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FINAL

1995 SITE MANAGEMENT PLAN

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

CONTRACT TASK ORDER 0290

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Prepared For

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

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1.0 INTRODUCTION

This report presents the Site Management Plan (SMP) for the Naval Base, Norfolk located in Norfolk, Virginia. This report has been prepared by Baker Environmental, Inc. (Baker) for use by Atlantic Division, Naval Facilities Engineering Command (LANTDIV) and Naval Base, Norfolk (Activity) personnel.

1.1 Purpose of the Site Management Plan

The purpose of the SMP is to provide a management tool for LANTDIV and Activity personnel to be used in planning, scheduling, and setting priorities for environmental remedial response activities to be conducted at Naval Base, Norfolk. This SMP focuses on activities planned for calendar year 1995, but will be updated annually, or as additional information becomes available.

The SMP presents a site ranking, which has been developed to prioritize sites such that the "worst" sites are addressed first. The primary factors considered in the site ranking methodology are human health and ecological risks presented by the site. However, other factors, such as current funding allocation, proximity of sites to property boundaries, proximity of sites to one another, known historical land use, and current or future land use, may also influence the prioritization process.

The SMP presents the rationale for the sequence of environmental investigation and remedial response activities to be completed and the estimated schedule for completion of these activities. Detailed schedules are provided for activities scheduled for calendar year 1995, and model schedules are provided for activities planned for 1996 and beyond.

1.2 Facility Description

1.2.1 Facility Location/Physical Description

Naval Base, Norfolk (the Base) is the largest naval base in the United States. It is situated on 4,631 acres of land (ref: A.T. Kearny, 1991) directly northwest of the City of Norfolk, Virginia. The location of the Base is shown in Figure 1-1. The Base is bounded on the north by Willoughby Bay,

on the west by the confluence of the Elizabeth and James Rivers, and on the south and east by the City of Norfolk. A portion of the Base eastern boundary is formed by Mason Creek.

The Base includes approximately 4,000 buildings and an airfield. The western portion of the Base is a developed waterfront area containing piers and facilities for loading, unloading and servicing naval vessels.

Land use in the surrounding area is industrial and residential. The waterfront area south of the Base provides shipping facilities for several large industries. A network of rail lines is located in the area to service the Base and nearby industries. Residential areas surround the Base to the south and east. Willoughby Spit, a low-density residential area located northeast of the Base, is also used for recreational activities.

A number of other military installations are located within a 25-mile radius of the Base. These include Fort Monroe and Langley Air Force Base to the north, Navy Amphibious Base - Little Creek and Fort Story to the east, Naval Air Station Oceana to the southeast, Norfolk Naval Shipyard and St. Juliens Creek Annex to the south, and Naval Supply Center-Craney Island Fuel Terminal to the southwest.

1.2.2 Facility History/Mission

Naval Base, Norfolk began operations in 1917, when the U.S. Navy acquired 474 acres of land to develop a naval base to support World War I activities. Bulkheads were built along the coast to extend available land. After dredge and fill operations, the total land under Navy control was 792 acres.

An additional 143 acres of land were acquired in 1918 and officially commissioned for the Naval Air Station (NAS). From 1936 until 1940, improvements to the piers and expansion of supplies/material handling facilities were completed.

During World War II (between 1940 and 1945), major construction projects were completed including a hospital, power plant, numerous runways and hangars, a tank farm, and several barracks/housing complexes. During this time, the area of the Naval Base expanded to over

2,100 acres due to U.S. involvement in World War II. After World War II, the Base continued to acquire land through various types of land transfers and dredge and fill operations conducted in areas of Mason Creek and Bousch Creek Basins and Willoughby Bay.

During its history, the Base has expanded to become the world's largest naval installation, with 105 ships homeported in Norfolk. The Base currently has 15 piers handling 3,100 ship movements annually.

The mission of the Naval Base, Norfolk is to provide fleet support and readiness for the U.S. Atlantic Fleet. The mission is four-fold: 1) to command assigned naval shore activities; 2) to coordinate support to afloat units, their air arm, and other naval activities; 3) to act as regional area coordinator; and, 4) to act as senior officer present afloat for administration in the Hampton Roads area.

1.2.3 Operations/Process Descriptions

Naval Base, Norfolk operates in various capacities to provide support to vessels, aircraft, and other activities. The Base includes many tenants, each performing different operations. The majority of operations involve servicing and maintenance of vessels and aircraft.

Service and maintenance of ships include defueling, refueling, utilities hook-up, on-board maintenance and coordination of ship movements in the harbor. Other functions include loading, unloading, and handling of fuels and oils used aboard the vessels. Ship and aircraft repair operations reportedly include paint stripping, patching, parts cleaning, repainting, engine overhauls, sandblasting and metal plating processes.

1.3 Environmental Setting

1.3.1 Topography and Surface Water Hydrology

Topographically, Naval Base, Norfolk is nearly level. Elevations on the Base range from sea level at the north and west boundaries to approximately 15 feet above sea level in central portions of the Base.

Four major surface water features surround the greater Norfolk area including the James and Elizabeth Rivers and Willoughby and Chesapeake Bays, all of which are tidal in nature in this area.

The majority of surface water on the Base flows to either Mason Creek or to the remnants of Bousch Creek. The main channel of Bousch Creek was filled during development of the Base and replaced by a network of drainage ditches and culverts. Due to the proximity of tidal waters and the low relief of the land, both Mason Creek and the remnant tributaries of Bousch Creek are tidal throughout the Base. Both creeks discharge to Willoughby Bay, and ultimately, to the Chesapeake Bay. Some surface water runoff from the Base discharges directly to the Elizabeth River.

A Federal Emergency Management Agency (FEMA) flood insurance study established that the 100-year floodplain elevation at the Base is 8.5 feet above sea level (ref: A.T. Kearny, 1991). Therefore, portions of the Base adjacent to Willoughby Bay and the Elizabeth River are within the 100-year floodplain.

1.3.2 Geology and Hydrogeology

Naval Base, Norfolk is located in the outer Atlantic Coastal Plain Physiographic Province, which is characterized by low elevations and gently sloping relief. The area is underlain by several thousand feet of sandy sediments gently dipping to the east. The sediments range in age from recent to Lower Cretaceous.

The uppermost geologic unit is the Columbia Group (Sand Bridge and Norfolk Formations). The Columbia Group ranges from 20 to 50 feet in thickness in the vicinity of the Base. The upper portion of the Columbia Group consists of unconsolidated fine sands and silts with low to moderate permeabilities, and the lower portion of the Columbia Group consists of relatively impermeable silt, clay, and sandy clay.

The Yorktown Formation underlies the Columbia Group. The unit is characterized by moderately consolidated coarse sand, gravel, and abundant shell fragments. The Yorktown Formation ranges in thickness from 90 to 100 feet in the vicinity of the Base.

The two significant aquifer systems in the area include the water table aquifer (Columbia Group) and the underlying Yorktown Aquifer. The water table aquifer is unconfined and consists of sand and shell lenses which are very heterogeneous and discontinuous. The water table aquifer is comprised of the sediments of the Columbia Group and sands of the uppermost Yorktown Formation that overlay the fine-grained confining unit (ref: Meng and Harsh, 1988). The Yorktown Aquifer is semi-confined and water-bearing zones are composed of beds of fine to coarse sand, gravel and shells.

A confining clay unit in the upper Yorktown Formation separates the Columbia and Yorktown Aquifers over a large portion of the Base. However, the clay unit is absent, or breached, in some locations. The breaching is thought to be a result of the scour and erosion processes associated with the former Bousch Creek.

1.4 Environmental History

1.4.1 Installation Restoration Program

Currently, Naval Base, Norfolk is not on the United States Environmental Protection Agency (USEPA) National Priorities List (NPL). Therefore, the Navy is acting as the lead agency in environmental investigations at the Base. The environmental condition of the Base is being investigated through the Department of Defense's Installation Restoration Program (IRP). The IRP at Naval Base, Norfolk has been conducted in accordance with applicable federal and state environmental regulations and requirements. In addition, the Navy has requested involvement and input from the federal and state regulatory agencies, (USEPA and the Virginia Department of Environmental Quality) throughout the IRP process by submitting documents for their review.

In 1975, the Department of Defense (DoD) began a program to assess past hazardous and toxic materials storage and disposal activities at military installations. The goals of this program, now known as the IRP, were to identify environmental contamination resulting from past hazardous materials management practices, to assess the impacts of the contamination on public health and the environment, and to provide corrective measures as required to mitigate adverse impacts to public health and the environment.

In 1976, the Resource Conservation and Recovery Act (RCRA) was passed by Congress to address potentially adverse human health and environmental impacts of hazardous waste management and disposal practices. RCRA was legislated to manage the present and future disposal of hazardous wastes. In 1980, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or "Superfund", was passed to investigate and remediate areas resulting from past, formerly accepted, hazardous waste management practices. This program is administered by the USEPA or state agencies.

In 1981, the DoD's IRP was re-issued, with additional responsibilities and authorities specified in CERCLA delegated to the Secretary of Defense. The Navy subsequently restructured the IRP to match the terminology and structure of the USEPA CERCLA Program. The current IRP is consistent with CERCLA and applicable state environmental laws. The CERCLA process is further discussed in Section 4.0 of this SMP.

1.4.2 Previous Base-Wide Investigations

Previous base-wide investigations completed through the IRP include the Initial Assessment Study (IAS), dated February 1983, the IRP Remedial Investigation - Interim Report (IRPRI), dated March 1988, and a RCRA Facility Assessment (RFA), completed for Naval Base, Norfolk in February 1991.

The purpose of the 1983 IAS was to identify and assess sites posing a potential threat to human health and/or the environment due to contamination from past hazardous materials handling and operations. A total of 18 potentially contaminated sites, designated Sites 1 through 18, were identified based on information obtained from historical records, photographs, site inspections, and personnel interviews. Each of the 18 sites was evaluated for the type of contamination, migration pathways, and pollutant receptors. The IAS concluded that 6 of the 18 sites posed sufficient threats to human health or the environment to warrant further evaluation in a confirmation study. Sampling and analysis were not performed as part of the IAS. During the confirmation study, sampling and monitoring would be performed at the site to confirm or refute the existence of the suspected contamination.

A confirmation study was subsequently performed for the six sites which were recommended for further investigation in the IAS. This effort for five of the six site was documented in the 1988 IRPRI Report. An independent confirmation study was performed by the Navy on Site 6 - CD Landfill. The objectives of the confirmation study were to determine the extent of contamination, develop and evaluate economically feasible remedial alternatives, and recommend a remedial action at the following five sites:

- Site 1 - Camp Allen Landfill
- Site 2 - NM Area Slag Pile
- Site 3 - Q-Area Drum Storage Yard
- Site 4 - Transformer Storage Area P-71
- Site 5 - Pesticide Disposal Site

Since the 1983 IAS, four additional IRP sites (Sites 19 through 22) have been identified and have been added to the IRP. The current status of the 22 IRP sites is summarized in Table 1-1.

During the course of the on-going IRP at Naval Base, Norfolk, several site-specific remedial investigations, feasibility studies, removal actions, and site remediations have been completed or are in progress. Remediations have been completed or are in progress at six sites (Sites 1, 4, 11, 16, 17, and 19) as indicated in Table 1-1.

A Draft RCRA Facility Assessment (RFA) was completed for Naval Base, Norfolk in February 1991. This study was a base-wide inventory of existing solid waste management units (SWMUs) and other Areas of Concern (AOCs) on the Base. A total of 274 SWMUs and 10 AOCs were tentatively identified in this study. The Navy has selected three of the SWMUs for investigation and evaluation under the IRP. A comprehensive review of these potential sites must be accomplished prior to finalizing the RFA.

The three SWMUs that were selected for inclusion in the IRP and will be considered in this SMP are:

- SWMU 1 - SP-2B Accumulation Area
- SWMU 2 - Building Z-309 Ash Hopper Storage Area
- SWMU 3 - Building Z-309 Oil/Lubricant Storage Area

A Base map of the Naval Base, Norfolk, showing the locations of the 20 IRP sites and the three SWMU sites, is provided as Figure 1-2.

1.5 Format of the Site Management Plan

This SMP consists of five sections.

- Section 1.0 (Introduction) describes the scope and purpose of the SMP, provides a description and history of the Base, and summarizes the environmental setting and previous environmental investigations conducted at the Base.

- Section 2 (Site Descriptions/Site Histories) provides specific information regarding each of the 23 sites that are included in the SMP. Site-specific information includes site physical characteristics, a description of past activities conducted at the site, and known contaminants in each site media. A site map is provided for each site.

- Section 3 (Site Ranking) presents a hazard ranking of sites, which has been developed to prioritize sites such that the "worst" sites are addressed first. The primary factors considered in the site ranking methodology are human health and ecological risks presented by the site.

- Section 4 (CERCLA Process Activities) provides a summary of the processes of investigation, feasibility study, and remedial action for CERCLA (IRP) sites.

- Section 5 (Site Management Plan Schedules) provides scheduling assumptions and SMP project schedules.

SECTION 1.0 - TABLES

TABLE 1-1

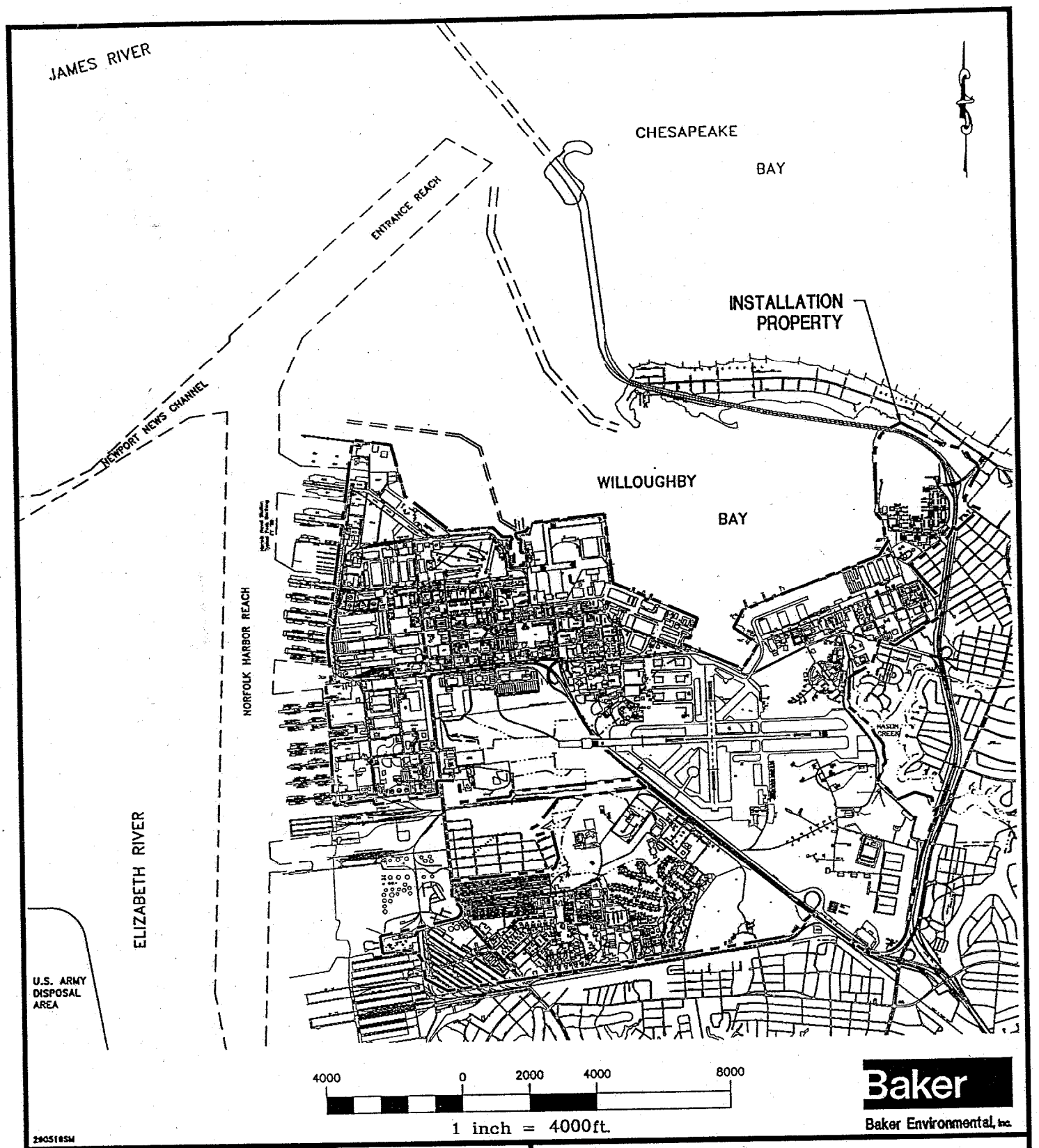
CURRENT STATUS SUMMARY IRP SITES
NAVAL BASE NORFOLK SITE MANAGEMENT PLAN

Site	PA or IAS	SI or CS	TBA	Work Plans	RI	FS	PRAP	ROD	RD	RA	Comments
1. Camp Allen Landfill	1983*	1988**		1991	1994	1994	1995	✓	✓	✓	Removal action (soil) completed. Long-term groundwater pump & treat being implemented.
2. NM Slag Pile	1983*	1988**		O	O	O	O	O			Limited sampling program revealed only minimal contamination.
3. Q-Area Drum Storage	1983*	1988**		1991	✓	✓	✓	✓	✓	O	Soil contamination - TPH, VOCs, pesticides. VOC-contaminated groundwater. Remedial Design in progress.
4. P-71 Transformer Storage	1983*	1988**		1991	1991	1991	1991	1992	1991	1992	Cleanup completed. Groundwater monitoring completed in 1995.
5. Pesticide Disposal Site	1983*	1988**		O	O	O	O	O			Pesticide-contaminated soil. No documented groundwater contamination. RI/FS planned.
6. CD Landfill	1983*	1991		1993	✓	✓	O	O	O	O	Heavy metal-contaminated soil/groundwater. RI/FS in progress.
7. Insert Chemical Landfill	1983*		O								State-approved, non-hazardous waste landfill. No further action recommended per IAS.
8. Asbestos Landfill	1983*		O								State-approved, non-hazardous waste landfill. No further action recommended per IAS.
9. Q-Area Landfill	1983*		O								Construction debris only landfill. No further action recommended per IAS.
10. Apollo Disposal Sites	1983*		O								Apollo fuel component has most likely biodegraded. No further action recommended per IAS.
11. Repair Shop Drains	1983*		O							X	Cleanup completed. No further action recommended per IAS.
12. Mercury Disposal Site	1983*		O								No evidence of mercury disposal found. No further action recommended per IAS.
13. Past Wastewater Outfalls	1983*		O								Industrial wastewater rerouted to treatment plant. No further action recommended per IAS.
14. Oil Spill - Piers 4, 5, 7	1983*										Site being addressed under the UST Program - no longer an IRP Site.
15. Oil Spill - Piers 20, 21, 22	1983*										Site being addressed under the UST Program - no longer an IRP Site.
16. Fire, Building X-136	1983*		O							X	Cleanup completed. No further action recommended per IAS.
17. Fire, Building SDA-215	1983*		O							X	Cleanup completed. No further action recommended per IAS.
18. Former NM Waste Storage	1983*		O								State landfill permit issued. No further action recommended per IAS.
19. Buildings V-60/V-90	1988	1988		1989	1989	1989	1989	1990	1989	1991	Cleanup completed. No further action recommended.
20. LP-20 Site	1991	1991		1994	✓	✓	O	O			PA/SI documented TPH and chlorinated solvents in groundwater. RI/FS in progress.
21. Building W-316	O	O									PA/SI planned.
22. Camp Allen Salvage Yard	1994	1994		O	O	O	O	O			PA/SI documented soil and groundwater contamination. RI/FS scheduled.

LEGEND:
1993 - Year Activity Completed
X - Activity Completed (date unknown)
✓ - Activity In Progress
0 - Activity Planned
PA = Preliminary Assessment
IAS = Initial Assessment Study
SI = Site Inspection
CS = Confirmation Study
RI = Remedial Investigation
FS = Feasibility Study
PRAP = Proposed Remedial Action Plan
ROD = Record of Decision or Decision Document
RD = Remedial Design
RA = Remedial Action
TBA = To Be Addressed

* Refers to "Initial Assessment Study of Sewells Point Naval Complex", dated February 1983.
** Refers to "Installation Restoration Program Remedial Investigation - Interim Report, dated March 1988.
*** TBA sites were not recommended for further action in the 1983 IAS; however, it is recognized that these sites may need to be addressed at some point due to changing regulatory requirements

SECTION 1.0 - FIGURES



LEGEND

— - - - — INSTALLATION PROPERTY BOUNDARY

SOURCE: U.S.G.S. TOPOGRAPHIC MAP, NORFOLK NORTH QUADRANGLE, VA, PHOTOINSPECTED 1989.

FIGURE 1-1
INSTALLATION LOCATION MAP

NAVAL BASE NORFOLK
NORFLOK, VIRGINIA

Norfolk Naval Station
Typical Peak Berthing
FY '88

Q AREA
LANDFILL
(SITE 9)

BUILDING W-316 PCB
STORAGE (SITE 21)

Q AREA
DRUM STORAGE
(SITE 3)

PAST INDUSTRIAL
WASTEWATER OUTFALLS
(SITE 13)

WILLOUGHBY

BAY

INSTRUMENT REPAIR
SHOP DRAINS (SITE 11)

CHEMICAL FIRE
BLDG. X-136
(SITE 16)

ALLEGED MERCURY
DISPOSAL SITE
(SITE 12)

PESTICIDE DISPOSAL
SITE (SITE 5)

BUILDING SP-26
ACCUMULATION AREA
(SITE 23)

P-71 TRANSFORMER
STORAGE AREA
(SITE 4)

BUILDING
V60/V90
(SITE 19)

BUILDING Z-309
(SITES 24 AND 25)

LP-20 SITE
(SITE 20)

CD LANDFILL
(SITE 6)

LP FUEL FARM

BOUSCH CREEK CULVERT

MASON
CREEK

ASBESTOS LANDFILL
(SITE 8)

INERT CHEMICAL
LANDFILL (SITE 7)

CAMP ALLEN
SALVAGE YARD
(SITE 22)

CAMP ALLEN
LANDFILL AREA A
(SITE 1)

CAMP ALLEN
LANDFILL AREA B
(SITE 1)

APOLLO FUEL
DISPOSAL SITES
(SITE 10)

CHEMICAL FIRE BLDG.
SDA-215 (SITE 17)

FORMER NM HAZARDOUS
WASTE STORAGE AREA
(SITE 18)

NM AREA
SLAG PILE
(SITE 2)

2000 0 1000 2000 4000

1 inch = 2000 ft.

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290500SM

FIGURE 1-2
BASE MAP WITH SITE LOCATIONS

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

2.0 SITE DESCRIPTIONS / SITE HISTORIES

This section provides specific information regarding each of the 23 sites that are included in the SMP. Site-specific information includes site physical characteristics, a description of past activities conducted at the site, and known contaminants in each site media. In addition, the current status of each site in the IRP is briefly discussed. A site map is provided for each site.

2.1 Installation Restoration Program (IRP) Sites

Site 1 - Camp Allen Landfill

The Camp Allen Landfill Site is comprised of two distinct areas (Area A and Area B), as shown in Figure 2-1. Area A is a 45-acre landfill that was used for disposal of metal plating and parts cleaning sludges, paint-stripping residue, various chlorinated organic solvents, overage chemicals, pesticides, asbestos, incinerator ash, fly and bottom ash from the Base power plant, and miscellaneous debris. The Area A landfill was operated from the 1940s until approximately 1974. Area B is located east of Area A and is approximately two acres in size. The Camp Allen Salvage Yard, which is scheduled to cease operations in April 1995, is located between Area A and Area B. Wastes from a 1971 salvage yard fire, including drums containing various chemicals, were buried via trench and fill operations in Area B.

Contamination from prior disposal practices at the Camp Allen Landfill Site has impacted surface and subsurface soil, sediment, surface water, and groundwater. The primary contaminants found at the site in all media are volatile organic compounds (VOCs). Sporadic areas of inorganic contamination of surface water/sediments in the surrounding drainage ditches and in the on-site pond also were detected. Groundwater contamination was found in both the water table aquifer and the deeper Yorktown Aquifer in both areas of the site. This is due to the lack of a confining layer between the two aquifers in the Camp Allen Landfill area.

Currently, the Base brig facility and a heliport are located over a portion of the Area A landfill. Area B currently is not used for any purpose. Presently, Area A and Area B are soil-covered and vegetated to minimize surface erosion. Both areas are adjacent to tidal drainage ditches that convey stormwater run-off to Willoughby Bay.

A non-time-critical removal action was implemented in Area B in 1994, which removed the primary source areas of contamination in this area. The Camp Allen Landfill Site RI/FS was completed in 1994. Proposed remediation of the site includes dual-phase vapor extraction (DPVE) for "hot spots" identified in the Area A landfill, and implementation of a groundwater extraction and treatment system in Areas A and B. The Decision Document is expected to be finalized in the summer of 1995. Groundwater treatment plant construction is scheduled to begin in May 1995, and the groundwater treatment system is expected to begin operations in May 1996. Some remedial activities have been completed including installation of extraction wells and performance of DPVE pilot studies.

Site 2 - NM Slag Pile

The NM Slag Pile is a two-acre disposal area for slag generated by an aluminum smelting operation conducted by the Navy in the NM area of the Naval Air Station during the 1950s and 1960s. Figure 2-2 illustrates the location of the NM Slag Pile Site.

During the smelting operation, the slag pile area was well-defined by a lack of vegetation around the site. The surface of the site has since been regraded and vegetated. Presently, a portion of the slag pile area is covered by a gravel parking lot.

The potential for site contamination from metals, including chromium, cadmium, and zinc, was identified in the 1983 IAS. Only trace amounts of inorganics were detected in surface soil, surface water and sediment samples taken during the 1988 Interim RI. However, the samples were taken after site regrading and placement of gravel surfacing had occurred at the site. Since these activities disturbed the surface soil, these analytical results may not be representative of potential subsurface contamination at the site.

Additional investigation is required to adequately characterize the extent of contamination at the site. A limited RI/FS is planned for this site in 1996.

Site 3 - Q-Area Drum Storage Yard

The Q-Area Drum Storage Yard (QADSY), shown on Figure 2-3, is a fenced compound that occupies approximately five acres and is located in the northwest corner of the Naval Base near the carrier piers. This area of the Naval Station was created by dredging operations in the early 1950s. QADSY is an open earthen yard which was used from the 1950s until the late 1980s to store tens of thousands of drums. The majority of drums contained new petroleum products, various chlorinated organic solvents, paint thinners, and pesticides. Evidence of spillage, including dark stains on the soil and oil-saturated soil, were observed throughout the storage yard during previous investigations. The northern portion of the yard, which was used to store leaking or damaged drums and hazardous materials, is particularly stained. The drums have been removed from the site, and the site currently is not used for any purpose.

An RI, performed in 1993, revealed soil contaminated with total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), and pesticides. In addition, VOCs were found in groundwater in both the water table aquifer and the deeper Yorktown Aquifer at the site. This is due to the lack of a confining layer between the two aquifers in this area. The general extent of a groundwater plume, which impacts approximately 29 acres beneath the fleet parking area west of the site, has been defined.

The RI/FS for this site was completed in April 1994. However, the Commonwealth of Virginia has requested additional investigation. The Final RI/FS is now scheduled to be completed by mid-1995. Pilot treatability studies have been completed and remedial designs for soil (soil vapor extraction) and groundwater (air sparging) currently are in progress. Remedial activities are also scheduled to begin in the fall of 1995.

Site 4 - P-71 Transformer Storage Area

The P-71 Transformer Storage Site is located south of Building P-71, as shown on Figure 2-4. This site, approximately 0.5 acre is size, was used to store new and out-of-service electrical transformers from the 1940s until 1978. Reportedly, transformer oil was drained from out-of-service transformers onto the ground surface in this area. During the 1983 IAS, much of the area had been covered with gravel, but soil in the open areas was exposed and exhibited dark stains - evidence of past spillage.

