the use of groundwater at OU-5/Site WP-1 for drinking water.

In addition, the low lead concentrations in surface soil (maximum value of 120 mg/kg) are not expected to present a significant contribution to blood lead levels in the base worker or construction worker (USEPA, 1994a). In both cases the potential routes of exposure to site soils (dermal, ingestion and inhalation), combined with the limited exposure duration for these receptors compared to the child receptor, minimize the expected dose received from the soil. Further, the IUEBK model assumes that the child is the most sensitive potential receptor. Based on this premise, if child blood lead levels do not exceed risk-based benchmarks, given the conditions at the site, then adult blood lead levels would also not be expected to exceed the risk-based benchmarks.

The levels of lead in the soil at OU-5/Site WP-1 are not unusual. Soil surveys have found soils within 25 meters of roadway to have from 30 to 2,000 mg/kg lead above background soil concentrations.

In summary, the lead concentrations in soils and groundwater are not expected to be of concern for the hypothetical future child resident, the current base worker, nor the future construction worker at OU-5/Site WP-1.

2.7.5.6 Total Site Risk. A summary of the total site risk estimates for OU-5/Site WP-1 is presented in this section. Table 2-36 includes the hazard indices and cancer estimates for all scenarios. Potential current total site risk is equivalent to the risk estimates calculated for a potential current on-site worker exposed to surface soil. This scenario is evaluated in Table 2-31 with an ELCR of 2E-07 and an HI of 0.004.

Total hypothetical future site risk for residential use was estimated by assuming that a future child resident could live on the site (6-year period), grow up, and continue to live there as an adult (24-year period), for a total residency period of 30 years. This total site risk is obtained by summing all of the residential exposures considered in the risk assessment: groundwater ingestion by an adult resident, soil exposure by a child resident (6-year period), and soil

TABLE 2.36

SUMMARY TABLE OF HAZARD INDICES AND CANCER RISKS FOR ALL SCENARIOS SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA Homestead Air Reserve Base, Florida

Scenario	Cancer Effects	Hazard Index
Groundwater Exposure for Future Adult Resident (Table 5-1, Section 5.1)	5E-04	3
Soil Exposure for Current Worker (Table 5-2, Section 5.2)	8E-07	0.02
Soil Exposure for Future Adults Resident (Table 5-3, Section 5.2)	9E-06	0.2
Soil Exposure for Future Child Resident (Table 5-4, Section 5.2)	2E-05	1
Surface Soil Exposure for Future Construction Worker (Table 5-5, Section 5.2)	1E-06	0.5
Total Risk to Future Resident (Child and Adult) (Tables 5-1, 5-3, and 5-4, Section 5.4)	5E-04	4

Note: all risks estimates are rounded to one significant figure.

exposure by adult (24-year period) residents. These scenarios are evaluated in Tables 2-30, 2-32, and 2-33. The combined risk across all pathways (groundwater, soils, surface water, and sediment) for a hypothetical future resident results in a total site excess lifetime cancer risk of 5E-04 and an HI of 4.

For the hypothetical construction worker, the total future site risk would be based on exposure to a combination of surface and subsurface soils. However, most soil layers at OU5/Site WP-1 are only one to two inches deep and the underlying layers are composed of limestone and bedrock. The construction worker scenario is evaluated in Table 2-34 with an excess lifetime cancer risk of 1E-06 and HI of 0.5.

Uncertainties in the Risk Assessment. The uncertainty associated with a risk estimate is primarily the combination of the uncertainties associated with the exposure estimates and the uncertainties in the toxicity evaluation. Additional uncertainty is inherent in environmental sampling, which itself introduces uncertainty, largely because of the potential for uneven distribution of chemicals in environmental media and the use of estimated data, such as J-qualified data. The rest of the discussion presented here focuses on the uncertainties in the exposure assessment and toxicity evaluation. It also presents a perspective on the overall effect of uncertainties on the risk estimates for OU-5/Site WP-1.

Risks associated with the future exposure pathways are only meaningful if the pathways are completed. For pathways, such as using shallow groundwater for drinking water, the probability is very low. It is expected that saltwater intrusion in this area already precludes the use of wells in this zone for potable supplies. Thus, use of groundwater at the site by the hypothetical future resident appears remote.