An RI, performed in 1991, revealed PCB contamination in the top three feet of soil and in the shallow groundwater. The predominant contaminant was Aroclor 1260. An FS, PRAP, and remedial design were performed in 1991.

The site soil and groundwater remediation was completed in 1992. The PCB-contaminated soil was excavated and disposed of at a permitted off-site landfill, and the groundwater was pumped from the site and transported off site for treatment. A post-cleanup groundwater monitoring program has been implemented at this site. The site currently is used for utility vehicle parking.

Site 5 - Pesticide Disposal Site

The Pesticide Disposal Site, located southeast of Building V-95, is shown on Figure 2-5. The site consists of a french drain, constructed from a 28-inch diameter culvert placed into a gravel-filled pit, that was used for disposal of waste pesticide materials from the 1960s until 1973. Approximately 100 gallons per week of pesticide rinse water, as well as intermittent discharges of overage concentrated pesticides, were disposed of using the french drain system.

The types of pesticides disposed of in the drain included chlordane, malathion, DDT, DDD, and dieldren. Currently, this area is fenced off and is used for storage of other materials.

A study performed in 1988 revealed pesticide contamination in the soil but no contamination of the shallow groundwater (one monitoring well installed) in the vicinity of the site. The site soil analysis indicated elevated levels of all the pesticides noted above. Concentrations of DDT and DDD were highest in the surface soil and gradually decreased with depth. Some small spillage of fuel oils has occurred directly adjacent to the site. Additional investigation is required to adequately characterize the extent of contamination. An RI/FS is planned for this site in late 1995 or 1996.

Site 6 - CD Landfill

The CD Landfill Site occupies approximately 30 acres and is located just east of Hampton Boulevard and south of the Naval Exchange, as illustrated in Figure 2-6. This landfill was used primarily for the disposal of inert, non-hazardous waste from 1974 until 1987. Materials disposed of in the landfill primarily included construction debris, salvage fuel boiler and power plant ash, and miscellaneous inert waste. However, significant quantities of cadmium-contaminated dust and sandblasting grit containing lead also were disposed at this site from 1974 until 1981. In 1981, the dust was subjected to EP toxicity testing, which found it to be hazardous for cadmium. After 1981, the cadmium-contaminated material was disposed offsite at a permitted hazardous waste disposal facility.

The landfill consists of two adjacent areas. The eastern half of the landfill was used from 1974 to 1979 before permit requirements were enacted. The western half of the landfill was permitted by the State of Virginia in 1979, and continued to operate from 1979 until 1987. In accordance with state regulations, a closure plan was submitted to the state in October 1988, but closure was suspended in lieu of addressing the site through the IRP. The landfill area has a soil cover and is vegetated. Seabee Road, which separates the eastern and western portions of the landfill, was constructed over the landfill in 1993.

The Draft RI, completed in December 1994, indicates that disposal/landfill activities at this site have affected soils, shallow groundwater, surface water and sediment. Soil data indicate inorganic (metals) contamination is widely distributed over the site. Most prevalent were arsenic, beryllium, lead and manganese. Semi-volatiles and pesticides were also found in one soil boring. Widespread cadmium contamination, suggested by past disposal practices and earlier studies, was not found during the RI. The RI results indicate that the shallow groundwater is contaminated primarily with metals including arsenic, beryllium and lead, which were present across the site. Monitoring of the deeper Yorktown Aquifer did not reveal elevated levels of organic or inorganic contaminants. Surface water and sediment had slightly elevated levels of semi-volatiles, pesticides, and metals in the drainage ditches adjacent to the site. Elevated levels of PCBs were also detected in shallow sediments.

An FS is in progress for the CD Landfill Site. The Decision Document is scheduled for completion and remedial design activities are scheduled to begin in 1996.

Site 7 - Inert Chemical Landfill

The Inert Chemical Landfill is located south of CD Landfill, as shown on Figure 2-6. It was used for a one-time disposal of overage inert chemicals, primarily un-used ion exchange resins. Eighty-four pallets of materials were buried in this landfill in June 1979, with the approval of the Virginia State Department of Health, Solid and Hazardous Waste Management Division.

The area of the landfill is approximately 2000 square feet. The landfill was constructed with a one-foot clay base and six-foot clay side berms. The landfill cover consists of two feet of soil and one foot of clay.

No further action is recommended for this site due to the inert, non-hazardous nature of the disposed materials and the fact that the state approved the landfill construction and the disposal methods.

Site 8 - Asbestos Landfill

The Asbestos Landfill is located just east of the Inert Chemical Landfill, as shown on Figure 2-6. It was used for a one-time disposal of asbestos materials generated during a ship retrofitting operation. Approximately 6500 bags (double-bagged) of asbestos materials were buried at this location in June 1979, with the approval of the Virginia State Department of Health, Solid and Hazardous Waste Management Division.

The area of the landfill is approximately 600 square feet, and the landfill construction method was similar to the Inert Chemical Landfill (clay base and side berms, with soil/clay cover materials).

No further action is recommended for this site due to the non-hazardous nature of the disposed materials and the fact that the state approved the landfill construction and the disposal methods.

Site 9 - Q-Area Landfill

The Q-Area Landfill, shown on Figure 2-7, is located on the northwestern corner of the Naval Base in the Q Area. This area was created by dredging operations in the early 1950s. This landfill was operated from 1974 until 1978 and reportedly was used for the disposal of construction debris only.

No further action was recommended for this site in the 1983 IAS since the landfill reportedly was used for non-hazardous construction debris only and there was no evidence of hazardous waste disposal in the landfill.

Site 10 - Apollo Fuel Disposal Sites

From 1967 until 1969, two or three Apollo spacecraft capsules were off-loaded from aircraft carriers at the Naval Base. A remaining fuel component, monomethylhydrazine, was drained from the capsules into 55-gallon drums. Reportedly, three or four drums from each spacecraft capsule were disposed of by pouring the fuel component onto the ground surface and allowing it to percolate through the soil at two locations. The two disposal sites are located in the NM Area, as shown in Figure 2-2. One site, consisting of a fenced area about 40 feet long and 20 feet wide, was located north of the Taussig Can Area. Three or four drums of the fuel component were disposed, and one or two disposal events were conducted at this site. The site was abandoned because of its proximity to a drainage ditch, and the fence was moved from the site to another site near Building NM-37, where the fence was re-constructed. The disposal procedure practiced at this site was the same as that used at the former site, with approximately the same quantity of material disposed.

Inspection of both Apollo Fuel Disposal Sites during the 1983 IAS indicated that the vegetation was not visibly stressed as a result of the past disposal operations. It is unlikely that the past disposal of the fuel component (monomethylhydrazine) has resulted in significant contamination. This fuel component most likely has degraded over the years to non-hazardous products. Therefore, no further action was recommended at this site.

Site 11 - Instrument Repair Shop Drains

Unknown quantities of radium wastes from ship dials were poured down the sink drains in the instrument repair shop located in Building V-60 (see Figure 2-5), contaminating the drain pipes and sink traps. The instrument repair shop was in operation from the late 1940s until 1956. As a interim measure to address the contamination, the drain traps were plugged with concrete to prevent flushing the radium to the storm sewer system and, ultimately, to Willoughby Bay.

In 1982, Chem Nuclear was awarded a contract to remove the low-level radiological contamination in the Building V-60 plumbing, and the cleanup was completed. The subsequent remediation (decontamination, demolition, and disposal) of Site 19 - Buildings V60/V90 in 1991 also included this site. Therefore, no further action is recommended for this site.

Site 12 - Alleged Mercury Disposal Site

Approximately 150 ten-pound glass bottles of elemental mercury were reportedly dumped off the seawall near Building V-88 (see Figure 2-5) into Willoughby Bay in the late 1960s. Subsequently, bottom sediment samples were collected from Willoughby Bay at the alleged dump site for mercury analysis, and divers probed the sediments for the glass containers in 1976. However, no evidence of mercury or the glass containers was found. Therefore, no further action is recommended for this site.

Site 13 - Past Industrial Wastewater Outfalls

Historically, numerous industrial wastewater streams generated by the Naval Base operations were discharged to the storm sewer system and, ultimately, to Willoughby Bay (see Figure 2-5). These discharges included metal plating solutions and rinse water, parts cleaning solutions, and paint stripping waste. These multiple discharges were a source of water pollution, which included metals (primarily chromium, cadmium and zinc), cyanide, oil and grease, and phenols.

In the mid-1970s, the industrial waste streams were re-routed to the Industrial Wastewater Treatment Plant (IWTP), which served as a centralized pretreatment facility with the effluent being discharged

to the Hampton Roads Sanitation District (HRSD) sewage treatment plant. Approximately 100,000 gallons per day have been routed to the IWTP since it began operation in 1976.

In addition, the discharges from the storm sewer system from the Naval Base have since been permitted under the National Pollutant Discharge Elimination System (NPDES). These permitted discharges consist primarily of storm water runoff, steam condensate, and non-contact cooling water.

In light of these corrective actions, the storm sewer outfalls are no longer considered a source of water pollution at the Naval Base, and no further actions are recommended at this time.

Site 16 - Chemical Fire, Building X-136

In July 1979, a chemical fire occurred in Building X-136 as a result of incompatible chemical storage, predominantly of calcium hypochlorite and acids. During the firefighting operation, approximately two tons of calcium hypochlorite was flushed down the storm drain with water, and ultimately discharged to the Elizabeth River. The Virginia State Water Control Board was notified of this flushing procedure, and no subsequent adverse water quality impacts to the Elizabeth River were observed. Figure 2-8 shows the location of Building X-136.

Inspection of the site of the chemical fire during the 1983 IAS indicated that the site had been adequately cleanup up. Therefore, no further action is recommended at this site.

Site 17 - Chemical Fire, Building SDA-215

In August 1981, a chemical fire occurred in cell 6 of Building SDA-215 as a result of incompatible chemical storage, predominantly of calcium hypochlorite and acids. Considerable site contamination resulted from the fire and fire-fighting operation. However, the site was cleaned up by removing the remaining hazardous chemicals and residues, as well as the contaminated soil adjacent to Building SDA-215. The contaminated materials were hauled off site to a permitted hazardous waste disposal facility. Figure 2-9 shows the location of Building SDA-215.

Inspection of the site of the chemical fire during the 1983 IAS indicated that the site had been adequately decontaminated. Therefore, no further action is recommended at this site.

Site 18 - Former NM Hazardous Waste Storage Area

The NM hazardous waste storage area was used from 1975 until 1979 to store drums of hazardous wastes, consisting mainly of waste oil, metal plating solutions and sludges, various chlorinated organic solvents, acids, and paint stripping solutions. The storage area was an open earthen yard located east of the large metal storage buildings, known as the Taussig Cans, in the NM Area. The approximate site location is shown in Figure 2-2.

Considerable leakage and spillage of waste oil and hazardous wastes onto the ground surface occurred in this area, and a significant intentional spill occurred in July 1979. Consequently, a pit was excavated, and an existing drainage ditch was widened and lengthened to convey waste oil and contaminated stormwater runoff to the unlined pit. Waste oil and contaminated runoff were periodically pumped from the pit into a tank truck, which transported it to the IWTP for treatment.

Sampling and analysis of the soil in the spill area indicated that it was contaminated with metals, primarily chromium and cadmium. However, a sample of the soil was subjected to EP toxicity testing and was found to be non-hazardous. The contaminated soil was then excavated and placed in piles near the spill area.

Subsequently, a landfill permit was obtained from the Virginia State Department of Health in October 1980 for the one-time disposal of the contaminated soil at this site by grading and seeding it to establish a vegetative cover. In addition, the permit required a continuing monitoring program to determine if contaminant migration is occurring.

The continuing monitoring program required the installation of a shallow groundwater monitoring well downgradient (northeast) of the site, and monthly monitoring of the well and water from the creek located north of the site. The monitoring program also included the sampling and analysis of standing water from the pit that was excavated in 1979, in lieu of sampling of the monitoring well.

Monthly monitoring of the standing water from the pit for the period February 1980 through April 1982 indicated that the Virginia groundwater standards for cadmium, chromium, cyanide, and phenols were slightly exceeded on a sporadic basis. Monthly monitoring of the creek for the same period indicated sporadic contamination with low levels of cadmium, chromium, cyanide, and

phenols. This suggested that contaminant migration to the creek via shallow groundwater inflow may be occurring.

In the IAS, no further action was recommended for this site since the disposal of the contaminated soil was permitted by the Virginia State Department of Health and because on-going monitoring was occurring. Monitoring of the former NM hazardous waste storage area is no longer conducted as part of the NPDES monitoring program for the Base because the former discharge point has been removed by regrading activities.

Site 19 - Buildings V-60/V-90

Buildings V-60/V-90, shown in Figure 2-5, were aircraft hangars used for maintenance and repair of F-14 and A-6 aircraft. The buildings, which have since been demolished and removed, housed an aircraft brake shop, instrument repair shop, engineering offices, and a cafeteria/kitchen.

In 1986, a fire occurred in an electrical switch gear in Building V-60. The electrical equipment at the source of the fire contained PCBs (Aroclor 1260). Following the fire, PCB-contaminated soot was visible on all horizontal surfaces in Building V-60 and the adjacent Building V-90.

An RI/FS was completed in 1989. The following chemicals were found in the buildings:

- beryllium (aircraft brake materials)
- Radium 226 (aircraft instrument paint)
- PCBs
- polychlorinated dibenzofuran (PCDF)
- polychlorinated dibenzodioxin (PCDD)
- asbestos
- acids
- solvents/degreasers
- pesticides
- miscellaneous chemicals

The extent of contamination of the buildings led to the decision to decontaminate the salvageable materials contained in the buildings and demolish the buildings in 1989. Confirmatory sampling, completed in late 1991, verified that the cleanup was successfully completed.

Site 20 - LP-20 Site

LP-20 Site is one of many large buildings located northwest of the NAS main runway, as shown in Figure 2-10. Currently, the building houses an aircraft engine overhaul and maintenance shop. In the past, a portion of the building was used for a metal plating operation. A large fuel storage area, known as LP fuel farm, is located south of the building.

Previous investigations of adjacent property, including the LP fuel farm, led to the installation of a product recovery system. Groundwater monitoring in the area was instituted to measure the effectiveness of the product recovery system.

A PA/SI completed in 1991 identified TPH and chlorinated solvents in the groundwater east and south of the site. An RI/FS is in progress at the LP-20 Site.

Site 21 - Building W-316

Building W-316 is located east of Pier H at the Naval Station, as shown in Figure 2-11. This building is a small storage facility used by the Navy Public Works Center (PWC) to store various electrical components. The building and small storage yard adjacent to the facility have been contaminated with PCBs from the electrical transformers stored in the storage yard area. The facility is still used for storage and has been posted with signs indicating PCB contamination. A PA/SI is planned for this site in late 1995 or 1996.

Site 22 - Camp Allen Salvage Yard

The Camp Allen Salvage Yard (CASY), which has been operating at the Naval Base since the 1940s, is scheduled to cease operations in April 1995. The CASY is located between Area A and Area B of the Camp Allen Landfill Site, as shown on Figure 2-1. Figure 2-1b illustrates the layout of the CASY. CASY activities have included storage and management of waste oils and chemicals,

used chemicals, and scrap industrial/commercial equipment. Metal smelting and miscellaneous incineration were past practices at CASY. Various recycling activities also have been performed at the salvage yard. The facility was also used as a storage area for acids, paint thinners, solvents, pesticides and transformers. A PCB spill occurred at the CASY in 1989 when a transformer was damaged by a forklift. The PWC responded to the spill and conducted preliminary cleanup at that time. The residue and waste from a 1971 salvage yard fire were buried in Area B of the Camp Allen Landfill Site. These materials were subsequently removed as part of a non-time-critical removal action in Area B of the Camp Allen Landfill in 1994.

A PA/SI was completed for the CASY in May 1994. The investigation results indicated the surface and subsurface soils to be contaminated with PCBs, pesticides, and metals. The shallow and deep groundwater aquifers in the vicinity are known to be contaminated from the Camp Allen Landfill RI results. However, groundwater contamination in the area will be addressed by the Camp Allen Landfill cleanup action currently being implemented. The extent of other contamination at this site will be addressed during an RI/FS, which is scheduled to begin in late 1995 or 1996.

2.2 Solid Waste Management Units (SWMUs)

SWMU 1 - SP-2B Accumulation Area

This site is one of many accumulation areas at the Naval Station that are used for temporary storage of containers of hazardous waste. The accumulation areas manage various types of wastes generated by operations and maintenance activities on the Base. The wastes are typically picked up periodically for off-site treatment, recycling, and/or disposal.

The SP-2B Accumulation Area is located outdoors, northeast of Building SP-2 next to a Coast Guard Trailer on A Street, as shown in Figure 2-12. This unit had dimensions of approximately 6 feet by 6 feet and a concrete base, was partially bermed, had a wooden roof, and was caged to prevent unauthorized access. This unit handled industrial wastes, which were stored in closed drums and were moved bi-weekly to a RCRA-regulated storage area. The unit is currently used to store equipment. The types of wastes that were previously managed in this unit are unknown.

In the RFA, a moderate potential for release to the soil/groundwater was determined due to the deterioration of the concrete base of the unit. It was recommended that soil sampling be performed at this unit to determine if a release of contaminants from the unit has occurred. It was recommended that soil samples be analyzed for metals and semi-volatiles.

SWMU 2 - Building Z-309 Former Ash Hopper Storage Area

This unit (designated SWMU M-14 in the RFA) is located adjacent to Building Z-309, in the western portion of the Naval Base, as shown in Figure 2-13. This unit received ash from boiler operations in Building Z-309. Collected ash was sent to an off-site solid waste landfill. This unit is a steel hopper approximately 30 feet by 30 feet and elevated 12 to 15 feet off the ground. It is underlain by a concrete base sloped to a drain, and is surrounded on three sides by a 3-inch asphalt berm. Black stains were observed on the concrete base below this unit.

This unit, which managed ash from boiler operations, operated from 1967 until 1986 when the Building Z-309 salvage fuel boilers ceased burning municipal waste. While in operation, the unit was emptied daily.

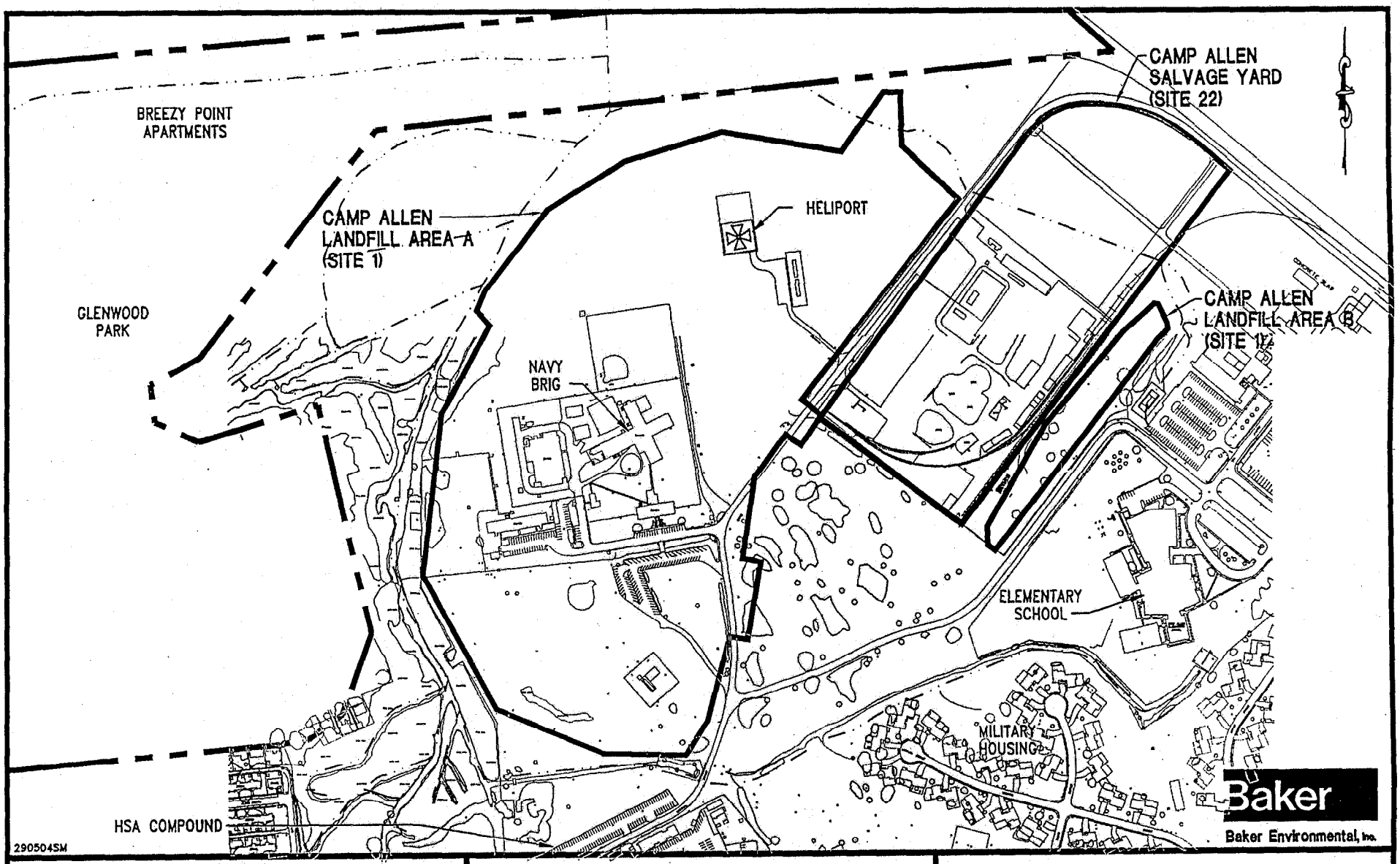
In the RFA, a moderate potential for release to the soil/groundwater was determined due to the presence of soil surrounding the concrete pad. It was recommended that soil sampling be performed at this unit to determine if a release of contaminants from the unit has occurred. Analysis of soil samples for metals and semi-volatiles was recommended.

SWMU 3 - Building Z-309 Oil/Lubricant Storage Area

This area is located adjacent to Building Z-309 (see Figure 2-13) in the northwest portion of the Naval Base. The area was used for storage of oils and lubricants used in the Z-309 area. Drums were stored horizontally on racks approximately 18 inches above a soil and gravel base. The area has a 2-foot wide by 6-inch berm on one side. The base of the area directly underneath the drums was observed to be heavily stained and partially covered with absorbent. Drip pans were present beneath the drum racks.

In the RFA, a high potential for release to the soil and groundwater was determined due to the presence of heavily stained soil beneath the drum racks. Soil sampling was recommended at this unit to determine if a release of contaminants from the unit has occurred. Analysis of soil samples for semi-volatiles was recommended.

SECTION 2.0 - FIGURES



LEGEND

– – – – PROPERTY BOUNDARY

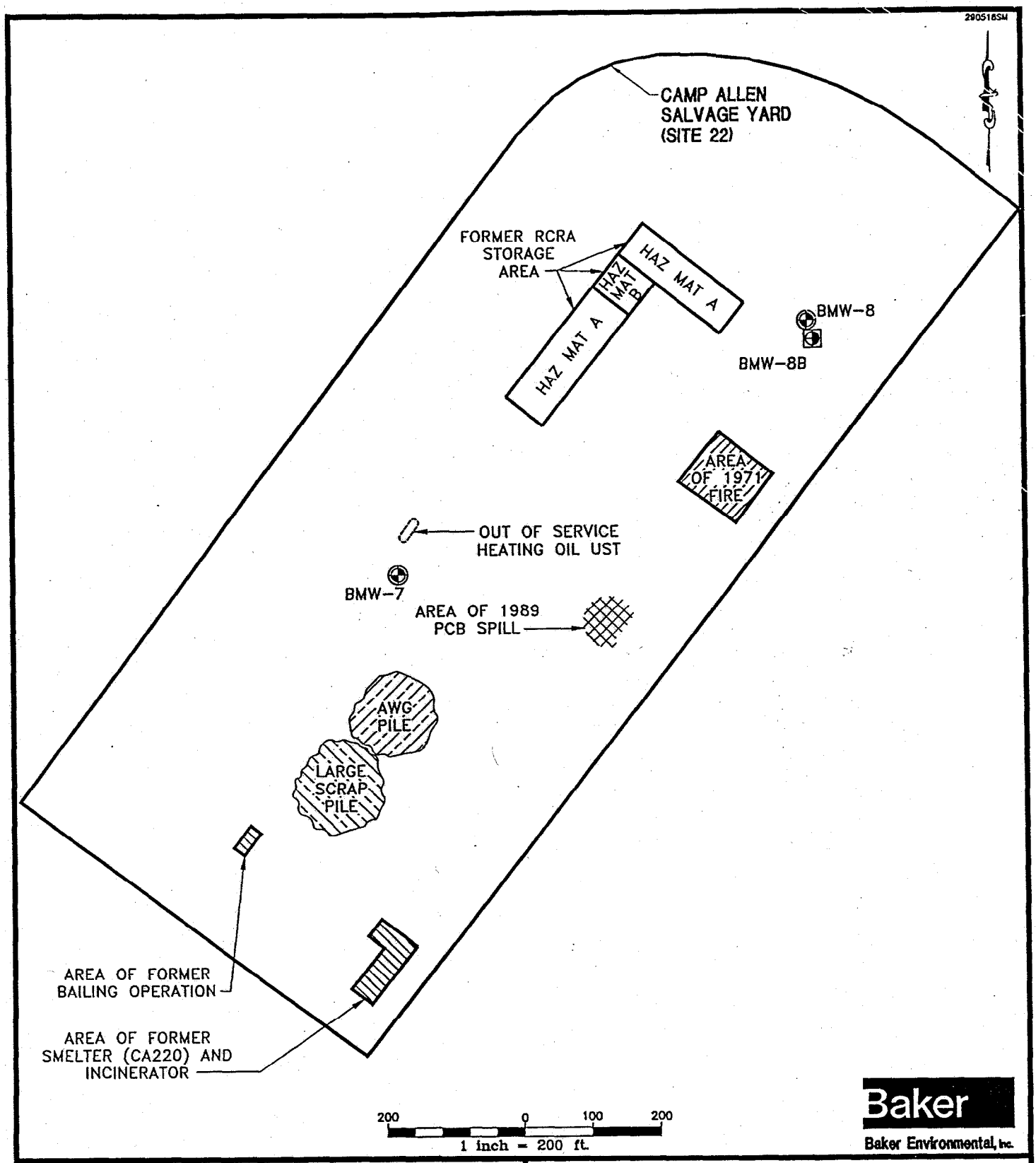
500 0 250 500 1000

1 inch = 500 ft.

SOURCE: LANTDIV, MARCH 1995.

FIGURE 2–1
CAMP ALLEN LANDFILL (SITE 1)
AND CAMP ALLEN SALVAGE YARD
(SITE 22)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA



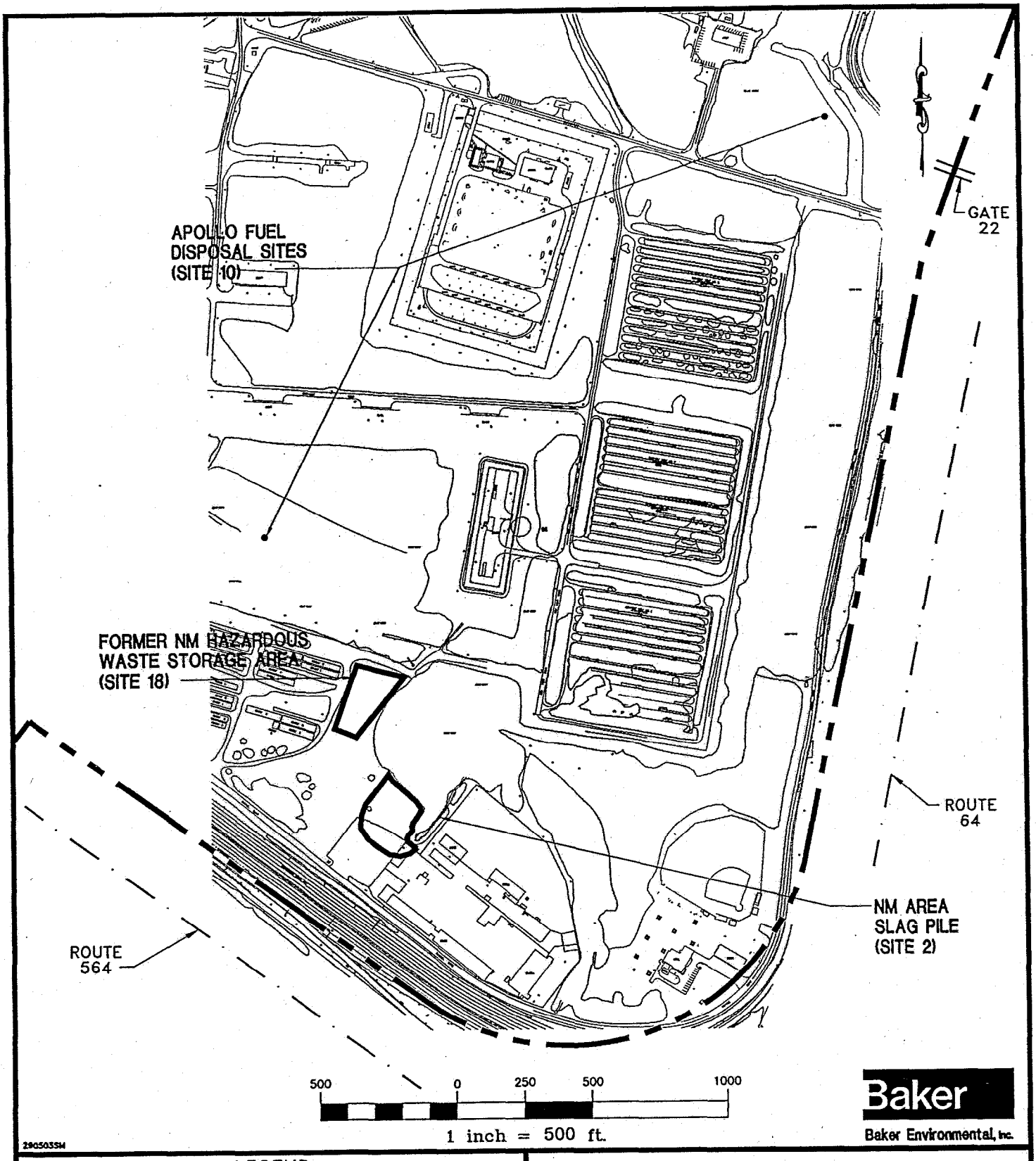
LEGEND

- BMW-7 — EXISTING SURFICIAL AQUIFER GROUNDWATER MONITORING WELL (25 FEET DEEP)
- BMW-8B — EXISTING YORKTOWN AQUIFER GROUNDWATER MONITORING WELL (65 FEET DEEP)
- AREA OF KNOWN PCB SPILL
- SURFACE WATER FLOW DIRECTION
- FIRE HYDRANT

SOURCE: MILLER-STEPHENSON & ASSOC. JUNE 1992

FIGURE 2-1B
SITE MAP
CAMP ALLEN SALVAGE YARD
(SITE 22)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA



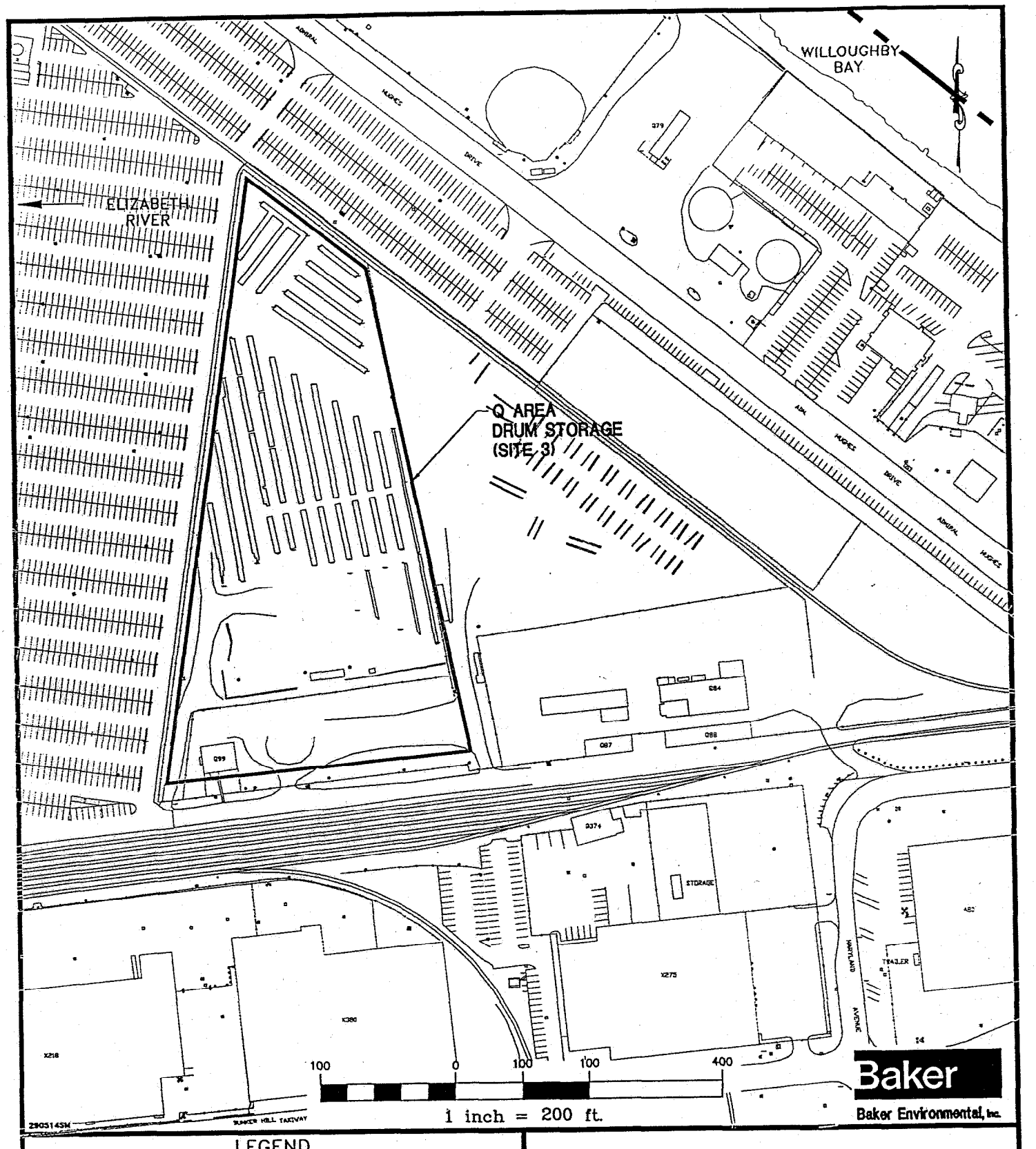
LEGEND

– – – – PROPERTY BOUNDARY

SOURCE: LANTDIV, MARCH 1995.

FIGURE 2–2
NM AREA SLAG PILE (SITE 2),
APOLLO FUEL DISPOSAL SITES (SITE 10)
AND FORMER NM HAZARDOUS WASTE
STORAGE AREA (SITE 18)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA



LEGEND

– PROPERTY BOUNDARY

SOURCE: LANTDIV, MARCH 1995.

FIGURE 2–3
Q AREA DRUM STORAGE (SITE 3)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

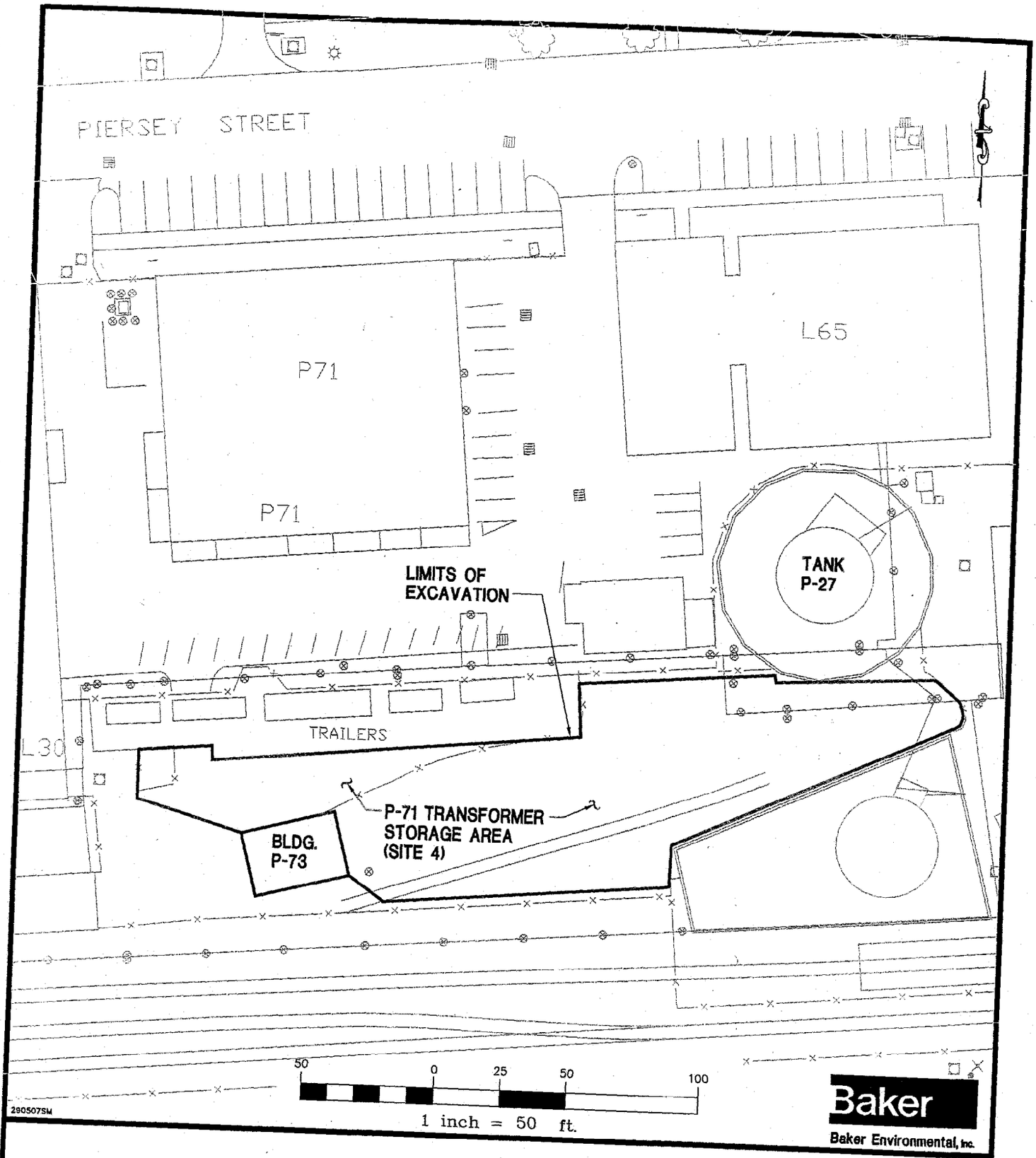
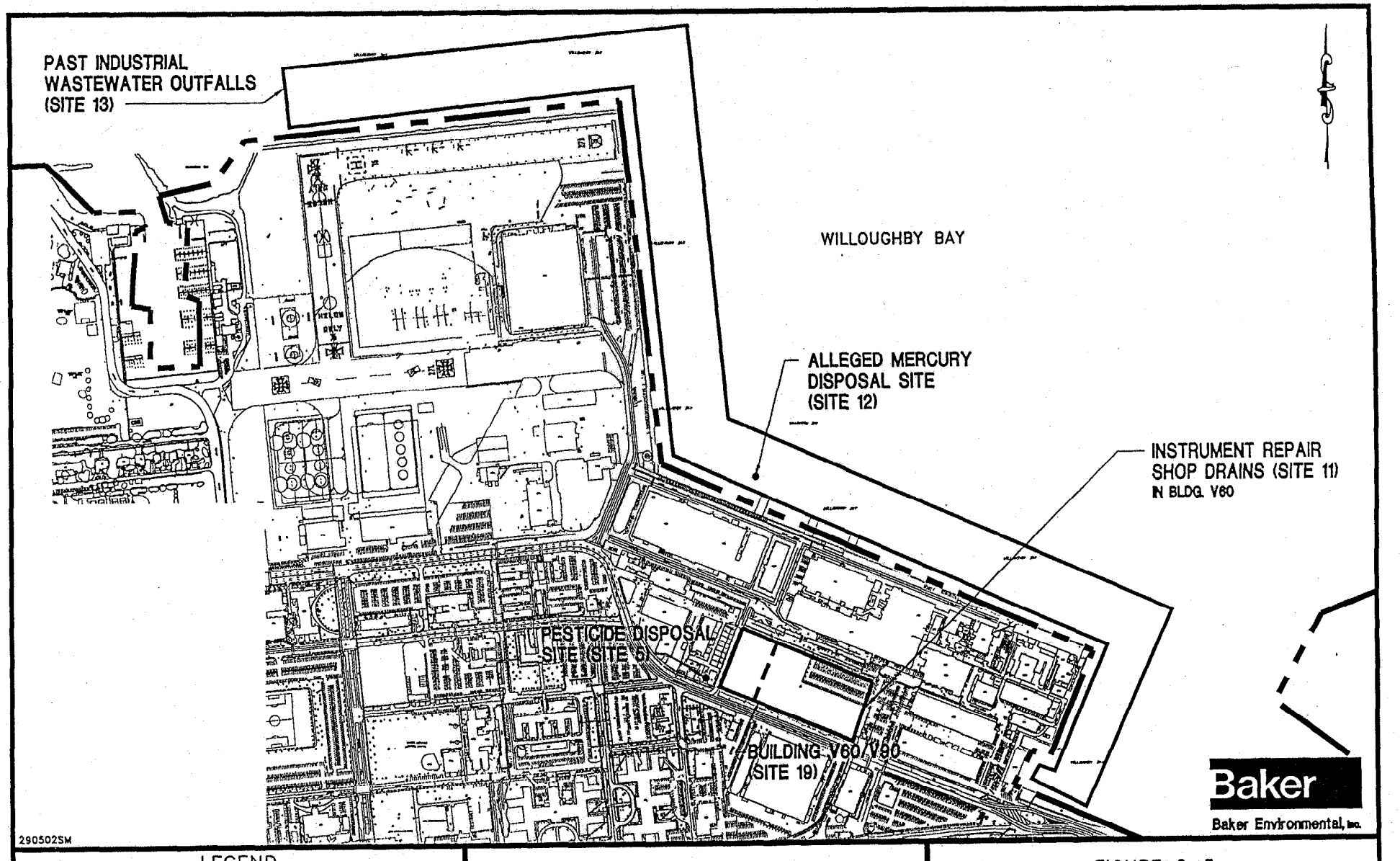


FIGURE 2-4
P-71 TRANSFORMER STORAGE AREA (SITE 4)

SOURCE: LANTDIV, MARCH 1995.

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA



LEGEND

PROPERTY BOUNDARY

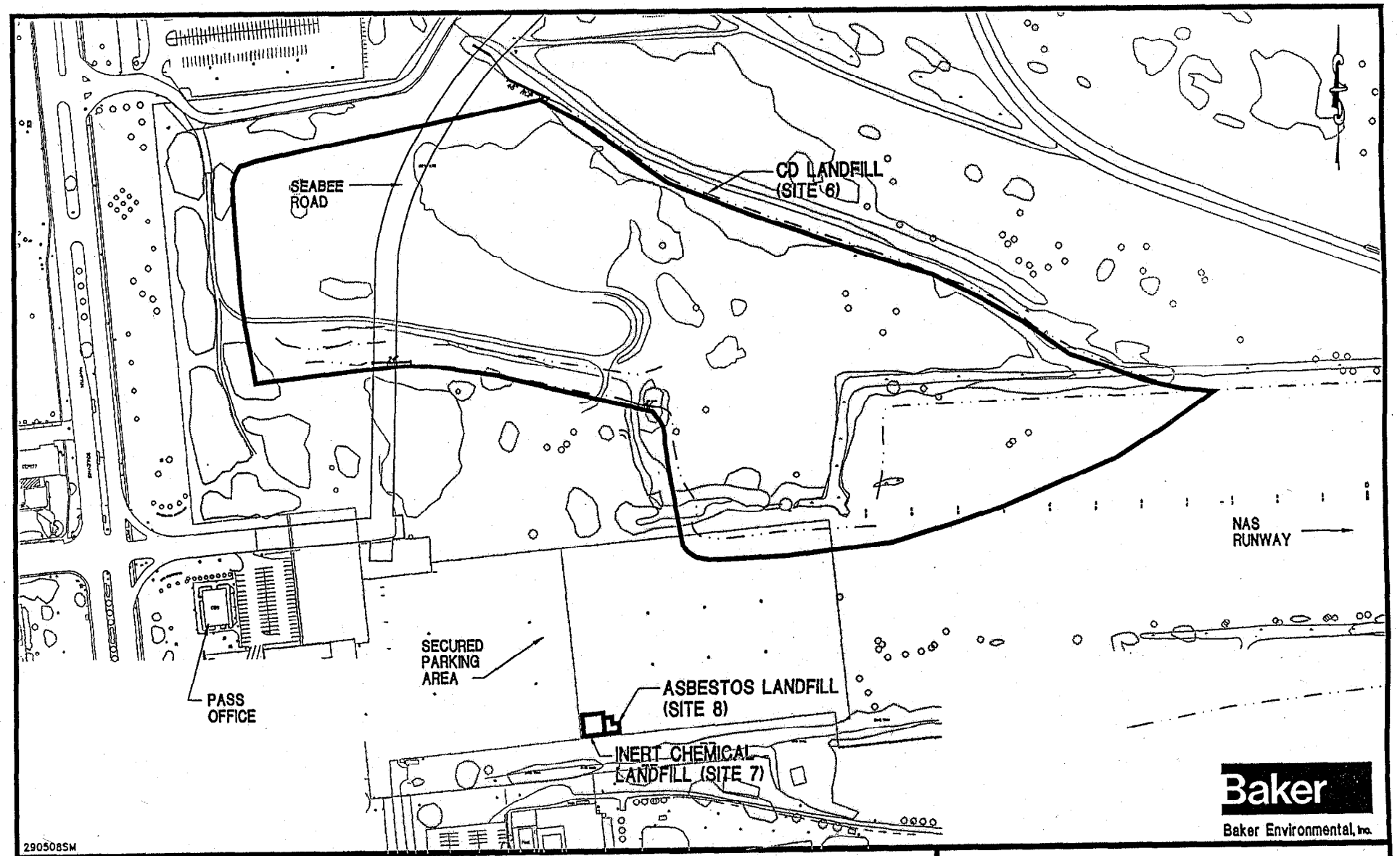
800 0 400 800 1600

1 inch = 800 ft.

SOURCE: LANTDIV, MARCH 1995.

FIGURE 2-5
PESTICIDE DISPOSAL SITE (SITE 5),
INSTRUMENT REPAIR SHOP DRAINS (SITE 11),
ALLEGED MERCURY DISPOSAL SITE (SITE 12),
PAST INDUSTRIAL WASTEWATER OUTFALLS (SITE 13)
AND BUILDINGS V60/V90 (SITE 19)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA



SOURCE: LANTDIV, MARCH 1995.

300 0 150 300 600

1 inch = 300 ft.

FIGURE 2-6
CD LANDFILL (SITE 6),
INERT CHEMICAL LANDFILL
(SITE 7) AND ASBESTOS LANDFILL
(SITE 8)
NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

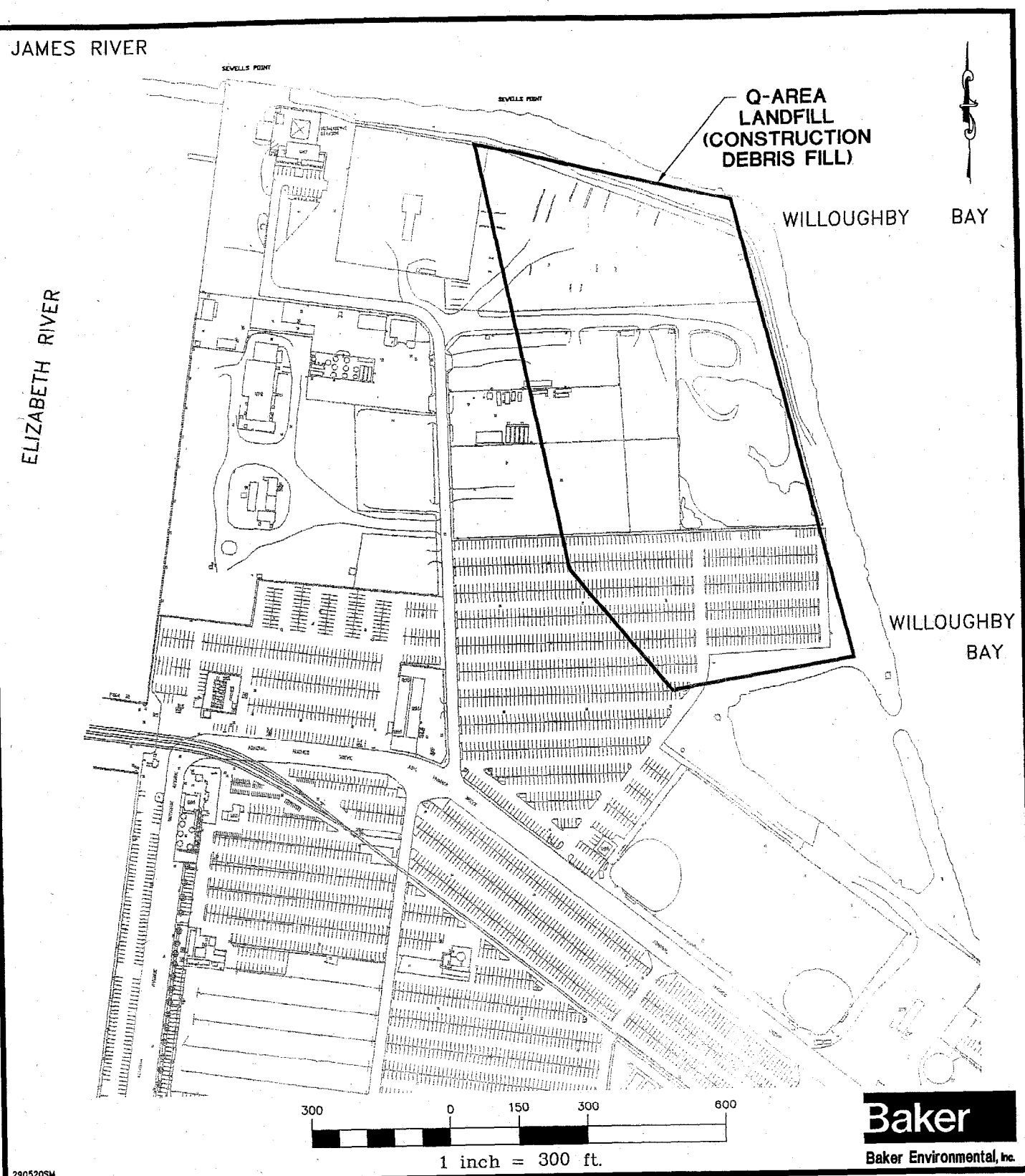


FIGURE 2-7
Q-AREA LANDFILL
(SITE 9)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

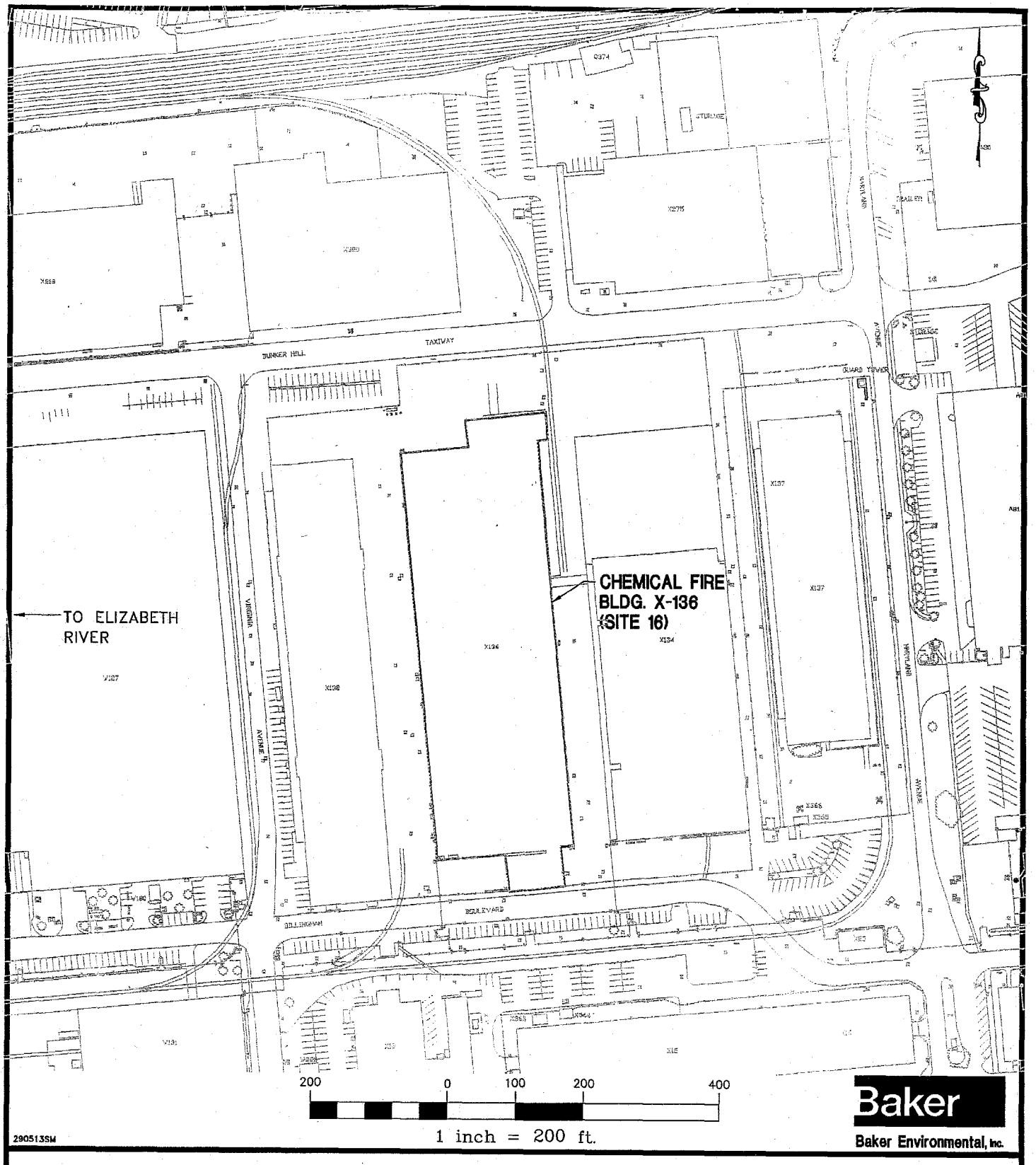


FIGURE 2-8
CHEMICAL FIRE, BUILDING X-136
(SITE 16)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