The exposure doses generally represent the reasonable maximum exposure that can be expected to occur. Most of the parameter values used in calculating the exposure, including the exposure point concentrations, were selected so that there was only a five to ten percent probability that the resulting exposure would be underestimated due to an error in an individual value. The analytical data used to estimate risks from groundwater contaminants probably do not lead to significant errors. These same conclusions can be made for soil samples. In cases where contaminated soil acts as a continuing source of groundwater contamination or where contaminants may be produced by biodegradation, the risk may be underestimated. Likewise, exposure doses are calculated based on the assumption that the current conditions would remain constant throughout the exposure period. If the source is eliminated, natural attenuation processes will reduce constituent concentrations and the likelihood of exposure, thus reducing risks for the hypothetical future exposure scenarios.

Exposure point concentrations were calculated assuming a lognormal distribution of concentrations. The entire site was used as an exposure unit. Differing ranges of different receptors were not considered in the calculation of exposure point concentrations, if a receptor had a smaller range than the size of the site. However, the assumption of a lognormal distribution of data, and the use of maxima in many cases for the exposure point concentrations, means that the exposure point concentration used for COPCs in this document are conservative.

The most important uncertainties associated with the toxicity evaluation are the absence of a quantitative dose-response relationship for developmental and reproductive effects, and the absence of slope factors and reference doses for some chemicals of potential concern. The developmental and reproductive toxicity of the indicator chemicals has not been quantitatively accounted for in performing the risk assessment, because this dose-response relationship has generally not been characterized for the chemicals of potential concern. Another factor which could lead to an underestimate of the-total potential risk at the site is the lack of RfDs or SFs for several chemicals of potential concern. A review of the chemicals of potential concern without RfDs or SFs indicates the following: calcium, iron, and potassium are all essential nutrients and unless present in high doses, would have low toxic potential.

The slope factors are upper bound values for a fit of carcinogenicity data to a specific mathematical function (of which the function selected is in itself generally conservative with respect to other mathematical functions that fit the data equally well). Both the slope factors and reference doses incorporate safety factors when extrapolating from animal data to humans (including sensitive individuals), although animals may be more sensitive to a given compound than people. Slope factors and reference doses typically have safety factors of 100 to 1,000. There are some notable exceptions to this, especially when there is human toxicity data available. The uncertainty factor for the RfD for arsenic is 1, implying that the chronic dose necessary to cause a toxic effect is well known (IRIS, 1991). On the other hand, it is possible that some compounds (such as the VOCs) have minimum threshold doses associated with a carcinogenic response in humans that are not observed in animal experiments, due to the differences between rodent and human metabolism. If this is true, the slope factors would be overestimates by one or more orders of magnitude.

Toxicity values derived from the IRIS database system were accompanied with a qualitative description of their “strength of evidence” as determined by the CRAVE Work Group; the corresponding confidence in each toxicity value added to the uncertainty.

The evaluation of health effects associated with arsenic exposure is presently a very controversial area. While existing toxicological models attempt to relate exposure levels to quantifiable carcinogenic and toxic risk, there is no general consensus that all arsenic exposure has negative consequences or that a threshold level of effect does not exist. For example, recent research indicates that arsenic may be nutritionally essential for humans, a requirement that has been demonstrated for four other mammalian species. The presently available technology for estimating cancer risks to humans at low levels may not be appropriate for evaluating arsenic exposure risks.

For purposes of this risk assessment, it was assumed that all of the chromium detected in media at the site was in the hexavalent form. Under most natural conditions in soils and water containing reducing agents, the majority of chromium is in the trivalent oxidation state. Hexavalent chromium is more toxic than trivalent chromium. Thus, the risk estimates calculated in this report for potential exposure to chromium likely overestimate the actual risk.

The non-carcinogenic risks associated with potential lead exposure were not evaluated in a manner similar to other constituents in this risk assessment (for lack of an RfD). However, the integrated exposure biokinetic/uptake (IEUBK) model developed by the USEPA (version 0.99d) was used to predict blood lead levels in young children. Although any pharmacokinetic model is subject to uncertainties, the predicted blood lead levels (which indicate potential hypothetical future lead exposure at the site is not a major concern) are believed to be a reasonable estimate.

There is also considerable uncertainty associated with the toxicity of mixtures. For the most part, data on the toxicity of chemical mixtures are unavailable. Rather, toxicity studies generally are performed using a single chemical; such is the case for the carcinogenic PAHs. Chemicals present in a mixture can interact to yield a new chemical or one can interfere with the absorption, distribution, metabolism, or excretion of another. Chemicals may also act by the same mechanism at the same target organ or can act completely independently. The risk assessment assumes that toxicity is additive; the excess lifetime cancer risks and HQ were each summed across chemicals. This assumes that the mixture of chemicals present at OU5/Site WP-1 has neither synergistic nor antagonistic interactions and that all of the chemicals have the same mechanism of action in the same target organ to produce the same toxic endpoints.

The toxicity of all chemicals in groundwater and soil has been assumed to be the same as the sum of the individual effects from each chemical. Neither synergistic nor antagonistic effects resulting from the interaction of the contaminants have been considered. In addition, transformation products with greater or less severe toxic effects than chemicals discussed herein may form, and are not accounted for in this evaluation.

Because of the arguments presented in this section, it can be stated that for those exposure scenarios which have been quantitatively evaluated and for which the most toxic and prevalent compounds at OU-5/Site WP-1 have reference doses and slope factors, this risk assessment is expected to be conservative, and the actual risks are expected to be less than those calculated.

2.7.5.7 Development of Remedial Goal Options. As risk characterization indicated that the risk benchmarks of 1E-04 for ELCR and 1 for HI were exceeded for certain of the scenarios considered, remedial goal options (RGOs) have been generated for OU-5/Site WP-1

Remedial Goal Options (RGOs) are outlined in this document to assess potential cleanup levels if site cleanup is necessary. RGOs were generated for surface soil for the base worker scenario and the construction worker scenario, and for potable use of groundwater. Residential RGOs for the residential scenario were not generated for soil as residential development is unlikely at the site, given the planned future military use of the site.

In the calculation of RGOs, concentrations for each individual chemical corresponding to ELCRs of 1E-04, 1E-05, and 1E-06 (for carcinogenic effects) and HQS of 3, 1, and 0.1 (for noncarcinogenic effects) are calculated for each chemical that has an ELCR exceeding IE-06 or a HQ exceeding 0.1. RGOs are specific to a certain risk scenario. RGOs were calculated, as per Florida DEP and USEPA Region IV guidance, by rearranging the site specific risk equations and solving for the concentration term for the target risk. RGOs were generated for those chemicals that were significant contributors to hazard, i.e. chemicals with an individual risk contribution of greater than 1E-06 or HQ of greater than 0.1. The corresponding state and federal guidance and results of the RGO calculations are presented in Tables 2-37 through 2-40.

TABLE 2-37

RISK-BASED REMEDIAL GOAL OPTIONS
AND FDEP SOIL TARGET LEVELS
HYPOTHETICAL FUTURE CONSTRUCTION WORKER AT
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
SURFACE SOIL (mg/kg)

COMPOUNDS	**SITE SPECIFIC REMEDIAL GOAL OPTIONS HAZARD INDEX**			**SITE SPECIFIC REMEDIAL GOAL OPTIONS CARCINOGENIC RISK**			**FDEP Soil Target Levels Based on an ELCR of 1E-06 / HI of 1**
	0.1	**1.0**	**3.0**	**1E-06**	**1E-05**	**1E-04**	
<u>Pesticides/PCBs</u>							
Chlordane Isomers	1.3E+00	1.3E+01	3.8E+01	NAP	NAP	NAP	3.0E+00
<u>Metals</u>							
Arsenic	6.4E+00	6.4E+00	1.9E+02	NAP	NAP	NAP	3.1E+00

NAP = Not Applicable
ELCR = Excess Lifetime Cancer Risk
HI = Hazard Index

TABLE 2-38

RISK-BASED REMEDIAL GOAL OPTIONS
AND FDEP SOIL TARGET LEVELS
HYPOTHETICAL FUTURE ADULT RESIDENT AT
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
SOIL (mg/kg)

COMPOUNDS	**SITE SPECIFIC REMEDIAL GOAL OPTIONS HAZARD INDEX**			**SITE SPECIFIC REMEDIAL GOAL OPTIONS CARCINOGENIC RISK**			**FDEP Soil Target Levels Based on an ELCR of 1E-06 / HI of 1**
	0.1	**1.0**	**3.0**	**1E-06**	**1E-05**	**1E-04**	
<u>BNAs</u>							
Benzo(a)pyrene	NAP	NAP	NAP	2.2E+01	2.2E+00	2.2E+01	1E-01
<u>Pesticides/PCBs</u>							
Chlordane Isomers	NAP	NAP	NAP	1.0E+00	1.0E+01	1.0E+02	5E-01
<u>Metals</u>							
Arsenic	NAP	NAP	NAP	1.4E+00	1.4E+01	1.4E+02	7E-01