SOURCE: LANTDIV, MARCH 1995

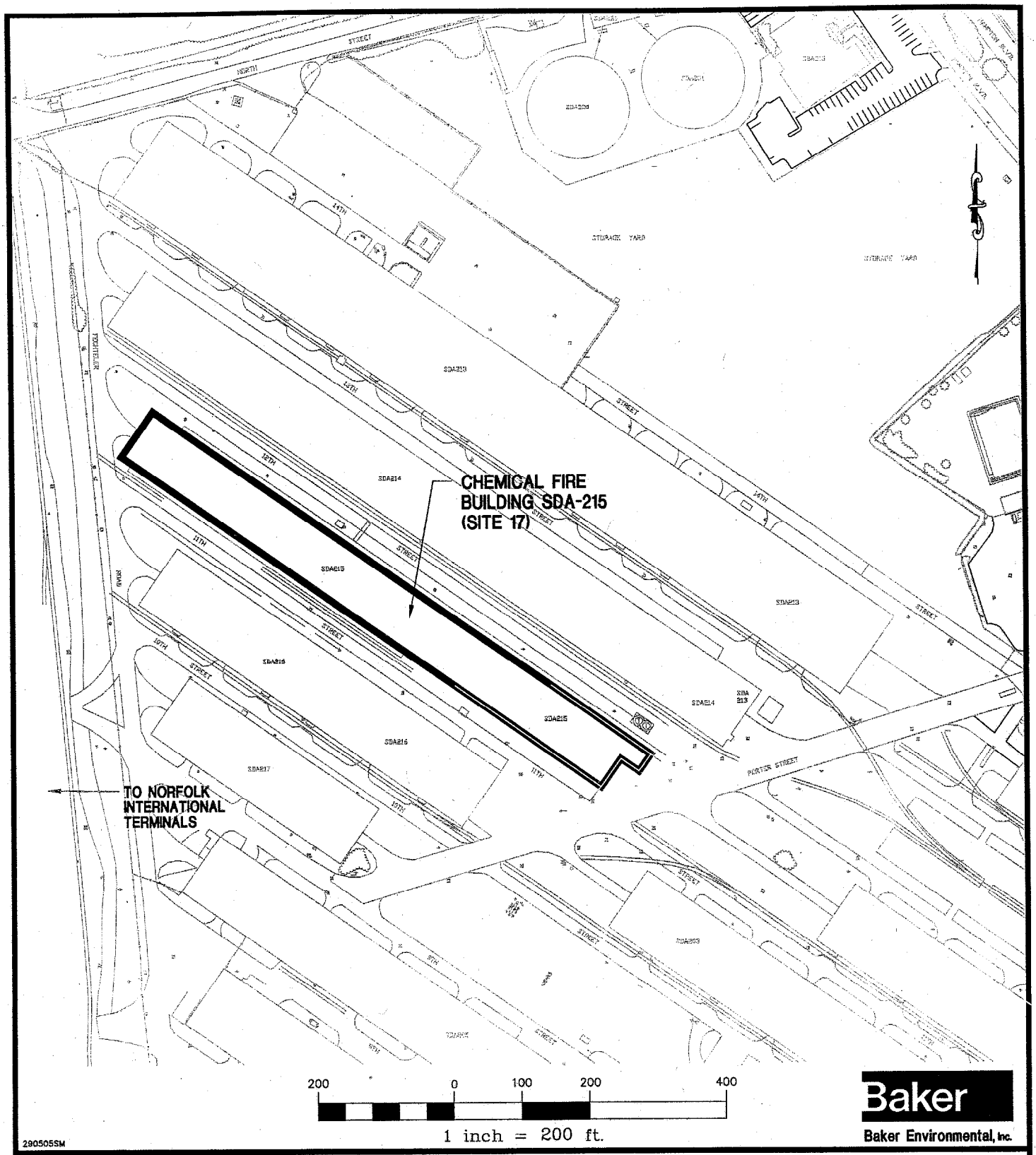
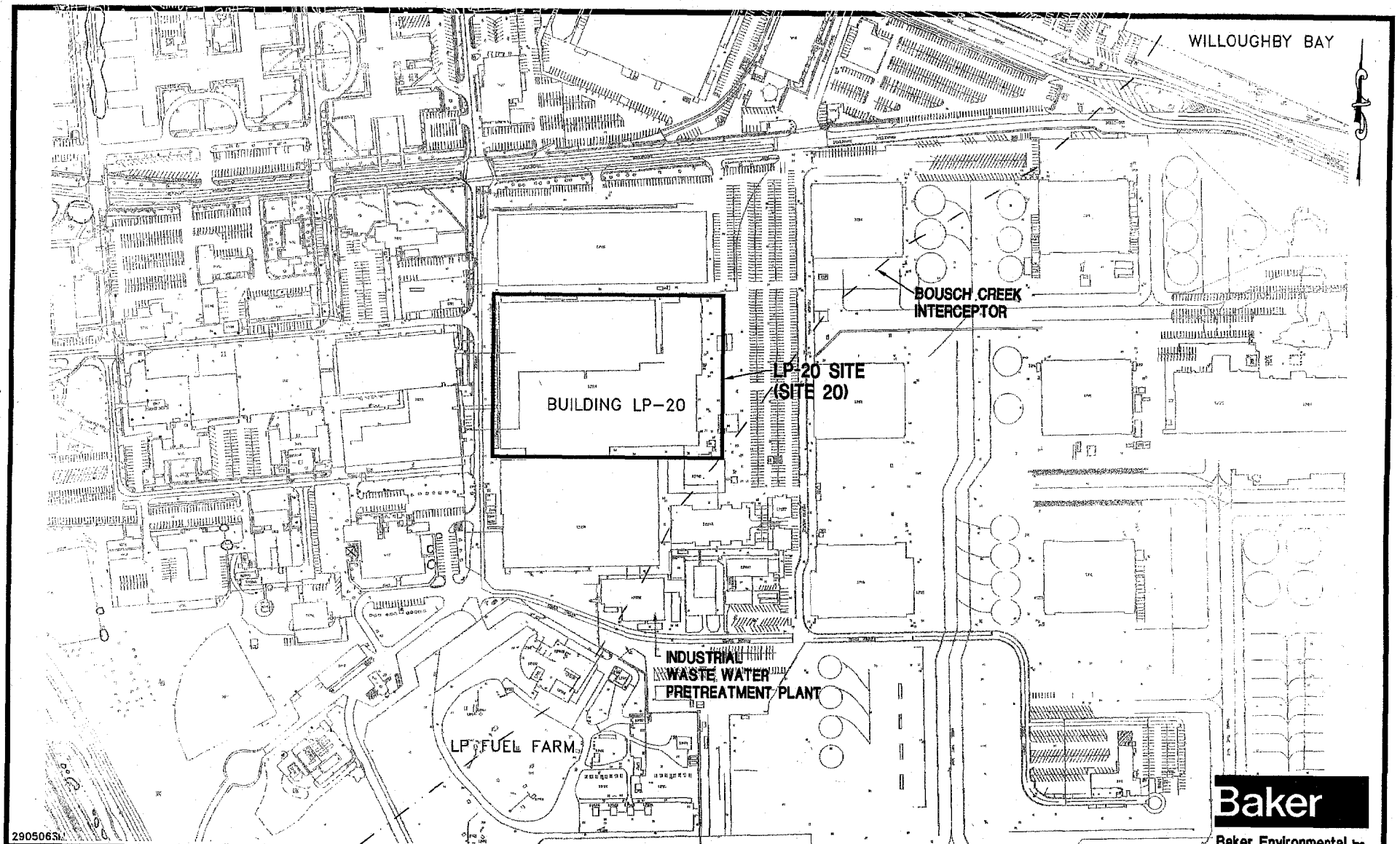


FIGURE 2-9
CHEMICAL FIRE, BUILDING SDA-215
(SITE 17)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

SOURCE: LANTDIV, MARCH 1995.



Baker

Baker Environmental, Inc.

400 0 200 400 800

1 inch = 400 ft.

SOURCE: LANTDIV, MARCH 1995.

FIGURE 2-10
LP-20 SITE (SITE 20)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

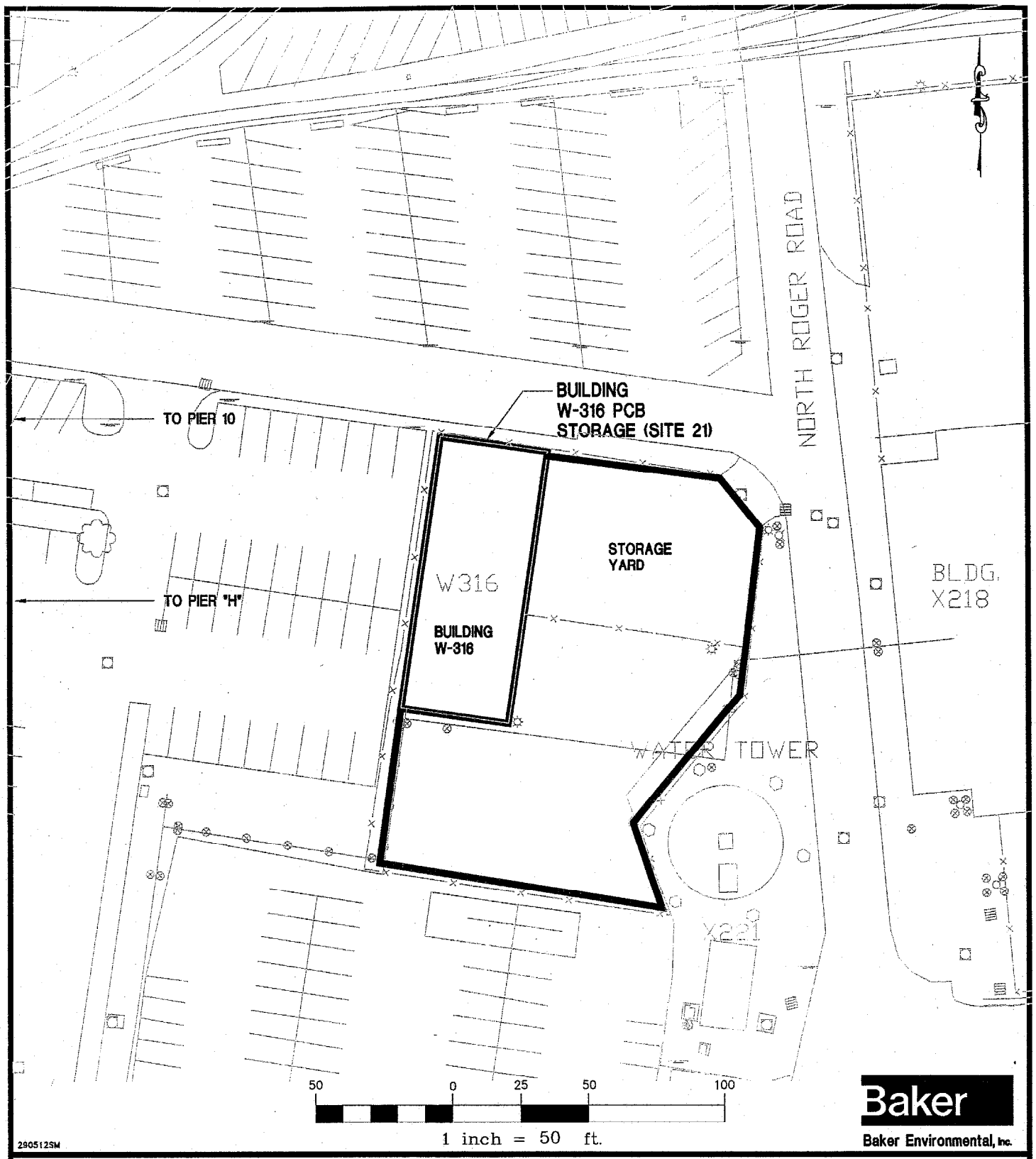
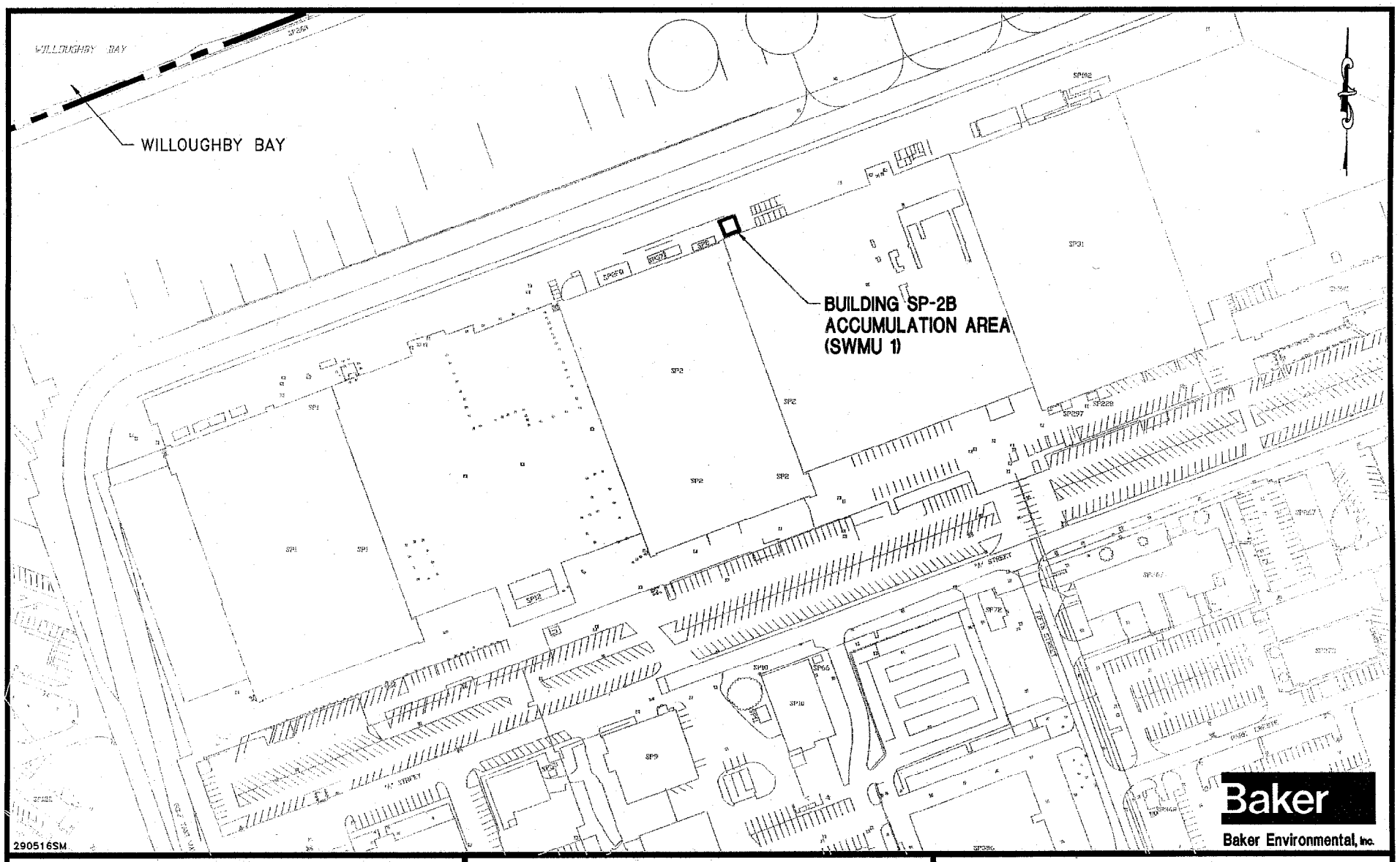


FIGURE 2-11
BUILDING W-316 PCB STORAGE
(SITE 21)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

SOURCE: LANTDIV, MARCH 1995.



Baker

Baker Environmental, Inc.

LEGEND

– – – – PROPERTY BOUNDARY

200 0 100 200 400

1 inch = 200 ft.

SOURCE: LANTDIV, MARCH 1995.

FIGURE 2–12
BUILDING SP–2B
ACCUMULATION AREA
(SWMU 1)

NAVAL BASE NORFOLK
NORFOLK, VIRGINIA

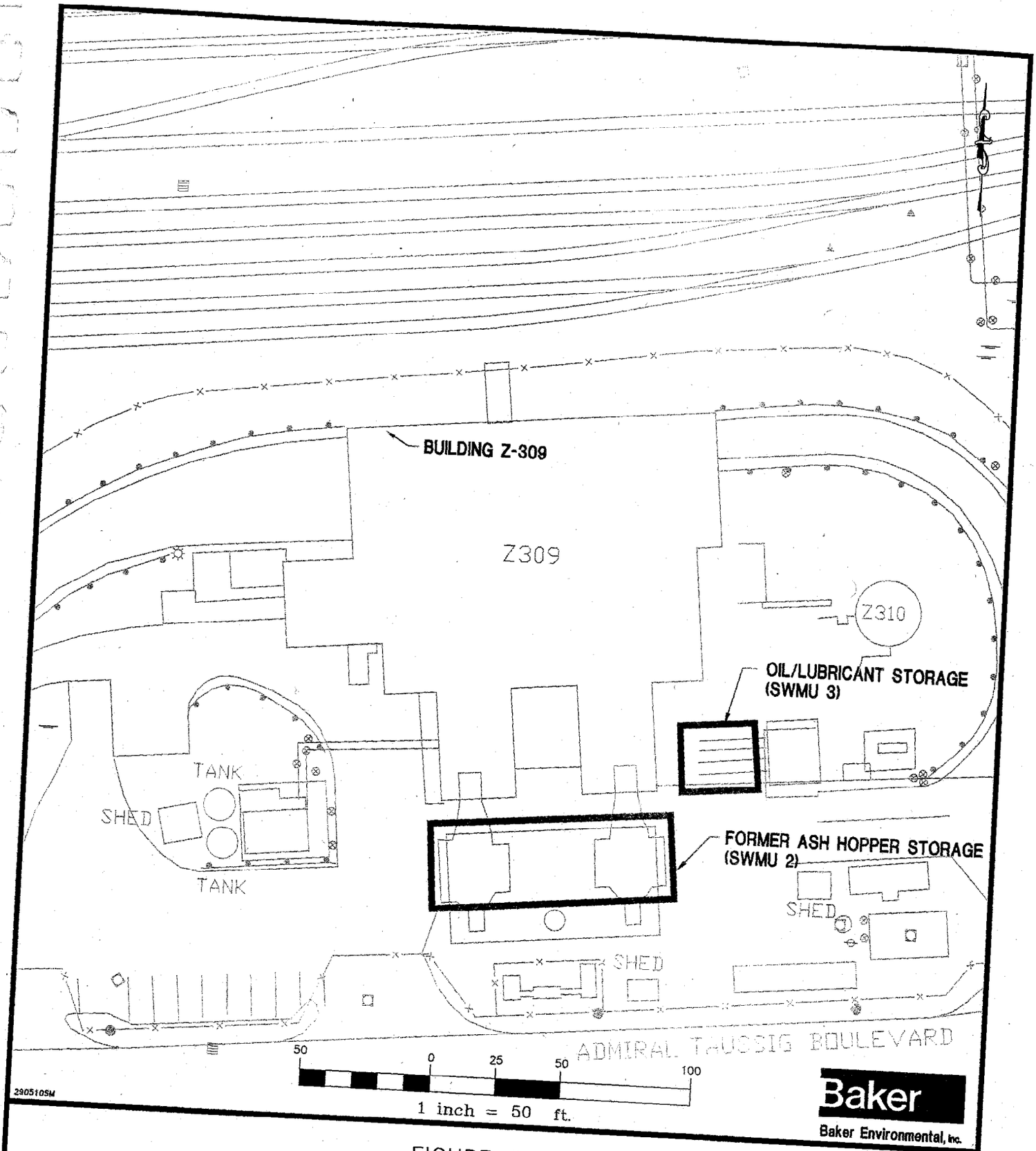


FIGURE 2-13
BUILDING Z-309 FORMER ASH HOPPER STORAGE
(SWMU 2) AND BUILDING Z-309
OIL/LUBRICANT STORAGE (SWMU 3)

SOURCE: LANTDIV, MARCH 1995.

NAVAL BASE NORFOLK
NOFOLK, VIRGINIA

3.0 SITE RANKING

The site ranking study of Naval Base, Norfolk sites presented in this section has been performed to prioritize sites so that the "worst" sites can be addressed first. Site ranking is a management tool to indicate [by actual media concentrations (when available), toxicity, potential exposure, and potential migration] which sites may pose the greatest risk to human health and/or the environment. Based on the site ranking results, the Navy can focus available resources for study and remediation on the highest ranked sites.

The primary factors considered in the site ranking methodology are human health and ecological risks presented by the site. However, other factors, such as current funding allocation, proximity of the sites to property boundaries, proximity of the sites to one another, known historical land use, and current or future land use, may also influence the prioritization process.

This evaluation is not the equivalent of a baseline risk assessment. The accuracy of the site ranking process is limited by the amount of available chemical data. Only 9 of the 23 Naval Base, Norfolk sites had analytical data available (see Table 3-1). No data is available for many sites and very limited data is available for other sites. Nonetheless, the site ranking is based on the best information available at this time. It is anticipated that the site ranking will be updated periodically as additional information becomes available.

In 1994, the Department of the Navy completed development of a computer-based prioritization model, Priority Risk Assessment for Restoration Studies (PRASERS), which was used in this study to prioritize sites at the Naval Base Norfolk. The model is both quantitative and qualitative in nature and was utilized only for sites with available chemical data. A description of model input parameters, calculations, and results are summarized in the following sections.

3.1 Quantitative Analysis

For the quantitative screening analysis, human health risk was evaluated assuming that the groundwater was used as drinking water (both ingestion and inhalation exposure scenarios were included in the drinking water determination). To be conservative, soil contact was assumed to be under a residential use scenario, including both ingestion and dermal contact. Ecological risk was

determined for the aquatic environment only (surface water and sediment), since benchmark values for terrestrial ecological risk are not readily available.

To initially rank/categorize the sites, Contaminant Hazard Factors (CHFs) for human health (carcinogenic and noncarcinogenic) and ecological risk were calculated based on available chemical data for each site. Appendix A presents the available chemical data used for each site. The CHF values were determined by dividing the maximum detected concentration of particular compounds in the environmental media (groundwater, soil, surface water, and/or sediment) by the appropriate corresponding screening value. Screening values utilized in the model include USEPA Region IX Preliminary Remediation Goal (PRG) screening values for soil and groundwater, Federal Ambient Water Quality Criteria (AWQC) screening values for surface water, and National Oceanic and Atmospheric Administration (NOAA) sediment screening values.

Equations for these calculations are as follows:

Human Contaminant Hazard Factor Calculation - Groundwater

Carcinogens

$$CHF_{gwc} = \Sigma (C_{max} / PRG)$$

Noncarcinogens

$$CHF_{gwnc} = \Sigma (C_{max} / PRG)$$

where: CHF_{gwc} = Contaminant Hazard Factor, sum of groundwater carcinogenic ratios
C_{max} = Maximum detected concentration (μg/L)
PRG = USEPA Region IX drinking water PRG (μg/L)
CHF_{gwnc}= Contaminant Hazard Factor, sum of groundwater noncarcinogenic ratios

Human Contaminant Hazard Factor Calculation - Soil

Carcinogens

$$CHF_{ssc} = \Sigma (C_{max} / PRG)$$

Noncarcinogens

$$CHF_{ssnc} = \Sigma (C_{max} / PRG)$$

where: CHF_{ssc} = Contaminant Hazard Factor, sum of soil carcinogenic ratios
C_{max} = Maximum detected concentration (mg/kg)
PRG = USEPA Region IX drinking water PRG (mg/kg)
CHF_{ssnc} = Contaminant Hazard Factor, sum of soil noncarcinogenic ratios

Ecological Contaminant Hazard Factor Calculation - Surface Water / Sediment

Surface Water	Sediment
$CHF_{sw} = \Sigma (C_{maxsw} / AWQC)$	$CHF_{sd} = \Sigma (C_{maxsd} / NOAA)$

where: CHF_{sw} = Contaminant Hazard Factor, sum of surface water ratios
C_{maxsw} = Maximum detected surface water concentration (μg/L)
AWQC = Federal Ambient Water Quality Criteria (μg/L)
CHF_{sd} = Contaminant Hazard Factor, sum of sediment ratios
C_{maxsd} = Maximum detected sediment concentration (mg/kg)
NOAA = NOAA sediment screening value (mg/kg)

Table 3-1 presents the CHFs for the various environmental media for the 11 Naval Base Norfolk sites with available chemical data.

3.2 Qualitative Analysis

Once the quantitative assessment was complete, a qualitative assessment addressing potential exposure pathways and potential contaminant transport was performed. This analysis was conducted to ensure that sites where human and/or ecological exposure to the contaminated media exists and/or the potential for contaminant migration is high would be ranked higher than sites with less potential to impact human health and the environment. This analysis was performed by qualitative analysis of Receptor Factors (exposure potential) and Migration Pathway Factors (contaminant transport potential), as described in the following sections.

3.2.1 Receptor Factor

Receptor Factors (RFs) identify the actual and/or potentially exposed human and ecological populations at each site. The RF was determined for each of the four environmental media based on the selection of statements that best represent site conditions, as described below. Table 3-2 presents the RF statements that were selected for each environmental media for each site.

Groundwater

For human receptors potentially exposed to contaminated groundwater, one of each of the following three statements was selected to represent conditions at a particular site:

a) Groundwater is currently used for human activities (i.e., drinking, agriculture, recreation).

b) Groundwater is not currently used for human activities (i.e., drinking, agriculture, recreation), but the potential exists.

c) There is no future potential for groundwater to be used for human activities (i.e., drinking, agriculture, recreation) due to high salinity, chlorides, total suspended solids, etc.

Surface Soil

For human receptors potentially exposed to contaminated soil, one of each of the following three statements was selected to represent conditions at a particular site:

a) There are sensitive receptors (i.e., children, elderly, hospital patients, pregnant women) present in the area and/or the area is routinely used by non-sensitive receptors (i.e., workers, individuals undergoing training).

b) There is the potential for sensitive receptors (i.e., children, elderly, hospital patients, pregnant women) to be present in the area and/or the area is occasionally used by non-sensitive receptors (i.e., workers, individuals undergoing training).

c) There is no potential for sensitive receptors (i.e., children, elderly, hospital patients, pregnant women) to be present in the area and/or the area is not used by non-sensitive receptors (i.e., workers, individuals undergoing training).

Surface Water

For aquatic ecological receptors potentially exposed to contaminated surface water, one of the following three statements was selected to represent conditions at a particular site:

a) Evidence exists that habitats containing federal and/or state threatened or listed endangered species, wetland areas, migratory bird habitats, etc. exist on or proximal to the site.

b) Habitats containing federal and/or state threatened or listed endangered species, wetland areas, migratory bird habitats, etc. have not yet been identified on or proximal to the site, but may exist.

c) It is unlikely that habitats containing federal and/or state threatened or listed endangered species, wetland areas, migratory bird habitats, etc. exist; or if existent, are protected by natural conditions (e.g. hydraulic gradient, attenuation, dilution).

Sediment

For aquatic ecological receptors potentially exposed to contaminated sediment, one of the following three statements was selected to represent conditions at a particular site:

a) Evidence exists that habitats containing federal and/or state threatened or listed endangered species, wetland areas, migratory bird habitats, etc. exist on or proximal to the site.

b) Habitats containing federal and/or state threatened or listed endangered species, wetland areas, migratory bird habitats, etc. have not yet been identified on or proximal to the site, but may exist.

c) It is unlikely that habitats containing federal and/or state threatened or listed endangered species, wetland areas, migratory bird habitats, etc. exist; or if existent, are protected by natural conditions (e.g. hydraulic gradient, attenuation, dilution).

3.2.2 Migration Pathway Factor

The Migration Pathway Factor (MPF) was used to identify the likelihood of off-site contaminant migration from any of the environmental media at the site. Table 3-2 presents the MPF statements that were selected for each environmental media for each site. The MPF was determined for each media sampled at a particular site by selecting one of the following statements as it applies to the sampled environmental media:

a) There is physical evidence/analytical data indicating off-site contaminant migration.

b) There is no current indication of off-site migration, but the potential exists.

c) Present engineering structures and/or physical/chemical properties of the detected constituents greatly restrict the potential for off-site migration.

3.2.3 Quantification of Qualitative Factors

Both the RF and MPF were quantified to incorporate the results of the qualitative media evaluation by adjusting the media-specific CHFs to account for the influence(s) of potential human and/or ecological receptors and potential contaminant migration, as described in the following section. Table 3-3 presents the adjusted CHF values per environmental media for each site.

Receptor Factor Quantification

The media-specific CHF was adjusted in the following manner to account for potential human and/or ecological receptors:

- Groundwater: If the selected response to the groundwater RF was (a), the carcinogenic CHF for groundwater was multiplied by a factor of 100 and the noncarcinogenic CHF was multiplied by a factor of 10. If the selected response was (b), the carcinogenic CHF for groundwater was multiplied by a factor of 10 and the noncarcinogenic CHF was multiplied by a factor of 5. If the selected response was (c), the CHF was not adjusted.

- Soil: If the selected response to the surface soil RF was (a), the carcinogenic CHF for soil was multiplied by a factor of 100 and the noncarcinogenic CHF was multiplied by a factor of 10. If the selected response was (b), the carcinogenic CHF for soil was multiplied by a factor of 10 and the noncarcinogenic CHF was multiplied by a factor of 5. If the selected response was (c), the CHF was not adjusted.

- Surface Water: If the selected response to the surface water RF was (a), the surface water CHF was multiplied by a factor of 10. If the selected response was (b), the surface water CHF was multiplied by a factor of 5. If the selected response was (c), the CHF was not adjusted.

- Sediment: If the selected response to the sediment RF was (a), the sediment CHF was multiplied by a factor of 10. If the selected response was (b), the sediment CHF was multiplied by a factor of 5. If the selected response was (c), the CHF was not adjusted.

These factors were chosen to increase the priority of those sites with evidence of, or the potential for, exposed human and/or ecological populations.

Migration Pathway Factor Quantification

The media-specific CHF was also adjusted to account for potential contaminant migration in the following manner:

- Groundwater: If the selected response to the groundwater MPF was (a), both the carcinogenic and noncarcinogenic CHF values for groundwater were multiplied by a factor of 10. If the selected response was (b), the carcinogenic and noncarcinogenic CHF values for groundwater were multiplied by a factor of 5. If the selected response was (c), the CHF was not adjusted.

- Soil: If the selected response to the soil MPF was (a), both the carcinogenic and noncarcinogenic CHF values for soil were multiplied by a factor of 10. If the selected response was (b), the carcinogenic and noncarcinogenic CHF values for soil were multiplied by a factor of 5. If the selected response was (c), the CHF was not adjusted.

- Surface Water: If the selected response to the surface water MPF was (a), the surface water CHF was multiplied by a factor of 10. If the selected response was (b), the surface water CHF was multiplied by a factor of 5. If the selected response was (c), the CHF was not adjusted.

- Sediment: If the selected response to the sediment MPF was (a), the sediment CHF was multiplied by a factor of 10. If the selected response was (b), the sediment CHF was multiplied by a factor of 5. If the selected response was (c), the CHF was not adjusted.

These factors were chosen to increase the priority of those sites with evidence of, or the potential for, off-site contaminant migration.

3.2.4 Total Site Risk

Table 3-4 presents the summarized, adjusted CHFs for carcinogenic, noncarcinogenic, and ecological risks at each site. Once the adjusted CHF values for each media were determined, three categories of total site risk (carcinogenic, noncarcinogenic, and ecological) were evaluated as describe below:

- Carcinogens: For human health, the adjusted carcinogenic values for groundwater and soil were added for a total site carcinogenic risk screening value. This value represents the total carcinogenic human health risk for the site.

- Noncarcinogens: Also for human health, the adjusted noncarcinogenic values for groundwater and soil were added for a total site noncarcinogenic risk screening value. This value represents the total noncarcinogenic human health risk for the site.
- Ecological: For ecological risk, the adjusted surface water and sediment values were added to determine the total ecological risk screening value for each site. This value represents the total ecological risk for the site.

3.3 Site Ranking Summary

The total site risk screening values determined in Section 3.2.4 were then ranked with the lowest non-zero (or non "--") value in each category (i.e., the least potential risk) receiving a score of 1. Categories (carcinogenic, noncarcinogenic, ecological) with no available data were not considered in the site ranking. In this case, that particular category was normalized to ensure that all three categories were evaluated on the same relative scale. To determine this normalization factor, the number of entries from the longest column was determined and designated "N_{max}". N_{max} was then divided by the number of entries in each of the other two columns to calculate the normalization factor for that category/column. Ranks within categories containing entries less than N_{max} were multiplied by the calculated normalization factor.

Once the ranks were normalized, the rank sum method was used to evaluate carcinogenic, noncarcinogenic, and ecological parameters together. Since these are distinctly different measurements, the actual ratios cannot be summed; rather the ranks were summed to allow for addition of unlike terms. The site with the highest sum of normalized ranks was then considered to be the worst site based on chemical concentrations, toxicity and exposure. Table 3-5 lists the sites in order of rank on a worst-first priority basis.

3.4 Site Prioritization Results

The site ranking system described herein was used to aid in the prioritization of investigation/remediation activities at Naval Base Norfolk. Site ranking, available funding allocation, completion of removal actions, and proximity of sites to the facility boundary have also been considered in the prioritization process. In general, site ranking was classified into four categories: 1) sites with chemical data available that are currently funded; 2) sites with no chemical

data available that are currently funded; 3) sites that are not currently funded; and 4) sites with completed remedial actions. A summary of the site ranking within each category follows.

Sites with Chemical Data Available that are Currently Funded

Seven sites were identified in this category. These sites are listed below in order of the respective ranks based on the results of the risk-based ranking methodology described in this section. The investigative/remedial phase, either planned or currently in progress, is also identified.

- Site 1 (Camp Allen Landfill) - Remedial Action in progress
- Site 3 (Q Area Drum Storage Yard) - Remedial Design in progress
- Site 6 (CD Landfill) - RI/FS reports in progress
- Site 20 (Building LP-20) - RI/FS reports in progress
- Site 22 (Camp Allen Salvage Yard) - RI/FS planned for late 1995 or 1996
- Site 2 (NM Slag Pile) - RI/FS Work Plans planned for 1996
- Site 5 (Pesticide Disposal Site) - RI/FS planned for late 1995 or 1996

Sites with no Chemical Data Available that are Currently Funded

Only Site 21 (Building W-316) was identified in this category. This site has a high priority due to the potential for PCB contamination based on historical use, and the current use of the site for storage. A PA/SI is planned for late 1995 or 1996.

Sites Not Currently Funded

Seven sites (7, 8, 9, 10, 12, 13, and 18) were identified in this category. Based on the 1983 IAS, no further action was recommended for each site. However, it may be necessary to re-evaluate these sites to determine if further action is required based on the current regulatory requirements.

Only one of these sites (Site 18) was included in the risk-based site ranking discussed in this section. Based on the compounds detected, Site 18 was ranked with the lowest priority of the sites evaluated by this method. However, limited data (one groundwater and one surface water sample) were available for Site 18.

Insufficient data were available to quantitatively rank Sites 7, 8, 9, 10, 12, and 13. Therefore, these sites were evaluated based on their proximity to the facility boundaries. Site 18 was ranked the highest in this category based on the historical use of this area to store hazardous waste. The ranking order for this category of site is:

- Site 18 (Former NM Waste Storage Area)
- Site 9 (Q-Area Landfill)
- Site 10 (Apollo Disposal Sites)
- Site 7 (Inert Chemical Landfill)
- Site 8 (Asbestos Landfill)
- Site 12 (Mercury Disposal Site)
- Site 13 (Past Wastewater Outfalls)

Sites with Completed Remedial Actions

Five sites (4, 11, 16, 17, and 19) were identified in this category. No further action, other than continued monitoring, is planned. Therefore, these sites were not prioritized.

3.4.1 Site Prioritization Summary

Based on the site prioritization process described above, the Naval Base Norfolk sites have been ranked in order of priority as follows:

- Site 1 (Camp Allen Landfill)
- Site 3 (Q-Area Drum Storage Yard)
- Site 6 (CD Landfill)
- Site 20 (Building LP-20).
- Site 22 (Camp Allen Salvage Yard)
- Site 2 (NM Slag Pile)
- Site 5 (Pesticide Disposal Site)
- Site 21 (Building W-316)
- Site 18 (Former NM Waste Storage Area)

- Site 9 (Q-Area Landfill)
- Site 10 (Apollo Disposal Sites)
- Site 7 (Inert Chemical Landfill)
- Site 8 (Asbestos Landfill)
- Site 12 (Mercury Disposal Site)
- Site 13 (Past Wastewater Outfalls)

SECTION 3.0 - TABLES

TABLE 3-1

INITIAL CONTAMINANT HAZARD FACTORS
SITES 1, 2, 3, 5, 6, 18, 19, 20, AND 22
NAVAL BASE NORFOLK, SITE MANAGEMENT PLAN

SITE NO.	SITE NAME	Groundwater		Soil		Sediment	Surface Water
		CHF_{gwc}	CHF_{gwnc}	CHF_{ssc}	CHF_{ssnc}	CHF_{sd}	CHF_{sw}
1	Camp Allen Landfill	182,517.718	544.588	509.949	5.726	11,426.701	1,049.826
2	NM Slag Pile	--	--	22.484	3.708	56.842	59.394
3	Q- Area Drum Storage Yard	25,130.119	145.666	6.087	0.024	67,512.663	--
5	Pesticide Disposal Site	--	0.044	76.465	0.013	--	--
6	CD Landfill	1,439.846	285.917	261.668	20.880	9,369.091	2,461.206
18	Former NM Waste Storage Area	--	2.420	--	--	--	58.182
19 *	Buildings V60/V90	--	--	6,194.576	2.685	--	--
20	Building LP-20	38,962.823	122.543	67.006	0.555	--	--
22	Camp Allen Salvage Yard	--	--	434.532	9.228	--	--

Notes: -- Not detected or analyzed
* Ranking based on data collected before completion of remedial activities. Confirmatory data not available.

CHF_{gwc} Contaminant Hazard Factor (carcinogenic groundwater values)
CHF_{gwnc} Contaminant Hazard Factor (noncarcinogenic groundwater values)
CHF_{ssc} Contaminant Hazard Factor (carcinogenic soil values)
CHF_{ssnc} Contaminant Hazard Factor (noncarcinogenic soil values)
CHF_{sd} Contaminant Hazard Factor
CHF_{sw} Contaminant Hazard Factor

TABLE 3-2

RESPONSES TO QUALITATIVE QUESTIONS
SITES 1, 2, 3, 5, 6, 18, 19, 20, AND 22
NAVAL BASE NORFOLK, SITE MANAGEMENT PLAN

Site Number	Site Name	Groundwater		Soil		Sediment		Surface Water	
		RF	MPF	RF	MPF	RF	MPF	RF	MPF
1	Camp Allen Landfill	b	b	b	c	a	a	a	a
2	NM Slag Pile	--	--	b	a	b	b	b	b
3	Q-Area Drum Storage Yard	c	a	b	a	b	a	--	--
5	Pesticide Disposal Site	c	c	b	b	--	--	--	--
6	CD Landfill	b	b	b	b	a	a	a	a
18	Former NM Waste Storage Area	c	c	--	--	--	--	c	c
19 *	Buildings V60/V90	--	--	a	c	--	--	--	--
20	Building LP-20	c	a	b	c	--	--	--	--
22	Camp Allen Salvage Yard	--	--	a	b	--	--	--	--

Notes: RF Receptor Factor
MPF Migration Pathway Factor
-- Not detected or analyzed
a, b, c Statement selected as most representative of site conditions (see Section 3.2.1)
* Ranking based on data collected before completion of remedial activities. Confirmatory data not available.

TABLE 3-3

ADJUSTED CONTAMINANT HAZARD FACTORS
SITES 1, 2, 3, 5, 6, 18, 19, 20, AND 22
NAVAL BASE NORFOLK, SITE MANAGEMENT PLAN

SITE NO.	SITE NAME	Groundwater		Soil		Sediment	Surface Water
		adj CHF_{gwc}	adj CHF_{gwnc}	adj CHF_{ssc}	adj CHF_{ssnc}	adj CHF_{sd}	adj CHF_{sw}
1	Camp Allen Landfill	9,125,885.900	13,614.700	5,099.490	28.630	1,142,670.100	104,982.600
2	NM Slag Pile	--	--	2,248.400	185.400	1,421.050	1,484.850
3	Q-Area Drum Storage Yard	251,301.190	1,456.660	608.700	1.200	3,375,633.150	--
5	Pesticide Disposal Site	--	0.044	3,823.250	0.325	--	--
6	CD Landfill	71,992.300	7,147.925	13,083.400	522.000	936,909.100	246,120.600
18	Former NM Waste Storage Area	--	2.420	--	--	--	58.182
19 *	Buildings V60/V90	--	--	619,457.600	26.850	--	--
20	Building LP-20	389,628.230	1,225.430	670.060	2.775	--	--
22	Camp Allen Salvage Yard	--	--	217,266.000	461.400	--	--

Notes: -- Not detected or analyzed
* Ranking based on data collected before completion of remedial activities. Confirmatory data not available.

adj CHF_{gwc} Adjusted Contaminant Hazard Factor (carcinogenic groundwater values)
adj CHF_{gwnc} Adjusted Contaminant Hazard Factor (noncarcinogenic groundwater values)
adj CHF_{ssc} Adjusted Contaminant Hazard Factor (carcinogenic soil values)
adj CHF_{ssnc} Adjusted Contaminant Hazard Factor (noncarcinogenic soil values)
adj CHF_{sd} Adjusted Contaminant Hazard Factor
adj CHF_{sw} Adjusted Contaminant Hazard Factor

TABLE 3-4

SUMMARY OF TOTAL CONTAMINANT HAZARD FACTORS
SITES 1, 2, 3, 5, 6, 18, 19, 20, AND 22
NAVAL BASE NORFOLK, SITE MANAGEMENT PLAN

SITE NUMBER	SITE NAME	CARCINOGENS[1]	NONCARCINOGENS[2]	ECOLOGICAL[3]
1	Camp Allen Landfill	9,130,985.390	13,643.324	1,247,652.651
2	NM Slag Pile	2,248.368	185.389	2,905.908
3	Q-Area Drum Storage Yard	2,519,109.863	1,457.853	3,375,633.154
5	Pesticide Disposal Site	3,823.240	0.363	--
6	CD Landfill	85,075.687	7,669.926	1,183,029.689
18	Former NM Waste Storage Area	--	2.420	58.182
19 *	Buildings V60/V90	619,457.594	26.850	--
20	Building LP-20	390,298.297	1,228.201	--
22	Camp Allen Salvage Yard	217,266.136	461.416	--

Notes: -- Not detected or analyzed
* Ranking based on data collected before completion of remedial activities. Confirmatory data not available.
(1) Sum of adjusted carcinogenic CHF for groundwater and soil
(2) Sum of adjusted noncarcinogenic CHF for groundwater and soil
(3) Sum of adjusted ecological CHF for surface water and sediment

TABLE 3-5

SITE RANKING RESULTS
SITES 1, 2, 3, 5, 6, 18, 19, 20, AND 22
NAVAL BASE NORFOLK, SITE MANAGEMENT PLAN

Site Number	Site Name	Ranking						Sum of Rank[(1)]
		CAR	Norm. CAR	NON	Norm. NON	ECO	Norm. ECO	
1	Camp Allen Landfill	10	11	11	11	4	9	31
3	Q-Area Drum Storage Yard	7	8	9	9	5	11	28
6	CD Landfill	5	6	10	10	3	7	23
20	Building LP-20	8	9	8	8	--	0	17
22	Camp Allen Salvage Yard	6	7	7	7	--	0	14
19 *	Buildings V60/V90	9	10	3	3	--	0	13
2	NM Slag Pile	3	3	6	6	2	4	13
5	Pesticide Disposal Site	4	4	1	1	--	0	5
18	Former NM Waste Storage Area	---	0	2	2	1	2	4

Notes:
CAR Ranking of carcinogenic CHF values
NON Ranking of noncarcinogenic CHF values
ECO Ranking of ecological CHF values
Norm. Normalized scores
(1) Sum = Norm. CAR + Norm. NON + Norm. ECO
-- Not detected or analyzed
* Ranking based on data collected before completion of remedial activities. Confirmatory data not available.

4.0 CERCLA PROCESS ACTIVITIES

As previously discussed (in Section 1.0), the Naval Base Norfolk currently is not listed on the USEPA NPL. Therefore, an FFA has not been developed for this Base and the environmental status of the Base is being investigated through the IRP. The IRP at Naval Base Norfolk is being implemented in accordance with applicable federal and state environmental regulations and requirements. The Navy has structured the IRP to be consistent with the terminology and structure of the USEPA CERCLA Program, which is described below.

4.1. CERCLA RI/FS Process

The CERCLA RI/FS process refers to the process of site investigation and remedial action that is used for CERCLA sites. For this SMP, the RI/FS process is applicable to the 20 IRP sites (Sites 1 through 13 and 16 through 22) as well as the 3 SWMUs.

The objectives of the CERCLA RI/FS process are to evaluate the nature and extent of contamination at a site, and to identify, develop, and implement appropriate remedial actions in order to protect human health and the environment. The RI/FS process includes the following major elements:

- RI - Remedial Investigation
- RA - Risk Assessment
- FS - Feasibility Study
- PRAP - Proposed Remedial Action Plan
- ROD - Record of Decision or Decision Document

These steps ultimately lead to either implementation of a remedial design/remedial action or the decision to take no action at the site, as illustrated in Figure 4-1. Where no further action is required at a site, a no-action ROD would be signed and the site removed from the program.

The RI, RA, FS, and PRAP documents are maintained in information repositories for review by the public. A formal public comment period and a public meeting (if required) generally follow the issuance of the Final PRAP. Public comments received on the Final PRAP are addressed as part of the Responsiveness Summary in the ROD. Subsequent to completion of the ROD, remedial

design/remedial action activities are initiated. In accordance with CERCLA, remedial action is required to begin within 15 months of the Final ROD.

RI/FS processes currently are in progress at several Naval Base Norfolk sites including Camp Allen Landfill, Q-Area Drum Storage, CD Landfill, and the LP-20 Site. In addition, RI/FS processes are planned to begin at several additional sites in late 1995 or 1996 including the NM Slag Pile, Pesticide Disposal Site, Building W-316, and the Camp Allen Salvage Yard.

4.2 Removal Action Process

Removal actions are implemented to clean-up or remove hazardous substances from the environment at a site in order to mitigate the spread of contamination. Removal actions may be implemented at any time during the RI/FS process.

Removal actions are classified as either time-critical or non-time-critical. Actions taken immediately to mitigate an imminent threat to human health or the environment, such as the removal of corroded or leaking drums, are classified as time-critical removal actions. Removal actions that may be delayed for six months or more without significant additional harm to human health or the environment are classified as non-time-critical removal actions.

For non-time-critical removal actions, an Engineering Evaluation/Cost Analysis (EE/CA) is prepared rather than the more extensive FS. An EE/CA focuses only on the substances to be removed rather than on all contaminated substances at the site. It is possible for a removal action to become the final remedial action if the risk assessment results indicate that no further remedial action is required in order to protect human health and the environment.

A non-time-critical soil removal action was completed at Area B of the Camp Allen Landfill in 1994; however, this was not considered a final remedy for the site. A soil removal action also was completed in the Q-Area that involved the removal of 750 cubic yards of petroleum-contaminated soil from the northwest corner of the site to allow construction of a parking lot. In addition, a soil removal action was completed in the NM Area (Taussig Can Area) in 1979 with the approval of the Commonwealth of Virginia. A monitoring well also was installed at this location.

4.3 Interim Remedial Action Process

Interim remedial actions are implemented to provide temporary mitigation of human health risks or to mitigate the spread of contamination in the environment. Similar to removal actions, they may be implemented at any time during the RI/FS process. Examples of interim remedial actions include installation of a pump-and-treat system for product recovery from the groundwater or installation of a fence to prevent direct contact with hazardous materials.

For interim remedial actions, a focused FS is prepared rather than the more extensive FS. As with the removal action, an interim remedial action may become the final remedial action if the risk assessment results indicate that no further remedial action is required in order to protect human health and the environment. In this case, a no-action ROD would be signed and the site removed from the program upon completion of the interim remedial action. No interim remedial actions have been completed to date at Naval Base Norfolk.

4.4 Treatability Studies

Treatability studies are performed to assist in the evaluation of a potentially promising remedial technology. The primary objectives of treatability testing are:

- to provide sufficient data to allow treatment alternatives to be fully developed and evaluated during the FS, and/or

- to support the remedial design of a selected alternative

Treatability studies may be conducted at any time during the RI/FS process. The need for a treatability study is generally identified during the FS.

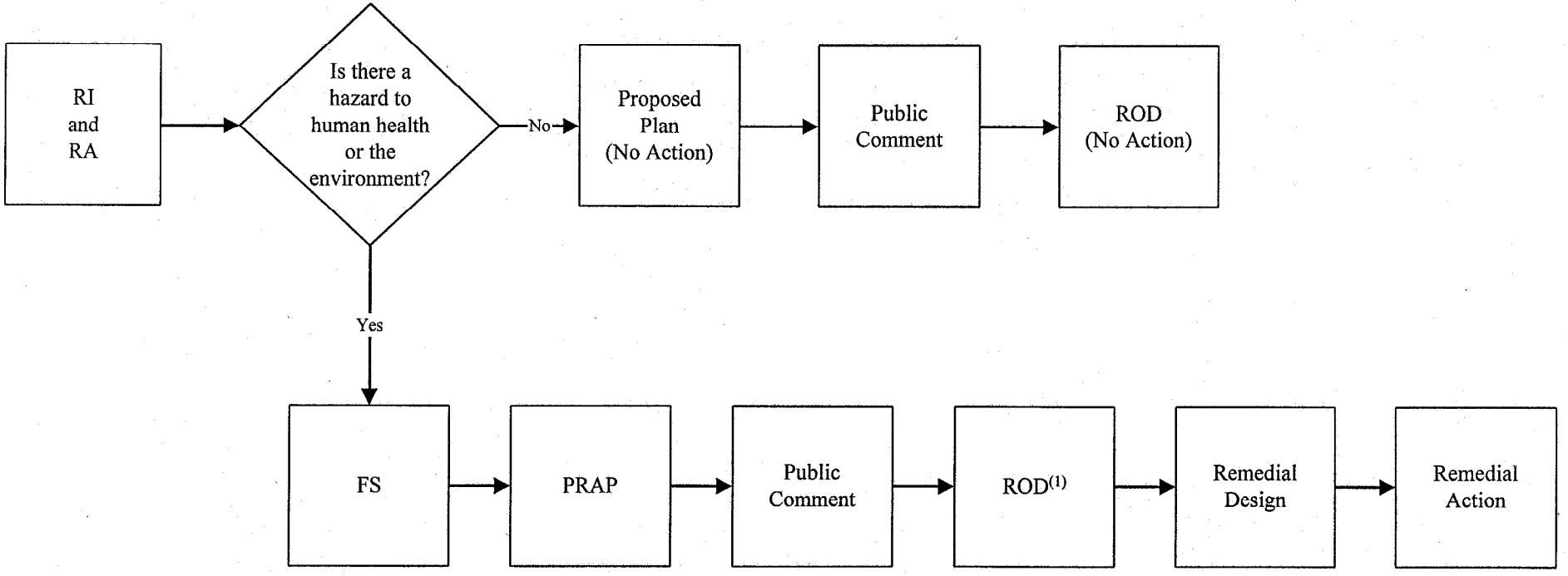
Treatability studies may be classified as either bench-scale (laboratory study) or pilot-scale (field studies). For technologies that are well-developed and tested, bench-scale studies are often sufficient to evaluate performance. For innovative technologies, pilot tests may be required to obtain the desired information. Pilot tests simulate the physical and chemical parameters of the full-scale process, and are designed to bridge the gap between bench-scale and full-scale operations.

Pilot-scale treatability studies have been conducted at the Camp Allen Landfill Site to evaluate air stripping and dual-phase vacuum extraction technologies. Additionally, soil vapor extraction and air sparging pilot-scale treatability studies were completed at the Q-Area Drum Storage Area in May 1995.

SECTION 4.0 - FIGURES

FIGURE 4-1

CERCLA RI/FS PROCESS
NAVAL BASE NORFOLK SITE MANAGEMENT PLAN



RI = Remedial Investigation
RA = Baseline Risk Assessment (human health and ecological risks)
FS = Feasibility Study
PRAP = Proposed Remedial Action Plan
ROD = Record of Decision or Decision Document (including Responsiveness Summary)

(1) Includes summary of any Interim Remedial Actions or Removal Actions

5.0 SITE MANAGEMENT PLAN SCHEDULES

The purpose of this section is to present project-specific schedules for projects that are or potentially will be active in 1995 or 1996, as well as model schedules for IRP and SWMU sites that will be initiated beyond 1996. Project-specific schedules for active projects will be updated periodically in the SMP. Potentially active projects for 1995/1996, for which project-specific schedules have been developed, are summarized in Table 5-1.

For projects that are currently active, the current project schedules as developed by LANTDIV and/or the project manager are presented. For projects that have not yet been initiated or for which project schedules have not been developed, model schedules are presented which illustrate potential overall schedules for "typical" projects. For these projects, scheduling assumptions are discussed below.

5.1 Scheduling Assumptions

Assumptions regarding durations of field investigations, laboratory analysis, data validation, document preparation, document review, and remedial design/remedial action are discussed below.

5.1.1 Field Investigation and Laboratory Analysis/Validation

The time required for RI field investigations depends on the size and complexity of the site and the overall scope of the field investigation (i.e., types of field investigation activities, number of sampling rounds, etc.). Generally, field investigations require from 2 to 6 months to complete.

A 30-day turnaround time was assumed for laboratory analysis. Twenty-eight days is the standard turnaround time for Naval Facilities Engineering Support Center (NFESC)-approved laboratories under the current Navy CLEAN Contract. A 14-day duration was assumed for validation of laboratory data.

5.1.2 Document Preparation and Document Review

The time required for document preparation under the RI/FS process (see Section 4.1) has been estimated based on prior experience in preparing the various types of documents. A summary of the estimated times required for development of the various types of documents typically prepared during the RI/FS process is presented in Table 5-2. The durations presented in Table 5-2 represent the time required to prepare the initial draft document and do not include time required for review and subsequent revisions of the document.

The time required for document review generally will vary according to the length and complexity of the document, as well as the availability of resources on the part of the reviewing agency. Since the Naval Base Norfolk is not currently operating under an FFA, specific document review periods for various types of documents have not been negotiated and agreed to by the Navy and the regulatory agencies. Therefore, review periods have been assumed based on FFAs that are in place at other naval installations and LANTDIV experience with review periods under the current IRP. If the Naval Base becomes an NPL Site, an FFA will be negotiated and the assumed document review process may be revised.

For purposes of this SMP, it is assumed that three versions of each document will be produced - a Draft, Draft Final, and Final version. The following corresponding document review periods were assumed.

Draft Document: 45-day review by LANTDIV
Draft Final Document: 60-day review by LANTDIV/agencies

For this SMP, it was assumed that 30 days would be required by the consultant to incorporate LANTDIV comments on the Draft Document and to prepare and submit the Draft Final Document. Also, it was assumed that 21 days would be required by the consultant to incorporate LANTDIV/agency comments on the Draft Final Document and to prepare and submit the Final Document.

5.1.3 Remedial Design/Remedial Action

The time required for remedial design/remedial action (RD/RA) depends on the type and complexity of the proposed remedial action. For example, the remedial design of a groundwater pump-and-treat system generally is much more complex than the remedial design for a soil removal/off-site disposal remedial action. Therefore, the groundwater pump-and-treat remedial design process may require up to one year, whereas the soil removal/off-site disposal remedial design may require less than three months. Similarly, the groundwater pump-and-treat system may operate for a long period of time (10- to 20-year period for remedial action), whereas the soil removal/off-site disposal remedial action may be completed in less than one year. Therefore, schedules for RD/RA activities are only provided for projects where the type of remedial action to be performed is known. The remaining sites are only scheduled up through the ROD phase of the RI/FS process.

5.2 IRP Site Project Schedules

This section presents the proposed activities and project-specific schedules for projects that are or potentially will be active in 1995 or 1996, as summarized in Table 5-1. For projects that are currently active, the current project schedules as developed by LANTDIV and/or the project manager are presented.

For projects that have not yet been initiated or for which schedules have not yet been developed, model schedules are presented which illustrate potential overall schedules for the projects. The model schedules illustrate potential overall schedules for "typical" IRP projects.

Project-specific schedules for IRP projects that are or potentially will be active in 1995/1996 are presented in Figures 5-1 through 5-8. In addition, two model schedules have been developed which illustrate potential overall schedules for "typical" IRP projects. The two model schedules, one illustrating a small or simple site and one illustrating a large or complex site, are presented in Figures 5-9 and 5-10, respectively.

The basic strategy used during development of the IRP project schedules was to overlap the RI/FS and RD/RA activities to the maximum extent practicable in order to compress the overall project schedules as much as possible without compromising the interdependencies of the various tasks and

documents in the RI/FS process. The amount of overlap of tasks was based on the degree of dependency between the various tasks and documents. Key dependencies and related assumptions are outlined below.