NAP = Not Applicable
ELCR = Excess Lifetime Cancer Risk
HT = Hazard Index

TABLE 2-39

RISK-BASED REMEDIAL GOAL OPTIONS
AND FDEP SOIL TARGET LEVELS
HYPOTHETICAL FUTURE CHILD RESIDENT AT
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
SOIL (mg/kg)

COMPOUNDS	SITE SPECIFIC REMEDIAL GOAL OPTIONS HAZARD INDEX			SITE SPECIFIC REMEDIAL GOAL OPTIONS CARCINOGENIC RISK			FDEP Soil Target Levels Based on an ELCR of 1E-06 / HI of 1
	0.1	**1.0**	**3.0**	**1E-06**	**1E-05**	**1E-04**	
<u>BNAs</u>							
Benzo(a)pyrene	NAP	NAP	NAP	1.1E-01	1.1E+00	1.1E+01	1.1E-01
<u>Pesticides/PCBs</u>							
Chlordane Isomers	3.4E-01	3.4E+00	1.0E+01	5.1E-01	5.1E+00	5.1E+01	5.0E-01
<u>Metals</u>							
Arsenic	2.3E+00	2.3E+01	6.9E+01	6.0E-01	6.0E+00	6.0E+01	7.0E-01
Manganese	1.7E+02	1.7E+03	5.0E+03	NAP	NAP	NAP	3.7E+02
Nickel	1.4E+02	1.4E+03	4.3E+03	NAP	NAP	NAP	1.5E+03

NAP = Not Applicable
ELCR = Excess Lifetime Cancer Risk
HI = Hazard Index

TABLE 2-40

RISK-BASED REMEDIAL GOAL OPTIONS
HYPOTHETICAL FUTURE ADULT RESIDENT AT
SITE WP-1/OU-5, ELECTROPLATING WASTE DISPOSAL AREA
GROUNDWATER (mg/L)

COMPOUNDS	**SITE SPECIFIC REMEDIAL GOAL OPTIONS HAZARD INDEX**			**SITE SPECIFIC REMEDIAL GOAL OPTIONS CARCINOGENIC RISK**			**EPA Maximum Contaminant Level**	**Florida Drinking Water Standard**
	0.1	**1.0**	**3.0**	**1E-06**	**1E-05**	**1E-04**		
VOCs								
Bromodichloromethane	NAP	NAP	NAP	1.4E-03	1.4E-02	1.4E-01		
BNAs								
Bis(2-Ethylhexyl)phthalate	0.073	0.73	2.19	6.1E-03	6.1E-02	6.1E-01		
Metals								
Aluminum	3.65	36.5	109.5	NAP	NAP	NAP	5E-02 to 2E-01[a]	0.2[b]
Arsenic	0.001	0.011	0.03	5.7E-05	5.7E-04	5.7E-03	0.05	
Chromium (VI)	0.018	0.18	0.55	NAP	NAP	NAP	1E-01	
Manganese	0.088	0.88	2.6	NAP	NAP	NAP	0.05[a]	
Vanadium	0.026	0.26	0.77	NAP	NAP	NAP	NA	

NAP = Not Applicable
ELCR = Excess Lifetime Cancer Risk
HI = Hazard Index
[a] USEPA Secondary Drinking Water Standard
[b] Florida Secondary Drinking Water Standard

For residential groundwater exposure, bromodichloromethane, bis(2-ethylhexyl)phthalate, and arsenic had ELCRs exceeding 10^{-6} and aluminum, arsenic, chromium, manganese, and vanadium had hazard indices above 0.1. In surface soils, the adult resident scenario exposure the chemicals benzo(a)pyrene, chlordane, and arsenic had ELCRs exceeding 10^{-6} but no hazard indices above 0.1. For the child soil exposure, benzo(a)pyrene, chlordane, and arsenic exceeded 10^{-6}, and chlordane, arsenic, manganese, and nickel had hazard indices above 0.1. The base worker exposure to soils scenario had no chemicals exceeding an ELCR of 10^{-6} or a HI or 0.1. The construction worker scenario for exposure to surface soils had no chemicals exceeding an ELCR of 10^{-6} but chlordane and arsenic exceeded HIs of 0.1.