- Remedial Investigation (RI): Preparation of the Draft RI was assumed to start once all of the analytical data have been received, but prior to data validation. Certain RI tasks can begin before the data are validated. However, in order to prevent duplication of effort, this overlap was assumed to be only two weeks.

- Feasibility Study (FS): Preparation of the Draft FS was assumed to begin approximately two months following the start of the RI. Many FS tasks are dependent on the nature and extent of contamination, which are generally defined in the RI Report.

- Proposed Remedial Action Plan (PRAP): Preparation of the Draft PRAP was assumed to start following receipt of agency comments of the Draft Final FS, since selection of the proposed remedial action(s) in the PRAP is contingent upon agency approval of the recommended alternative.

- Record of Decision or Decision Document (ROD): Preparation of the Draft ROD was assumed to begin following receipt of agency comments on the Draft Final PRAP. Since public comments received during the public comment period must be responded to in the ROD, preparation of the Final ROD would not begin until closure of the public comment period.

5.3 Submittals List

Table 5-3 presents a summary list of submittals that have been or may be required throughout the life of each project or site. The table summarizes final documents that have been submitted, documents that are planned or are in progress, and documents that may be required in the future.

SECTION 5.0 - TABLES

TABLE 5-1

ACTIVE PROJECTS FOR 1995/1996
NAVAL BASE NORFOLK SITE MANAGEMENT PLAN

ACTIVE PROJECT		ESTIMATED START DATE
Site 1 -	Camp Allen Landfill PRAP/ROD Camp Allen Landfill RD/RA	In Progress In Progress
Site 2 -	NM Slag Pile RI/FS	Fiscal Year 1996
Site 3 -	Q-Area RI/FS Q-Area PRAP/ROD Q-Area RD/RA	In Progress Fall 1995 Fall 1995
Site 5 -	Pesticide Disposal Site RI/FS	Fiscal Year 1996
Site 6 -	CD Landfill RI/FS CD Landfill PRAP/ROD	In Progress Fall 1995
Site 20 -	LP-20 RI/FS LP-20 PRAP/ROD	In Progress Fall 1995
Site 21 -	Building W-316 PA/SI	Fiscal Year 1996
Site 22 -	Camp Allen Salvage Yard RI/FS	Fiscal Year 1996

PA = Preliminary Assessment
SI = Site Inspection
RI = Remedial Investigation
FS = Feasibility Study
PRAP = Proposed Remedial Action Plan
ROD = Record of Decision or Decision Document
RD = Remedial Design
RA = Remedial Action

Note: Fiscal Year 1996 runs from October 1, 1995 to September 30, 1996. Starting dates are contingent upon available funding and site risk relative to all Navy sites.

TABLE 5-2

DOCUMENT PREPARATION DURATIONS
NAVAL BASE NORFOLK SITE MANAGEMENT PLAN

Document	Duration (Months) [1]
Preliminary Assessment/Site Inspection	2
RI/FS Work Plans	2
Remedial Investigation Report	3-4
Feasibility Study	3-4
Proposed Plan	2
Record of Decision	2
Pre-Final Remedial Design	2
Final Design	1-2
Engineering Evaluation/Cost Analysis	1-2
Removal Action Work Plan	2
Removal Action Report	1-2
Treatability Study Work Plan	2
Treatability Study Report	1-2

[1] Durations represent estimated time required to complete Draft Documents.

TABLE 5-3

SUBMITTALS LIST SUMMARY
NAVAL BASE NORFOLK IRP SITES

Document Name	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13
Preliminary Assessment	X	X	X	X	X	X	X	X	X	X	X	X	X
Site Inspection Report	X	X	X	X	X	X	NO	NO	MAY	NO	NO	NO	NO
RI / FS Work Plans	X	O	X	X	O	X	NO	NO	MAY	NO	NO	NO	NO
Community Relations Plan	X	YES	X	X	O	X	NO	NO	MAY	NO	NO	NO	NO
Health and Safety Plan	X	YES	X	X	O	X	NO	NO	MAY	NO	NO	NO	NO
Remedial Investigation Report	X	YES	X	X	O	O	NO	NO	MAY	NO	NO	NO	NO
Feasibility Study Report	X	YES	X	X	O	O	NO	NO	MAY	NO	NO	NO	NO
Pilot / Treatability Work Plan	X	NO	O	NO	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO
Pilot / Treatability Report	X	NO	O	NO	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO
Proposed Remedial Action Plan	X	YES	O	X	O	O	NO	NO	MAY	NO	NO	NO	NO
Record of Decision	O	YES	O	X	O	O	NO	NO	MAY	NO	NO	NO	NO
Focused Feasibility Study	NO	NO	NO	NO	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO
Engineering Evaluation/Cost Analysis	X	NO	NO	NO	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO
Removal Action Plan	X	NO	NO	NO	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO
Removal Action Memorandum	X	NO	NO	NO	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO
Remedial Design Work Plan	X	MAY	O	X	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO
Remedial Design Documents	X	MAY	O	X	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO
Remedial Action Work Plan	X	MAY	O	X	MAY	MAY	NO	NO	MAY	NO	X	NO	NO
Remedial Action Completion Report	O	MAY	O	X	MAY	MAY	NO	NO	MAY	NO	X	NO	NO
Operations & Maintenance Plan	O	MAY	O	NO	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO
Long-Term Monitoring Plan	O	MAY	O	X	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO
Periodic Review Assessment Reports	O	MAY	O	YES	MAY	MAY	NO	NO	MAY	NO	NO	NO	NO

TABLE 5-3 (Continued)

SUBMITTALS LIST SUMMARY
NAVAL BASE NORFOLK IRP SITES

Document Name	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22	SWMU 1	SWMU 2	SWMU 3
Preliminary Assessment	X	X	X	X	X	O	X	X	X	X
Site Inspection Report	NO	NO	MAY	X	X	O	X	MAY	MAY	MAY
RI / FS Work Plans	NO	NO	MAY	X	X	MAY	O	MAY	MAY	MAY
Community Relations Plan	NO	NO	MAY	X	X	MAY	O	MAY	MAY	MAY
Health and Safety Plan	NO	NO	MAY	X	X	MAY	O	MAY	MAY	MAY
Remedial Investigation Report	NO	NO	MAY	X	O	MAY	O	MAY	MAY	MAY
Feasibility Study Report	NO	NO	MAY	X	O	MAY	O	MAY	MAY	MAY
Pilot / Treatability Work Plan	NO	NO	MAY	NO	MAY	MAY	MAY	MAY	MAY	MAY
Pilot / Treatability Report	NO	NO	MAY	NO	MAY	MAY	MAY	MAY	MAY	MAY
Proposed Remedial Action Plan	NO	NO	MAY	X	O	MAY	O	MAY	MAY	MAY
Record of Decision	NO	NO	MAY	X	O	MAY	O	MAY	MAY	MAY
Focused Feasibility Study	NO	NO	MAY	NO	MAY	MAY	MAY	MAY	MAY	MAY
Engineering Evaluation/Cost Analysis	NO	NO	MAY	NO	MAY	MAY	MAY	MAY	MAY	MAY
Removal Action Plan	NO	NO	MAY	NO	MAY	MAY	MAY	MAY	MAY	MAY
Removal Action Memorandum	NO	NO	MAY	NO	MAY	MAY	MAY	MAY	MAY	MAY
Remedial Design Work Plan	NO	NO	MAY	X	MAY	MAY	MAY	MAY	MAY	MAY
Remedial Design Documents	NO	NO	MAY	X	MAY	MAY	MAY	MAY	MAY	MAY
Remedial Action Work Plan	X	X	MAY	X	MAY	MAY	MAY	MAY	MAY	MAY
Remedial Action Completion Report	X	X	MAY	X	MAY	MAY	MAY	MAY	MAY	MAY
Operations & Maintenance Plan	NO	NO	MAY	NO	MAY	MAY	MAY	MAY	MAY	MAY
Long-Term Monitoring Plan	NO	NO	MAY	MAY	MAY	MAY	MAY	MAY	MAY	MAY
Periodic Review Assessment Reports	NO	NO	MAY	MAY	MAY	MAY	MAY	MAY	MAY	MAY

TABLE 5-3 (Continued)

SUBMITTALS LIST SUMMARY
NAVAL BASE NORFOLK IRP SITES

Notes:

X = Final document submittal
O = Document planned or in progress
YES = Document likely to be required
MAY = Document may or may not be required
NO = Document likely not to be required

Site 1 - Camp Allen Landfill
Site 2 - NM Slag Pile
Site 3 - Q-Area Drum
Site 4 - P-71 Transformer
Site 5 - Pesticide Disposal
Site 6 - CD Landfill
Site 7 - Inert Landfill
Site 8 - Asbestos Landfill
Site 9 - Q-Area Landfill
Site 10 - Apollo Disposal
Site 11 - Shop Drains
Site 12 - Mercury Disposal
Site 13 - Past Outfalls
Site 16 - Building X-136 Fire
Site 17 - Building SDA-215 Fire
Site 18 - NM Waste Storage
Site 19 - Buildings V60/V90
Site 20 - LP-20 Site
Site 21 - Building W-316
Site 22 - Camp Allen Salvage Yard
SWMU 1 - SP-2B Accumulation Area
SWMU 2 - Z-309 Ash Hopper
SWMU 3 - Z-309 O/L Storage

SECTION 5.0 - FIGURES

Figure 5-1
Site1 - Camp Allen Landfill
Feasibility Study, Proposed Plan, Decision Document, Removal Action, and Remediation

ID	Task Name	Duration	Start	Finish
1	**CAMP ALLEN LANDFILL PROJECT**	**413d**	**10/1/94**	**5/1/96**
2	**Feasibility Study**	**34d**	**10/1/94**	**11/17/94**
3	Final	47ed	10/1/94	11/17/94
4	**Proposed Plan (PRAP)**	**133d**	**10/1/94**	**4/5/95**
5	Draft	47ed	10/1/94	11/17/94
6	Navy Review	75ed	11/17/94	1/31/95
7	Draft Final	8ed	1/31/95	2/8/95
8	EPA/State/Navy Review	16ed	2/8/95	2/24/95
9	Final	6ed	2/24/95	3/2/95
10	**Public Comment Period**	30ed	3/6/95	4/5/95
11	**Decision Document (ROD)**	**198d**	**11/1/94**	**8/4/95**
12	Draft	30ed	11/1/94	12/1/94
13	Navy Review	109ed	12/1/94	3/20/95
14	Draft Final	56ed	3/20/95	5/15/95
15	EPA/State/Navy Review	60ed	5/15/95	7/14/95
16	Final	21ed	7/14/95	8/4/95
17	**Removal Action**	**65d**	**10/1/94**	**12/30/94**
18	Area B Soil Removal	90ed	10/1/94	12/30/94
19	Removal Completion Report	90ed	10/1/94	12/30/94
20	**Remedial Design (RD)**	**0d**	**10/1/94**	**10/1/94**
21	Final Remedial Design	0ed	10/1/94	10/1/94
22	**Remedial Action Begins**	**413d**	**10/1/94**	**5/1/96**
23	Extraction Well Installation	48ed	10/1/94	11/18/94
24	DPVE Pilot Studies	76ed	10/1/94	12/16/94
25	GW Treat Plant Construction	365ed	5/2/95	5/1/96

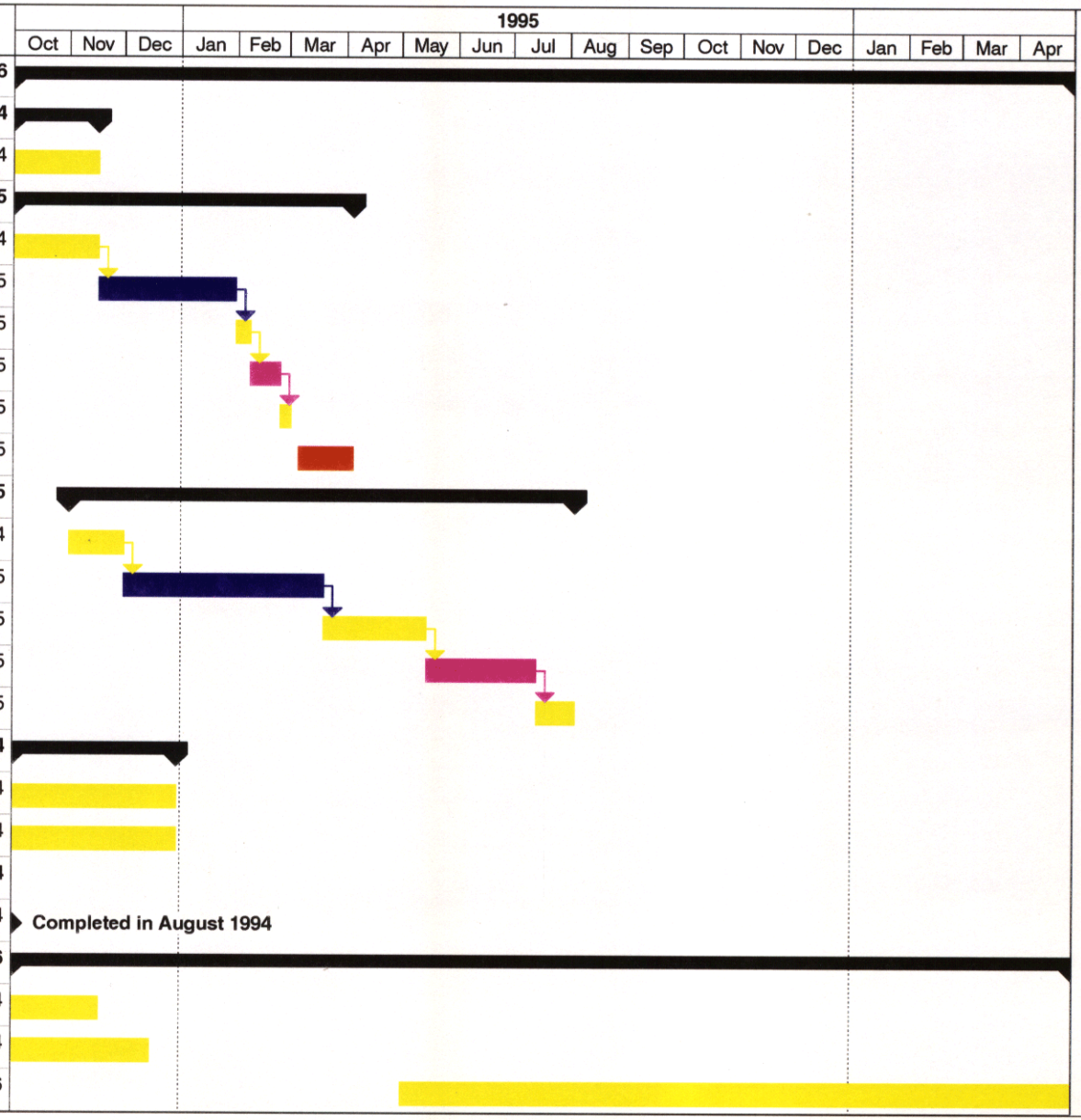


Figure 5-1
6/19/95

Navy Review
Agency Review
Contractor Work Progress
Summary Task
Milestone

Figure 5-2
Site 2 - NM Area Slag Pile
Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document

ID	Task Name	Duration
1	**NM AREA SLAG PILE**	**744d**
2	**RI/FS Work Plans**	**155d**
3	Draft	60ed
4	Navy Review	45ed
5	Draft Final	30ed
6	EPA/State/Navy Review	60ed
7	Final	21ed
8	**Remedial Investigation**	**264d**
9	RI Field Work	60ed
10	Laboratory Analysis	30ed
11	Data Validation	14ed
12	Draft	120ed
13	Navy Review	45ed
14	Draft Final	30ed
15	EPA/State/Navy Review	60ed
16	Final	21ed
17	**Feasibility Study**	**200d**
18	Draft	120ed
19	Navy Review	45ed
20	Draft Final	30ed
21	EPA/State/Navy Review	60ed
22	Final	21ed

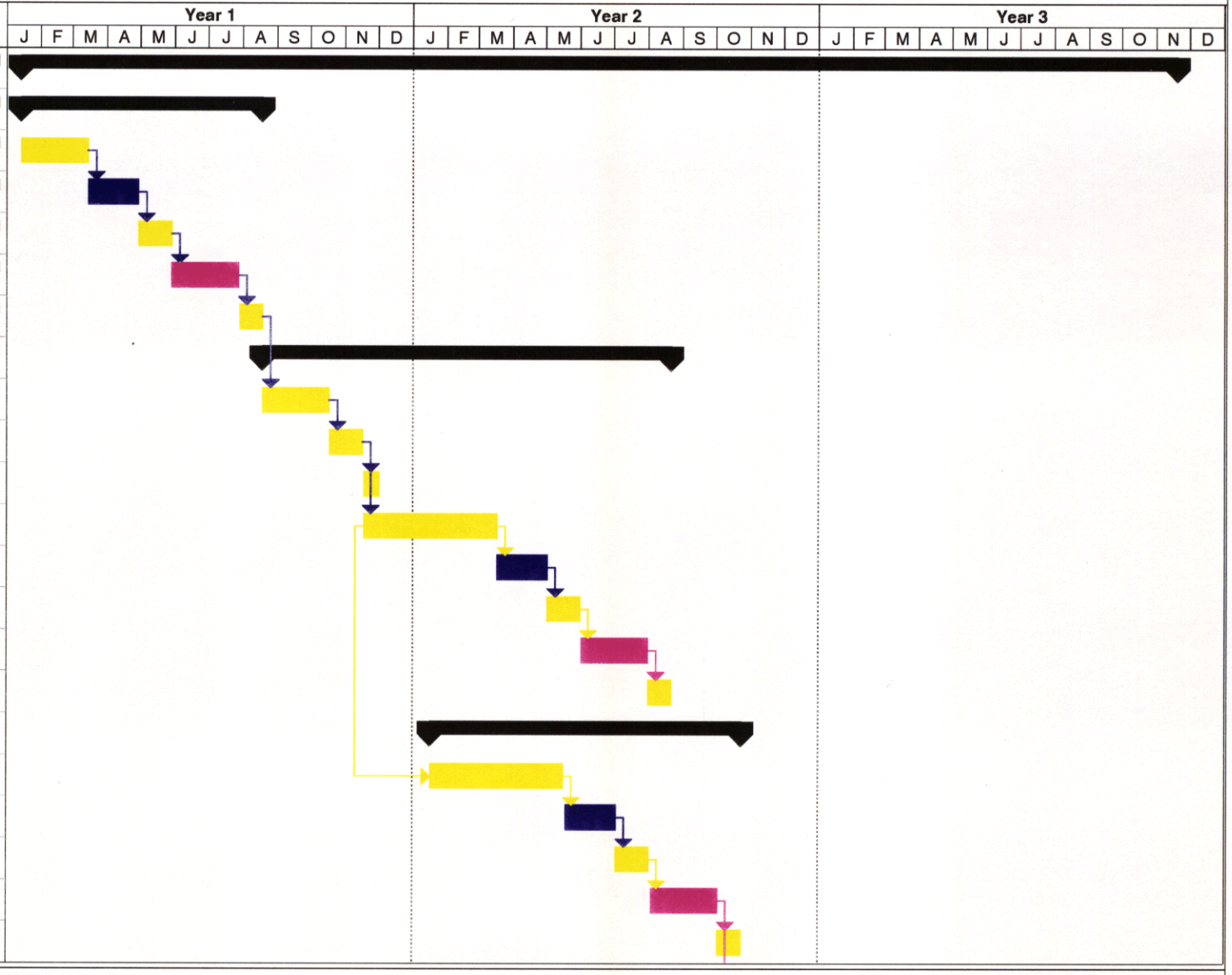


Figure 5-2
6/19/95

Navy Review
Agency Review
Contractor Work Progress
Summary
Milestone

Figure 5-2
Site 2 - NM Area Slag Pile
Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document

ID	Task Name	Duration
23	**Proposed Plan (PRAP)**	**155d**
24	Draft	60ed
25	Navy Review	45ed
26	Draft Final	30ed
27	EPA/State/Navy Review	60ed
28	Final	21ed
29	**Public Comment Period**	30ed
30	**Decision Document (ROD)**	**155d**
31	Draft	60ed
32	Navy Review	45ed
33	Draft Final	30ed
34	EPA/State/Navy Review	60ed
35	Final	21ed

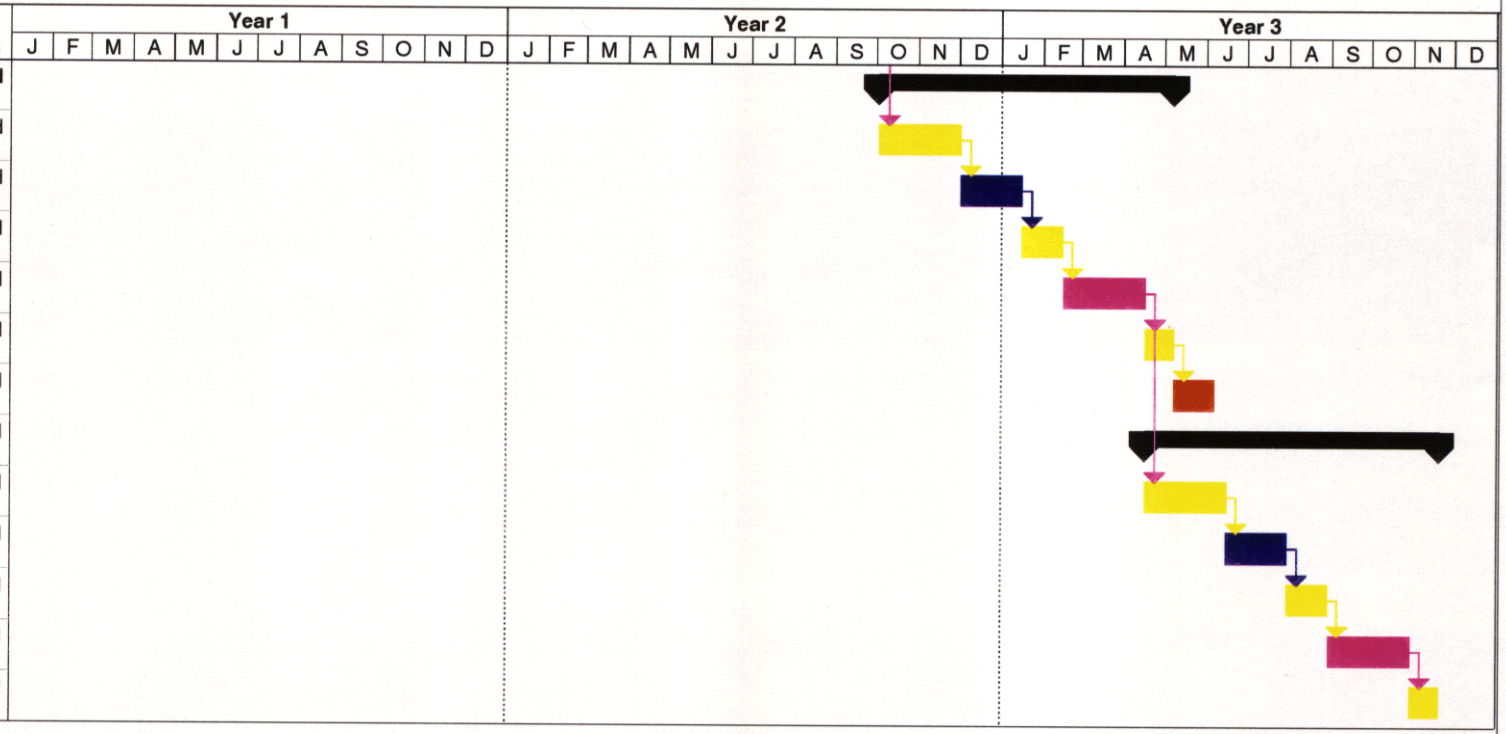


Figure 5-2
6/19/95

Navy Review
Agency Review
Contractor Work Progress
Summary
Milestone

Figure 5-3
Site 3 - Q-Area Drum Storage
Remedial Investigation, Feasibility Study, Proposed Plan, Decision Document, Remedial Design, and Remediation

ID	Task Name	Duration	Start	Finish
1	**Q-AREA DRUM STORAGE**	**399d**	**10/1/94**	**4/11/96**
2	**Remedial Investigation**	**161d**	**10/1/94**	**5/14/95**
3	Draft Final	60ed	10/1/94	11/30/94
4	EPA/State/Navy Review	90ed	11/30/94	2/28/95
5	Final	75ed	2/28/95	5/14/95
6	**Feasibility Study**	**161d**	**10/1/94**	**5/14/95**
7	Draft Final	60ed	10/1/94	11/30/94
8	EPA/State/Navy Review	90ed	11/30/94	2/28/95
9	Final	75ed	2/28/95	5/14/95
10	**Proposed Plan (PRAP)**	**107d**	**5/15/95**	**10/11/95**
11	Draft	30ed	5/15/95	6/14/95
12	Navy Review	45ed	6/14/95	7/29/95
13	Draft Final	5ed	7/31/95	8/5/95
14	EPA/State/Navy Review	60ed	8/7/95	10/6/95
15	Final	5ed	10/6/95	10/11/95
16	**Public Comment Period**	30ed	10/11/95	11/10/95
17	**Decision Document (ROD)**	**109d**	**11/10/95**	**4/11/96**
18	Draft	30ed	11/10/95	12/10/95
19	Navy Review	45ed	12/11/95	1/25/96
20	Draft Final	5ed	1/25/96	1/30/96
21	EPA/State/Navy Review	60ed	1/30/96	3/30/96
22	Final	10ed	4/1/96	4/11/96

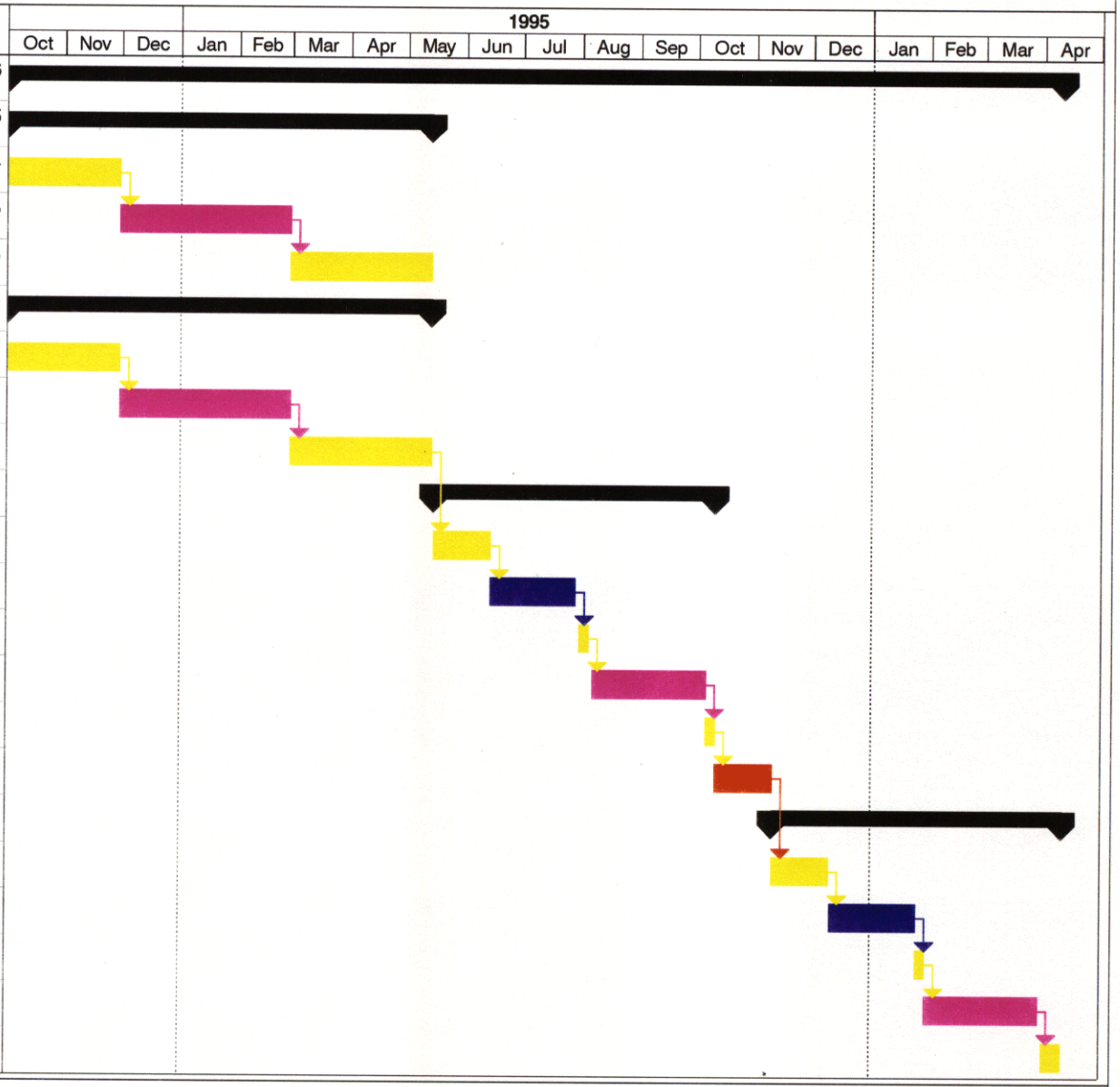


Figure 5-3
6/19/95

Navy Review
Agency Review
Contractor Work Progres
Summary
Milestone

Figure 5-3
Site 3 - Q-Area Drum Storage
Remedial Investigation, Feasibility Study, Proposed Plan, Decision Document, Remedial Design, and Remediation

ID	Task Name	Duration	Start	Finish
23	**Pilot Treatability Studies**	**88d**	**3/1/95**	**7/3/95**
24	Draft Work Plan	29ed	3/1/95	3/30/95
25	Navy Review	15ed	3/30/95	4/14/95
26	Final Work Plan	24ed	4/14/95	5/8/95
27	Pilot Testing Field Studies	14ed	5/8/95	5/22/95
28	Draft Pilot TS Report	14ed	5/22/95	6/5/95
29	Navy Review	14ed	6/5/95	6/19/95
30	Final Pilot TS Report	14ed	6/19/95	7/3/95
31	**Remedial Design - Soil**	**102d**	**3/13/95**	**8/2/95**
32	30% Remedial Design	49ed	3/13/95	5/1/95
33	Navy Review	31ed	5/1/95	6/1/95
34	Final Remedial Design	30ed	6/1/95	7/1/95
35	Construction Bidding	30ed	7/3/95	8/2/95
36	**Remedial Action Begins - Soil**	0d	11/1/95	11/1/95
37	**Remedial Design-Groundwater**	**175d**	**3/1/95**	**11/1/95**
38	35% Remedial Design	125ed	3/1/95	7/4/95
39	Navy Review	14ed	7/4/95	7/18/95
40	100% Remedial Design	30ed	7/18/95	8/17/95
41	Navy Review	14ed	8/17/95	8/31/95
42	Final Remedial Design	30ed	8/31/95	9/30/95
43	Construction Bidding	30ed	10/2/95	11/1/95
44	**Remedial Action Begins - GW**	0ed	11/1/95	11/1/95

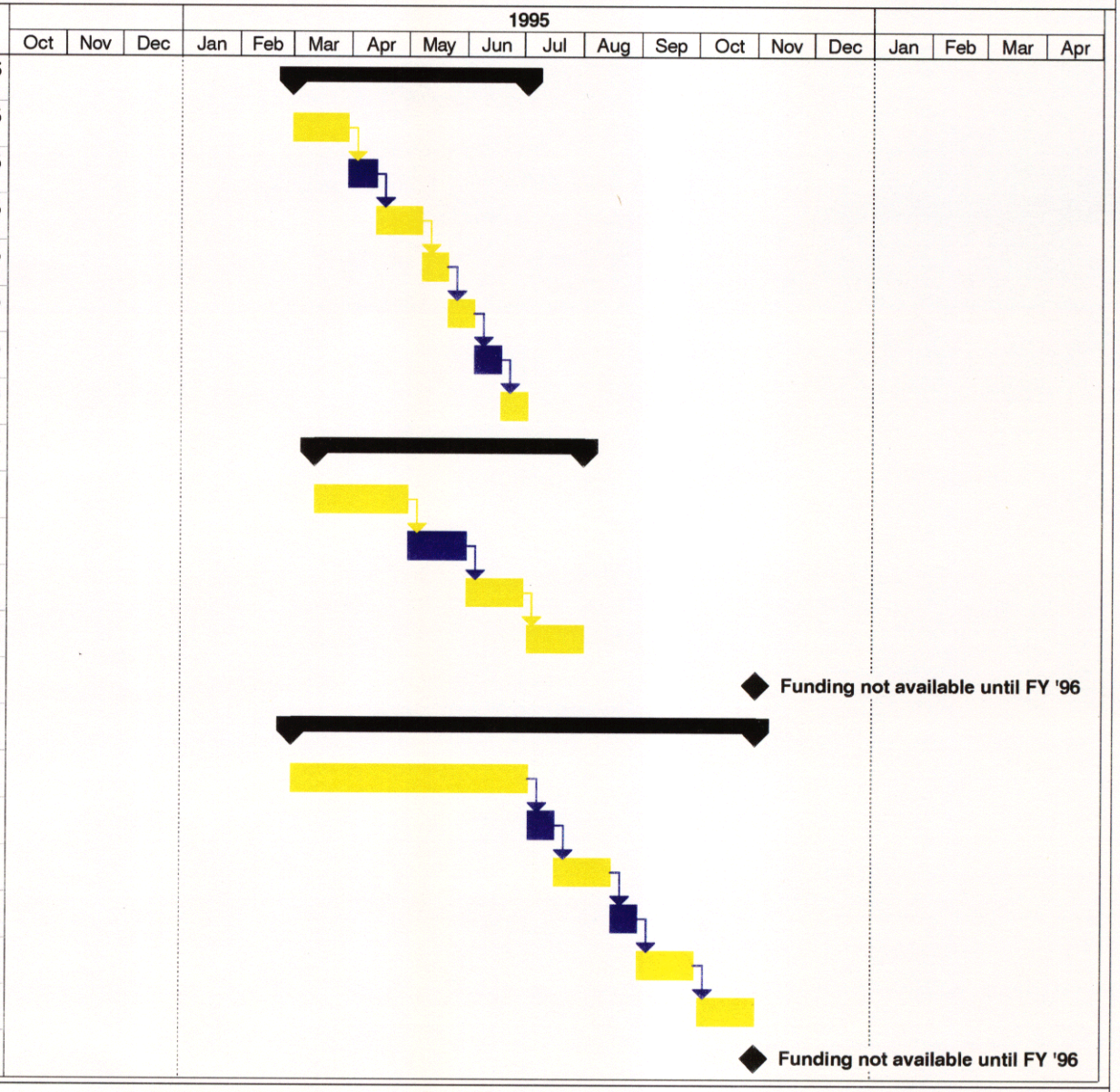


Figure 5-3
6/19/95

Navy Review
Agency Review
Contractor Work Progres
Summary
Milestone

Figure 5-4
Site 5- Pesticide Disposal Site
Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document

ID	Task Name	Duration
1	**PESTICIDE DISPOSAL SITE**	**721d**
2	**RI/FS Work Plans**	**156d**
3	Draft	60ed
4	Navy Review	45ed
5	Draft Final	30ed
6	EPA/State/Navy Review	60ed
7	Final	21ed
8	**Remedial Investigation**	**244d**
9	RI Field Work	60ed
10	Laboratory Analysis	30ed
11	Data Validation	14ed
12	Draft	90ed
13	Navy Review	45ed
14	Draft Final	30ed
15	EPA/State/Navy Review	60ed
16	Final	21ed
17	**Feasibility Study**	**176d**
18	Draft	90ed
19	Navy Review	45ed
20	Draft Final	30ed
21	EPA/State/Navy Review	60ed
22	Final	21ed

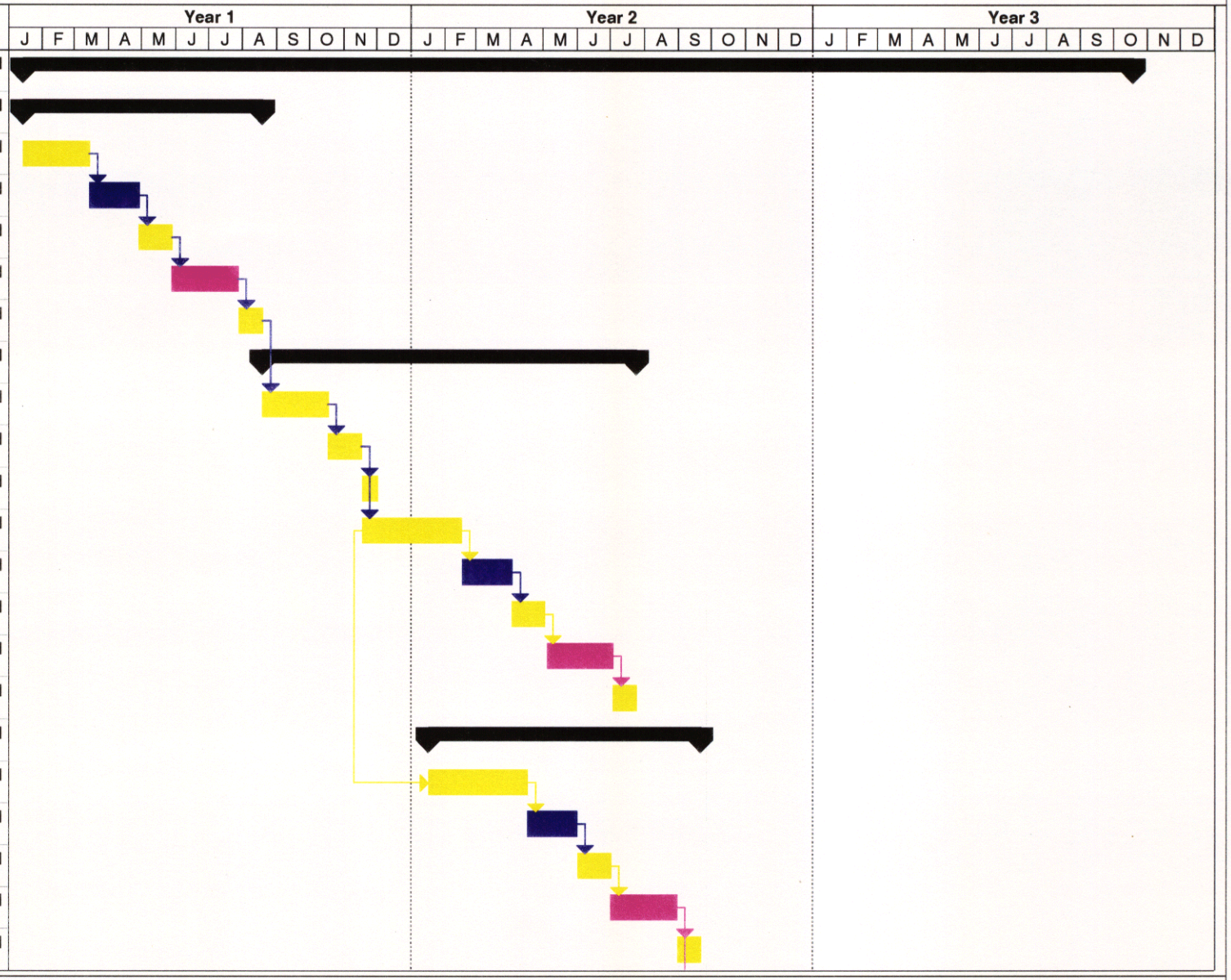


Figure 5-4
6/19/95

Navy Review
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Figure 5-4
Site 5- Pesticide Disposal Site
Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document

ID	Task Name	Duration
23	**Proposed Plan (PRAP)**	**155d**
24	Draft	60ed
25	Navy Review	45ed
26	Draft Final	30ed
27	EPA/State/Navy Review	60ed
28	Final	21ed
29	**Public Comment Period**	30ed
30	**Decision Document (ROD)**	**155d**
31	Draft	60ed
32	Navy Review	45ed
33	Draft Final	30ed
34	EPA/State/Navy Review	60ed
35	Final	21ed

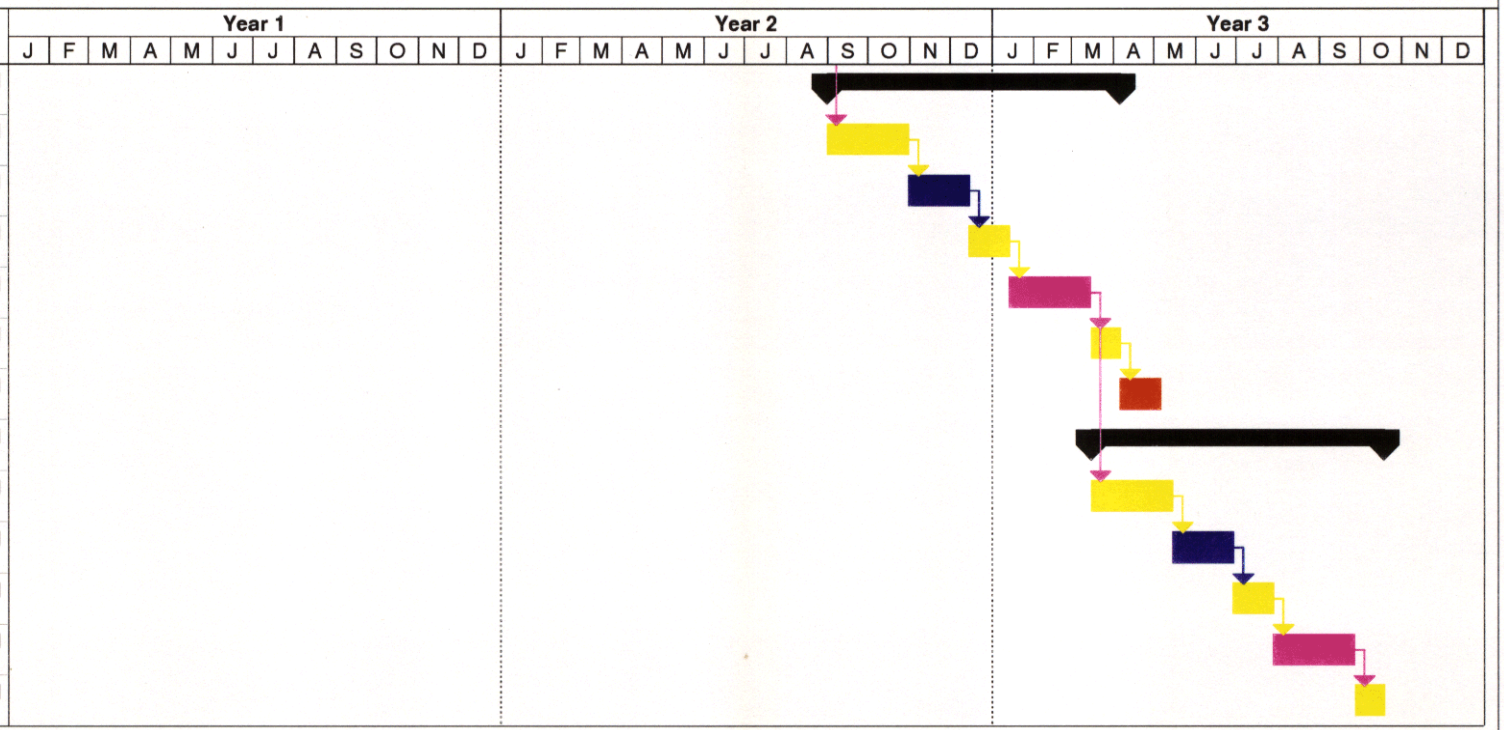

Figure 5-4
6/19/95

Navy Review
Agency Review
Contractor Work Progress
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Figure 5-5
Site 6 - CD Landfill
Remedial Investigation, Feasibility Study, Proposed Plan, Decision Document, Remedial Design, and Remediation

ID	Task Name	Duration	Start	Finish
1	**CD LANDFILL PROJECT**	**831d**	**10/1/94**	**12/6/97**
2	**Remedial Investigation**	**271d**	**10/1/94**	**10/16/95**
3	Draft	69ed	10/1/94	12/9/94
4	Navy Review	87ed	12/9/94	3/6/95
5	Draft Final	148ed	3/6/95	8/1/95
6	EPA/State/Navy Review	60ed	8/1/95	9/30/95
7	Final	14ed	10/2/95	10/16/95
8	**Feasibility Study**	**279d**	**11/1/94**	**11/27/95**
9	Draft	83ed	11/1/94	1/23/95
10	Navy Review	204ed	1/23/95	8/15/95
11	Draft Final	30ed	8/15/95	9/14/95
12	EPA/State/Navy Review	60ed	9/14/95	11/13/95
13	Final	14ed	11/13/95	11/27/95
14	**Proposed Plan (PRAP)**	**124d**	**11/13/95**	**5/3/96**
15	Draft	30ed	11/13/95	12/13/95
16	Navy Review	45ed	12/13/95	1/27/96
17	Draft Final	21ed	1/29/96	2/19/96
18	EPA/State/Navy Review	60ed	2/19/96	4/19/96
19	Final	14ed	4/19/96	5/3/96
20	**Public Comment Period**	30ed	5/3/96	6/2/96

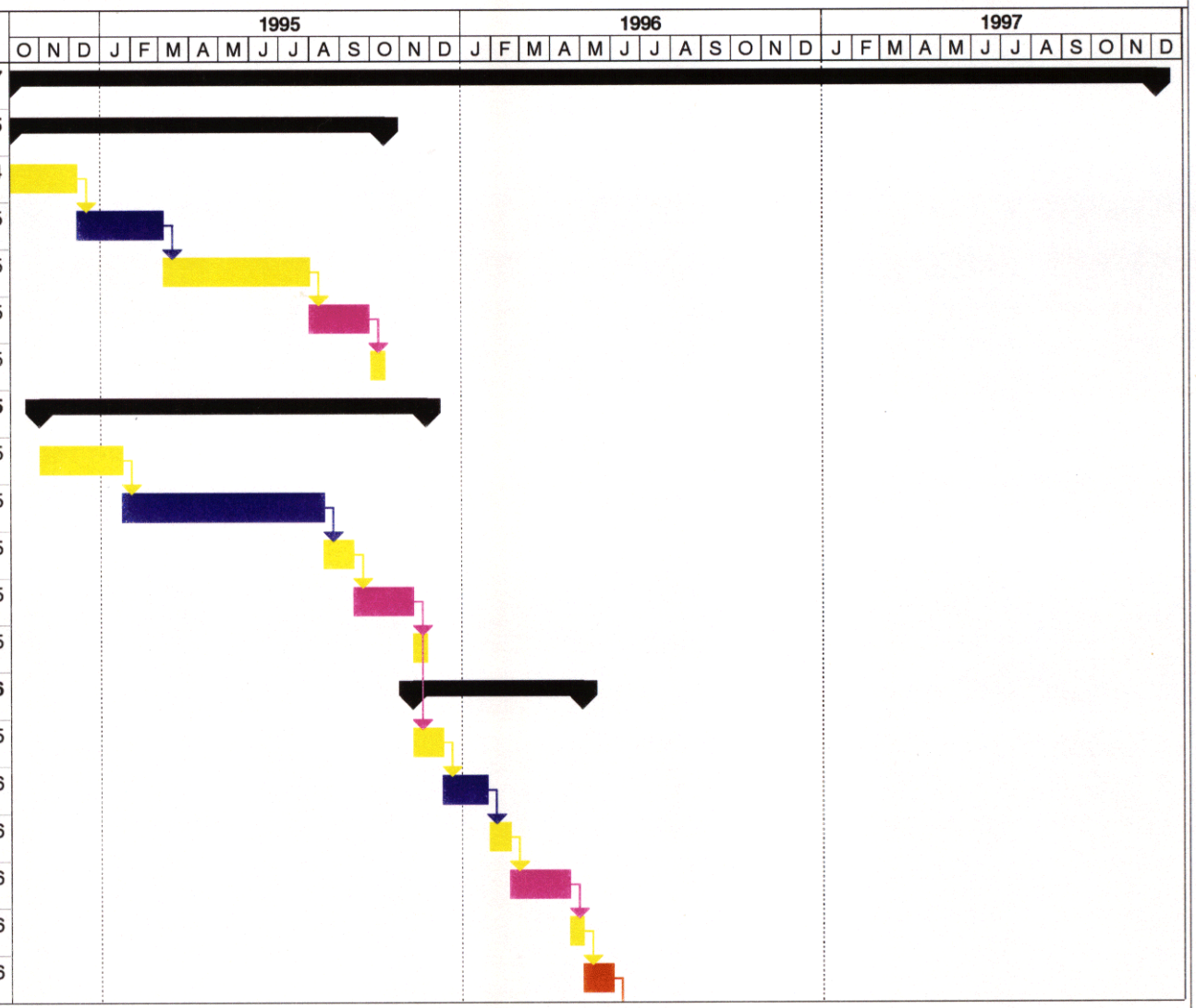

Figure 5-5
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Navy Review
Agency Review
Contractor Work Progress
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Figure 5-5
Site 6 - CD Landfill
Remedial Investigation, Feasibility Study, Proposed Plan, Decision Document, Remedial Design, and Remediation

ID	Task Name	Duration	Start	Finish
21	**Decision Document (ROD)**	**124d**	**6/3/96**	**11/22/96**
22	Draft	30ed	6/3/96	7/3/96
23	Navy Review	45ed	7/3/96	8/17/96
24	Draft Final	21ed	8/19/96	9/9/96
25	EPA/State/Navy Review	60ed	9/9/96	11/8/96
26	Final	14ed	11/8/96	11/22/96
27	**Remedial Design (RD)**	**271d**	**11/22/96**	**12/6/97**
28	30% Remedial Design	60ed	11/22/96	1/21/97
29	EPA/State/Navy Review	60ed	1/21/97	3/22/97
30	90% Remedial Design	90ed	3/24/97	6/22/97
31	EPA/State/Navy Review	60ed	6/23/97	8/22/97
32	Final Remedial Design	30ed	8/22/97	9/21/97
33	Construction Bidding	75ed	9/22/97	12/6/97
34	**Remedial Action Begins**	0d	12/6/97	12/6/97

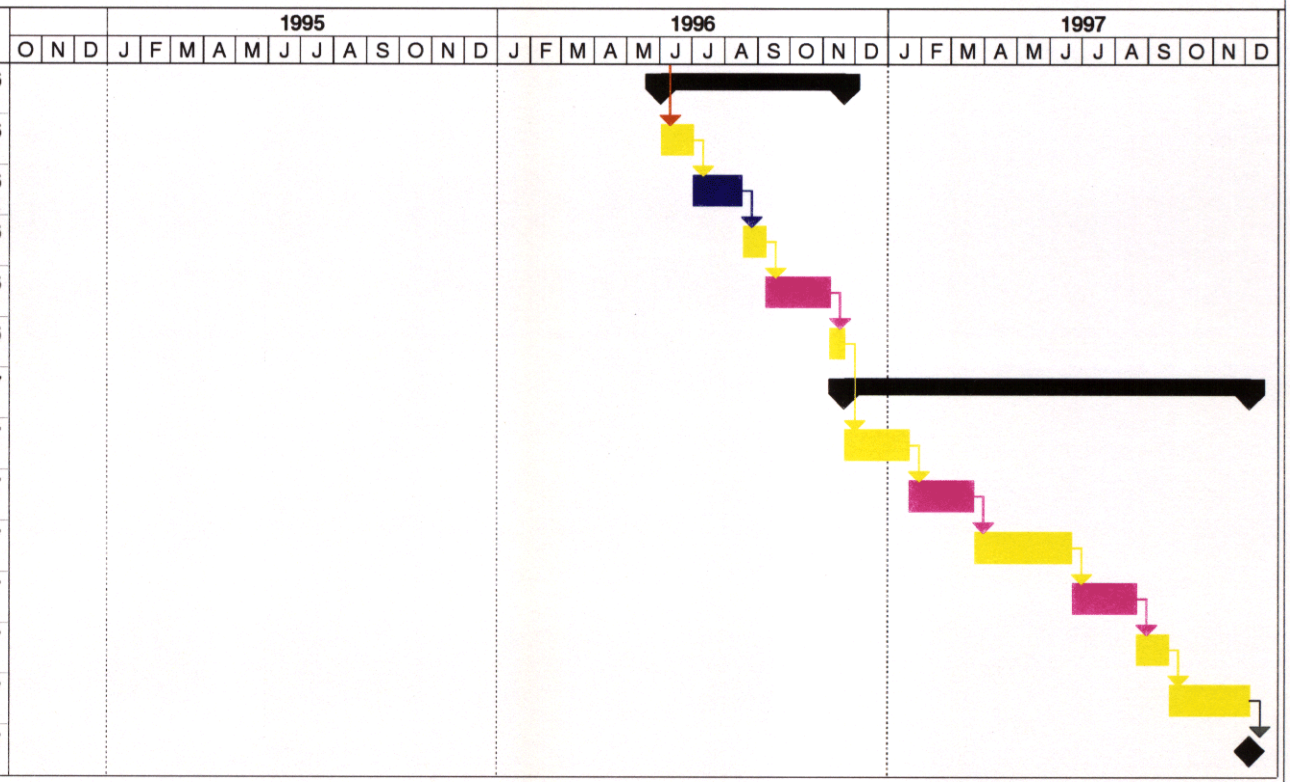

Figure 5-5
6/19/95

Navy Review
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Figure 5-6
Site 20 - LP-20 Site
Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document

ID	Task Name	Duration	Start	Finish
1	**LP-20 SITE**	**334d**	**12/5/94**	**3/10/96**
2	**Remedial Investigation**	**259d**	**12/5/94**	**11/26/95**
3	RI Field Work	72ed	12/5/94	2/15/95
4	Laboratory Analysis/Validation	42ed	2/17/95	3/31/95
5	Draft	93ed	3/15/95	6/16/95
6	Navy Review	30ed	6/16/95	7/16/95
7	Draft Final	42ed	7/17/95	8/28/95
8	EPA/State/Navy Review	60ed	8/28/95	10/27/95
9	Final	30ed	10/27/95	11/26/95
10	**Feasibility Study**	**157d**	**4/24/95**	**11/26/95**
11	Draft	53ed	4/24/95	6/16/95
12	Navy Review	30ed	6/16/95	7/16/95
13	Draft Final	42ed	7/17/95	8/28/95
14	EPA/State/Navy Review	60ed	8/28/95	10/27/95
15	Final	30ed	10/27/95	11/26/95
16	**Proposed Plan (PRAP)**	**96d**	**10/27/95**	**3/10/96**
17	Draft	45ed	10/27/95	12/11/95
18	Navy Review	15ed	12/11/95	12/26/95
19	Draft Final	14ed	12/26/95	1/9/96
20	EPA/State/Navy Review	44ed	1/9/96	2/22/96
21	Final	17ed	2/22/96	3/10/96
22	**Public Comment Period**	30ed	1/15/96	2/14/96