2.7.6 Ecological Risk Assessment

Conditions at OU-5/Site WP- 1 provide little usable or preferred habitat for terrestrial species. Little vegetation is available for food or cover, and the shallow depth of soil to bedrock is expected to restrict the activities of burrowing animals. Base personnel activity at OU-5/Site WP-1 likely inhibit the activities of animals. Although avian species may potentially visit the site, it is highly unlikely that they would derive a significant portion of their diet from the limited resources available at OU-5/Site WP-1. Therefore, while constituent concentrations detected at OU-5/Site WP-1 might potentially represent ecotoxicological hazard, it is unlikely that terrestrial biota would inhabit or frequent the site.

While there is limited vegetative cover at the site, groundwater may be a potential source of exposure to plants via their root systems. Possible uptake would be modified by a variety of factors such as alkalinity of soils, organic content of soils, possible synergistic or antagonistic effects of multiple compounds, and the individual chemical and physical characteristics of the COCs in groundwater. Comparison with literature toxicity information indicates that the concentrations at OU-5/Site WP- 1 should not be significant.

Additionally, the potential for animals to contact groundwater constituents would be possible if groundwater were to recharge the drainage swales/canals. The maximum detected concentrations of several metals in groundwater were greater than Florida and Federal MCLs and associated surface water criteria protective of freshwater and saltwater aquatic species. These exceedences of surface water quality criteria or MCLs do not indicate the potential for adverse impacts to aquatic biota or terrestrial animals, respectively, due to the inability to sustain a resident aquatic population in the intermittent ditch and the limited expected use of these canals by wildlife.

Uncertainties in Ecological Risk. Although the effects of constituents on ecological receptors are a concern, it is difficult to predict if observed effects on individual populations will result in any real damage to the ecosystem. Populations are dynamic; therefore, information concerning the normal range of variability within the pcpulations needs to be known. Sublethal effects, which may be very important to overall ecosystem health, are difficult to detect, and constituents present at low concentrations may not kill organisms directly but may greatly diminish their ability to survive and reproduce. Finally, it is important to note that constituent contamination is not the only manner in which humans impact ecosystems. Habitat destruction from development, agriculture and recreation are likely the major ways in which humans cause ecological impacts (Moriarty, 1988).

In summary, there is no evidence of significant use of the site as habitat by ecological receptors. Urbanization and base operations have already replaced this ecosystem and rendered its current use and likely future use as poor quality habitat for wildlife.

2.8 DESCRIPTION OF THE “NO FURTHER INVESTIGATION” ALTERNATIVE

Under its legal authorities, USEPA's primary responsibility at Superfund sites is to undertake remedial actions that achieves adequate protection of human health and the environment. Based on <u>soil</u> and <u>groundwater</u> analytical results collected to date, and the Interim Action remedial activities, the Electroplating Waste Disposal Area has been cleaned to industrial standards and therefore must be controlled in the future <u>with Land Use Controls</u> to safeguard both human health and the environment and be subject to <u>a five year review</u> to assure that the remedial actions do not allow for contaminant migration.

Homestead Air Force Base, Florida
Operable Unit No. 5, Site WP-1 5
Electroplating Waste Disposal Area

Responsiveness Summary for the
Record of Decision

RESPONSIVENESS SUMMARY

FOR THE

RECORD OF DECISION

The responsiveness summary serves three purposes. First, it provides regulators with information about the community preferences regarding both the remedial alternatives and general concerns about Operable Unit No. 5, Homestead ARB. Second, the responsiveness summary documents how public comments have been considered and integrated into the decision making, process. Third, it provided the USEPA with the opportunity to respond to each comment submitted by the public on the record.

The Remedial Investigation/Baseline Risk Assessment Report and Proposed Plan (PP) for Homestead ARB, OU-5/Site WP-1 were released to the public in October and December 1996, respectively. These documents were made available to the public in both the administrative record and an information repository maintained at the Air Force Base Conversion Agency OL-Y office

A public comment period was held from March 16, 1997 to April 14, 1997 as part of the community relations plan for OU-5/Site WP-1. Additionally, a public meeting was held on Thursday, March 19, 1997 at 7:00 pm at South Dade Senior High School. A Public Notice was published in the Miami Herald and South Dade News Leader on February 21, 1997. At this meeting the USAF, in coordination with USEPA Region 4, FDEP and Dade County Environmental Resources Management (DERM) will be prepared to discuss the Remedial Investigation, the Baseline Risk Assessment and the Preferred Alternative as described in the proposed Plan.

The Air Force Reserves did not receive any public comment either during the public comment period or at the public meeting.