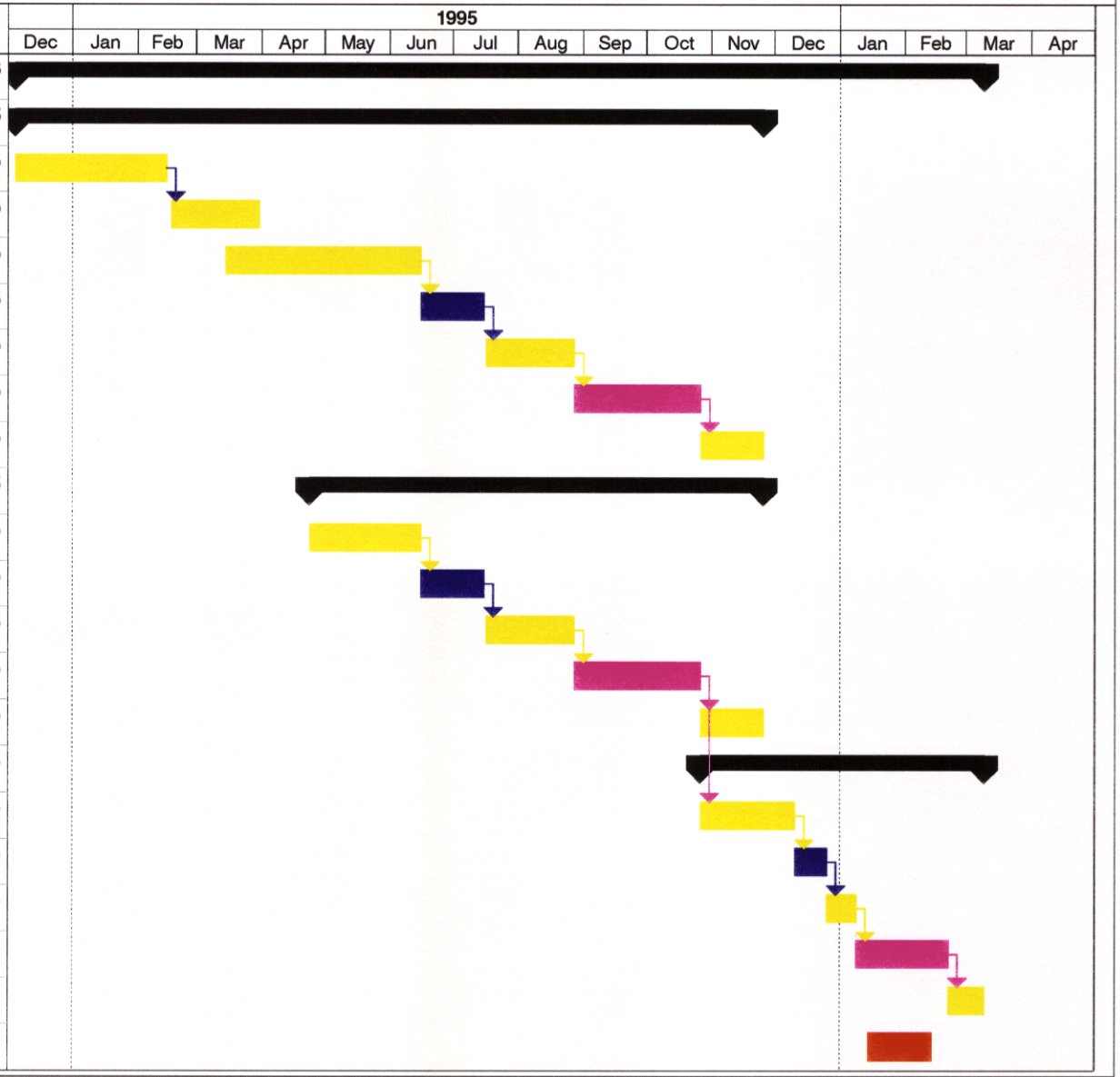

Figure 5-6
6/19/95

Navy Review
Agency Review
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Figure 5-6
Site 20 - LP-20 Site
Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document

ID	Task Name	Duration	Start	Finish
23	**Decision Document (ROD)**	**99d**	**10/17/95**	**3/2/96**
24	Draft	45ed	10/17/95	12/1/95
25	Navy Review	15ed	12/1/95	12/16/95
26	Draft Final	14ed	12/18/95	1/1/96
27	EPA/State/Navy Review	44ed	1/1/96	2/14/96
28	Final	17ed	2/14/96	3/2/96

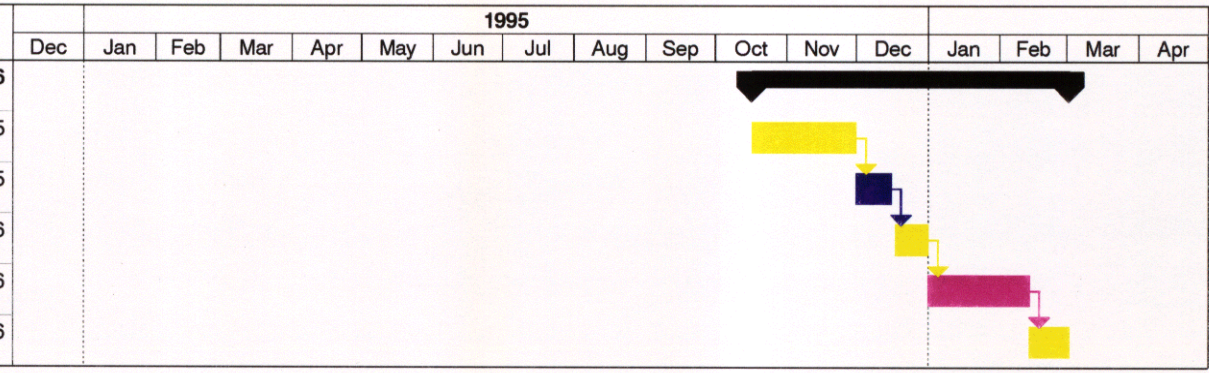

Figure 5-6
6/19/95

Navy Review
Agency Review
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Figure 5-7
Site 21 - Building W-316 PCB Storage
Preliminary Assessment / Site Inspection (PA/SI)

ID	Task Name	Duration
1	**BUILDING W-316 PCB STORAGE**	**315d**
2	**PA/SI Work Plans**	**135d**
3	Draft	30ed
4	Navy Review	45ed
5	Draft Final	30ed
6	EPA/State/Navy Review	60ed
7	Final	21ed
8	**PA/SI**	**180d**
9	PA Research/Interviews	30ed
10	SI Field Work	30ed
11	Laboratory Analysis	30ed
12	Data Validation	14ed
13	Draft	60ed
14	Navy Review	45ed
15	Draft Final	30ed
16	EPA/State/Navy Review	60ed
17	Final	21ed

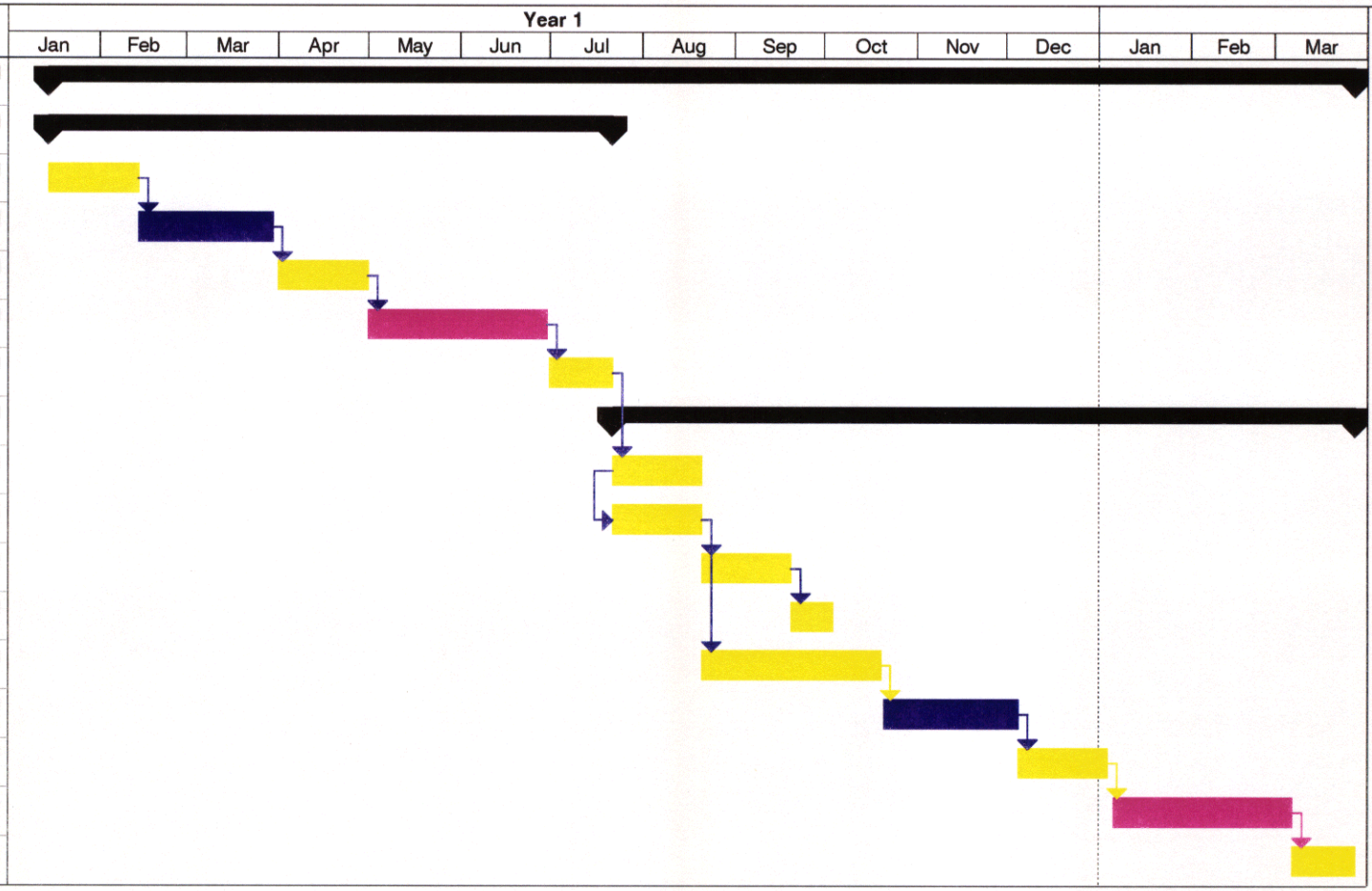

Figure 5-7
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Navy Review
Agency Review
Contractor Work Progress
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Figure 5-8
Site 22 - Camp Allen Salvage Yard Site
Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document

ID	Task Name	Duration
1	**CAMP ALLEN SALVAGE YARD**	**744d**
2	**RI/FS Work Plans**	**155d**
3	Draft	60ed
4	Navy Review	45ed
5	Draft Final	30ed
6	EPA/State/Navy Review	60ed
7	Final	21ed
8	**Remedial Investigation**	**264d**
9	RI Field Work	60ed
10	Laboratory Analysis	30ed
11	Data Validation	14ed
12	Draft	120ed
13	Navy Review	45ed
14	Draft Final	30ed
15	EPA/State/Navy Review	60ed
16	Final	21ed
17	**Feasibility Study**	**200d**
18	Draft	120ed
19	Navy Review	45ed
20	Draft Final	30ed
21	EPA/State/Navy Review	60ed
22	Final	21ed

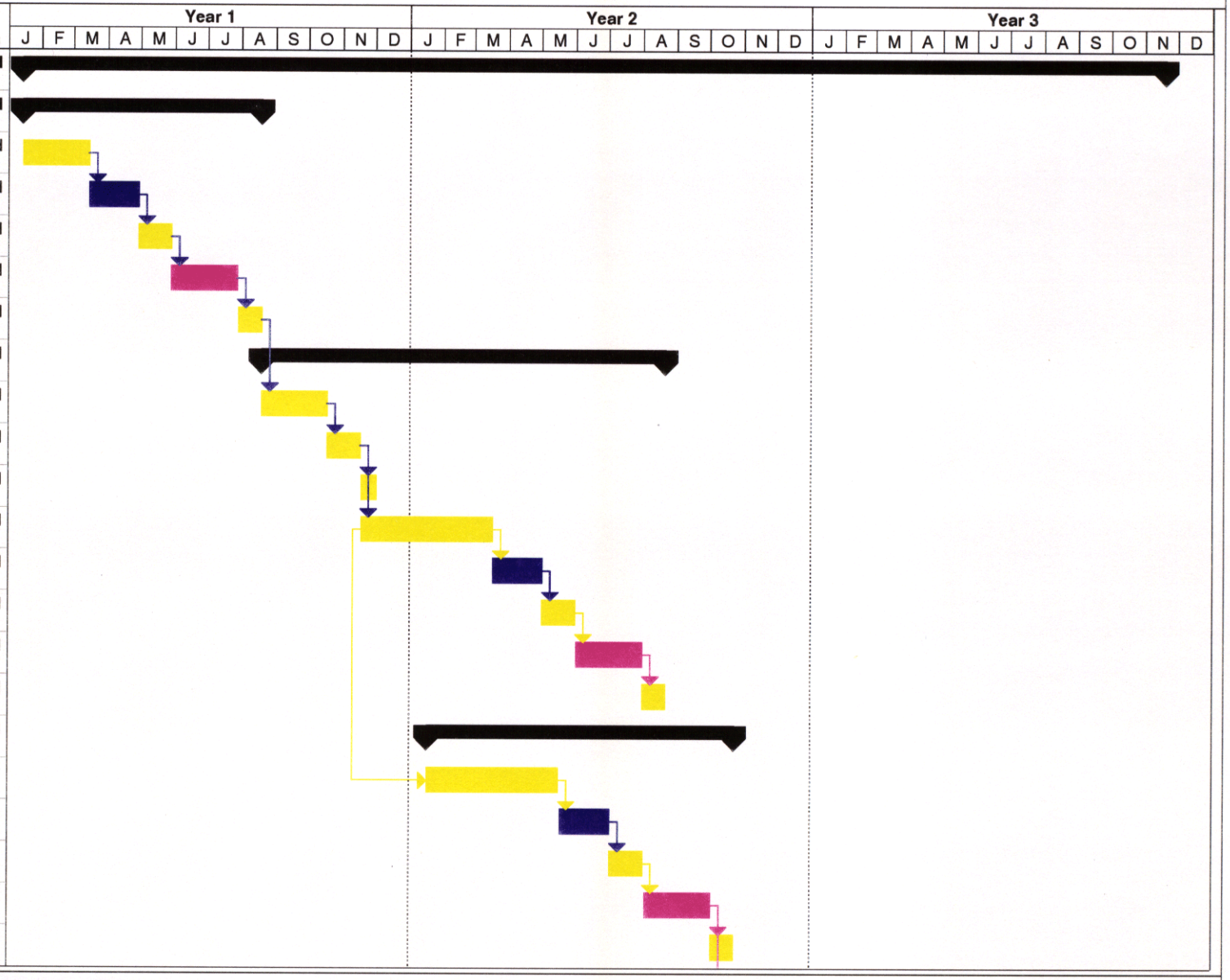

Figure 5-8
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Navy Review
Agency Review
Contractor Work Progress
Summary
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Figure 5-8
Site 22 - Camp Allen Salvage Yard Site
Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document

ID	Task Name	Duration
23	**Proposed Plan (PRAP)**	**155d**
24	Draft	60ed
25	Navy Review	45ed
26	Draft Final	30ed
27	EPA/State/Navy Review	60ed
28	Final	21ed
29	**Public Comment Period**	30ed
30	**Decision Document (ROD)**	**155d**
31	Draft	60ed
32	Navy Review	45ed
33	Draft Final	30ed
34	EPA/State/Navy Review	60ed
35	Final	21ed

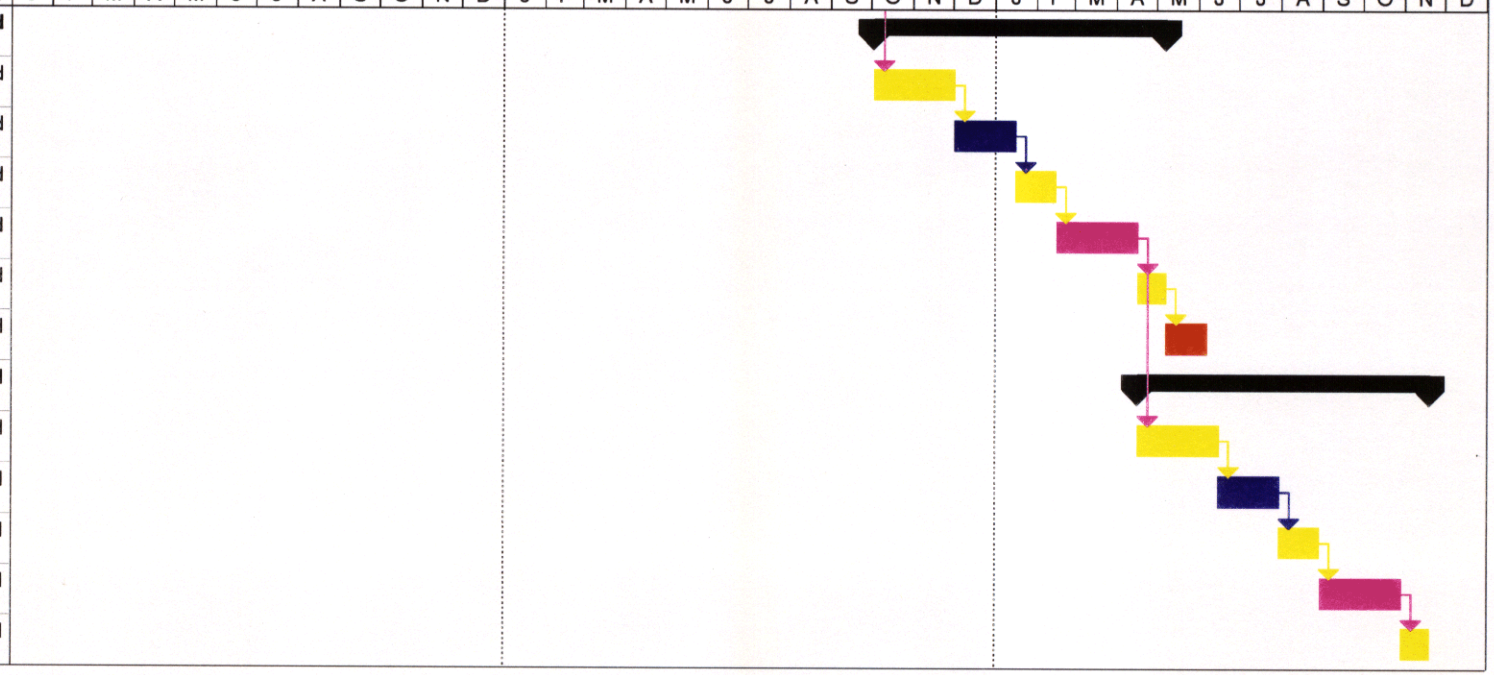

Figure 5-8
6/19/95

Navy Review
Agency Review
Contractor Work Progress
Summary
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Figure 5-9
Model Schedule - Simple IRP Site (No-Action ROD)
Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document

ID	Task Name	Duration
1	**MODEL SCHEDULE - SIMPLE IRP**	**725d**
2	**RI/FS Work Plans**	**158d**
3	Draft	60ed
4	Navy Review	45ed
5	Draft Final	30ed
6	EPA/State/Navy Review	60ed
7	Final	21ed
8	**Remedial Investigation**	**246d**
9	RI Field Work	60ed
10	Laboratory Analysis	30ed
11	Data Validation	14ed
12	Draft	90ed
13	Navy Review	45ed
14	Draft Final	30ed
15	EPA/State/Navy Review	60ed
16	Final	21ed
17	**Feasibility Study**	**176d**
18	Draft	90ed
19	Navy Review	45ed
20	Draft Final	30ed
21	EPA/State/Navy Review	60ed
22	Final	21ed

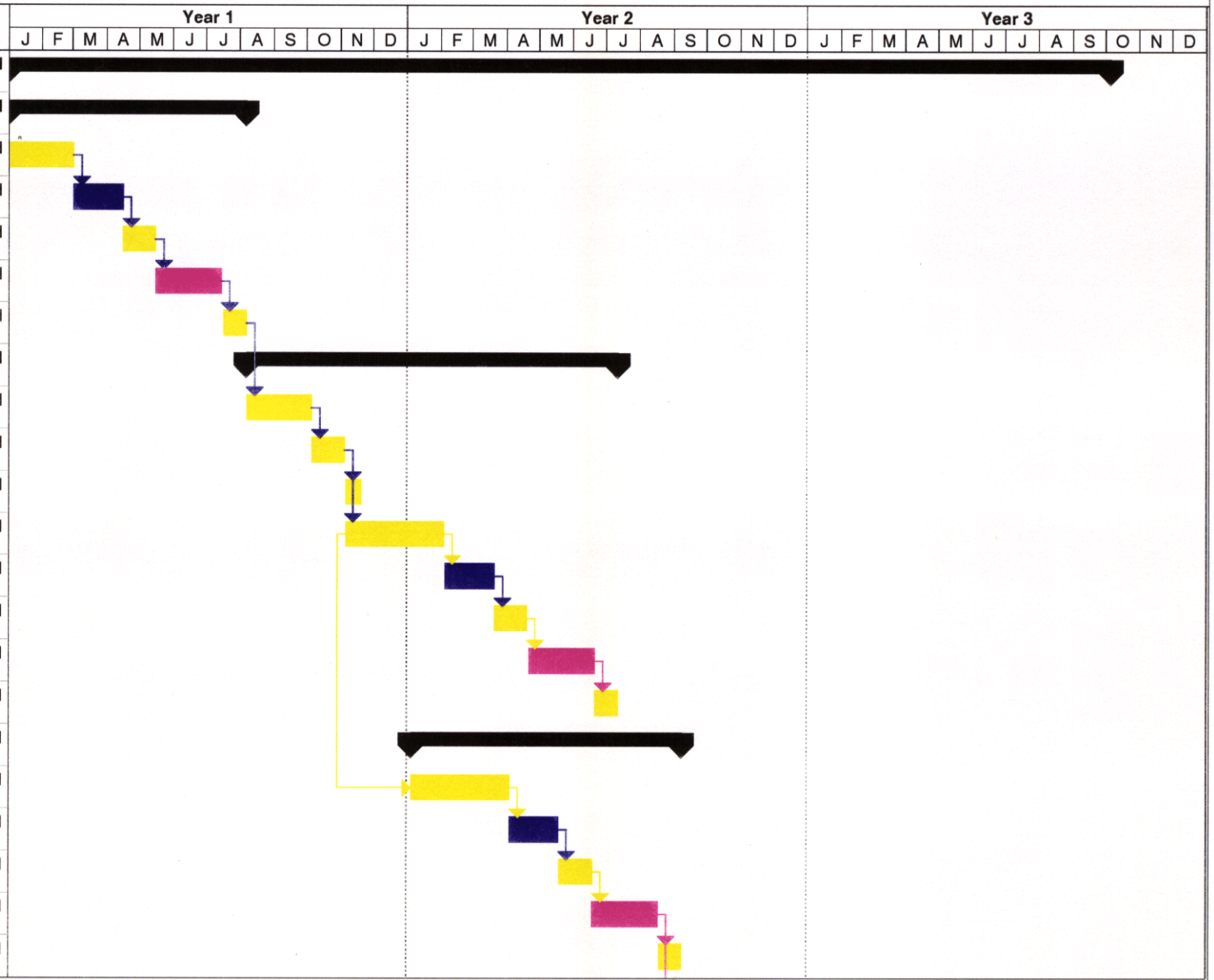

Figure 5-9
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Navy Review
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Figure 5-9
Model Schedule - Simple IRP Site (No-Action ROD)
Remedial Investigation, Feasibility Study, Proposed Plan, and Decision Document

ID	Task Name	Duration
23	**Proposed Plan (PRAP)**	**155d**
24	Draft	60ed
25	Navy Review	45ed
26	Draft Final	30ed
27	EPA/State/Navy Review	60ed
28	Final	21ed
29	**Public Comment Period**	30ed
30	**Decision Document (ROD)**	**155d**
31	Draft	60ed
32	Navy Review	45ed
33	Draft Final	30ed
34	EPA/State/Navy Review	60ed
35	Final	21ed

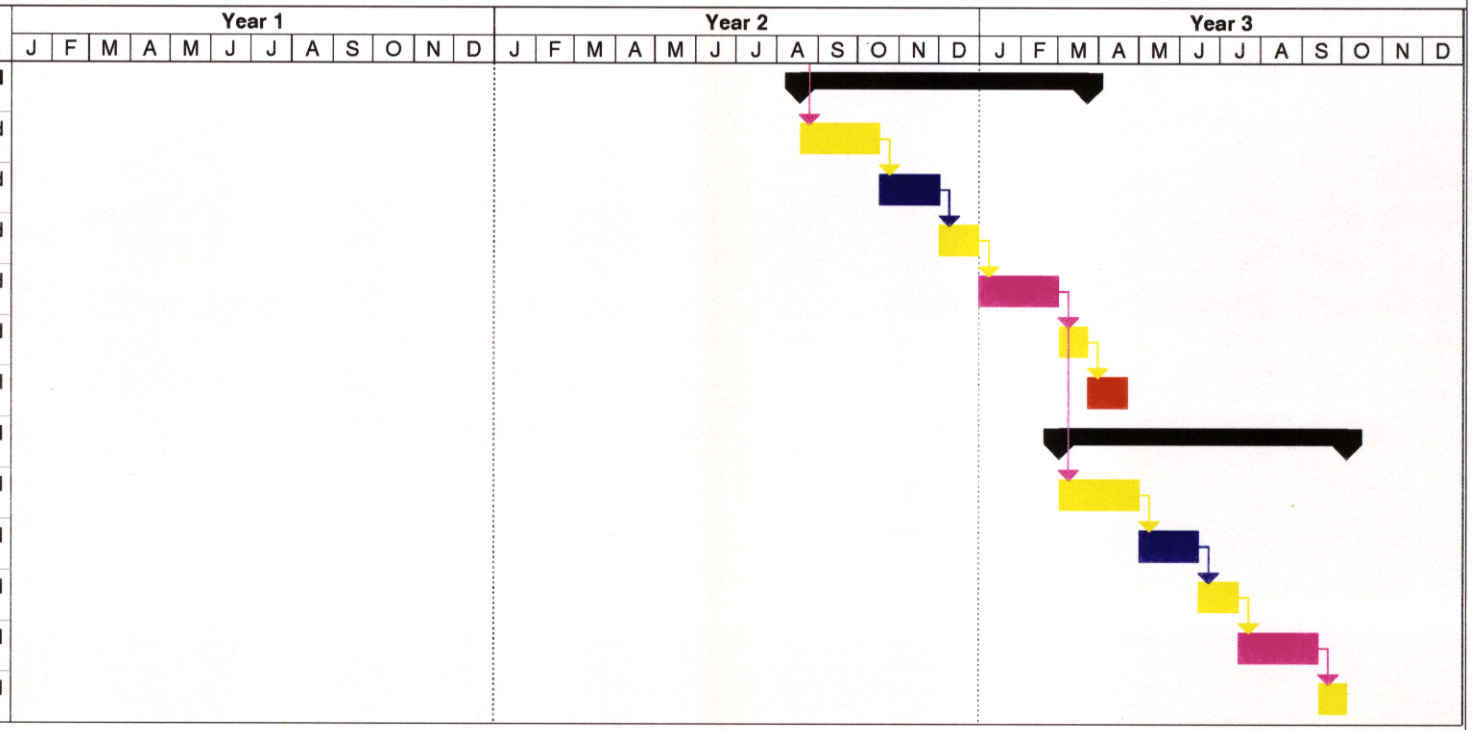

Figure 5-9
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Figure 5-10
Model Schedule - Complex IRP Site (w/Treat Study & Removal Action)
RI/FS, Proposed Plan, Decision Document, Removal Action, Treatability Study, Remedial Design and Remediation

ID	Task Name	Duration
1	**MODEL SCHEDULE - COMPLEX IRP**	**994d**
2	**RI/FS Work Plans**	**157d**
3	Draft	60ed
4	Navy Review	45ed
5	Draft Final	30ed
6	EPA/State/Navy Review	60ed
7	Final	21ed
8	**Remedial Investigation**	**287d**
9	RI Field Work	90ed
10	Laboratory Analysis	30ed
11	Data Validation	14ed
12	Draft	120ed
13	Navy Review	45ed
14	Draft Final	30ed
15	EPA/State/Navy Review	60ed
16	Final	21ed
17	**Feasibility Study**	**199d**
18	Draft	120ed
19	Navy Review	45ed
20	Draft Final	30ed
21	EPA/State/Navy Review	60ed
22	Final	21ed
23	**Proposed Plan (PRAP)**	**155d**
24	Draft	60ed
25	Navy Review	45ed
26	Draft Final	30ed
27	EPA/State/Navy Review	60ed
28	Final	21ed
29	**Public Comment Period**	45ed
30	**Decision Document (ROD)**	**155d**
31	Draft	60ed
32	Navy Review	45ed
33	Draft Final	30ed
34	EPA/State/Navy Review	60ed
35	Final	21ed

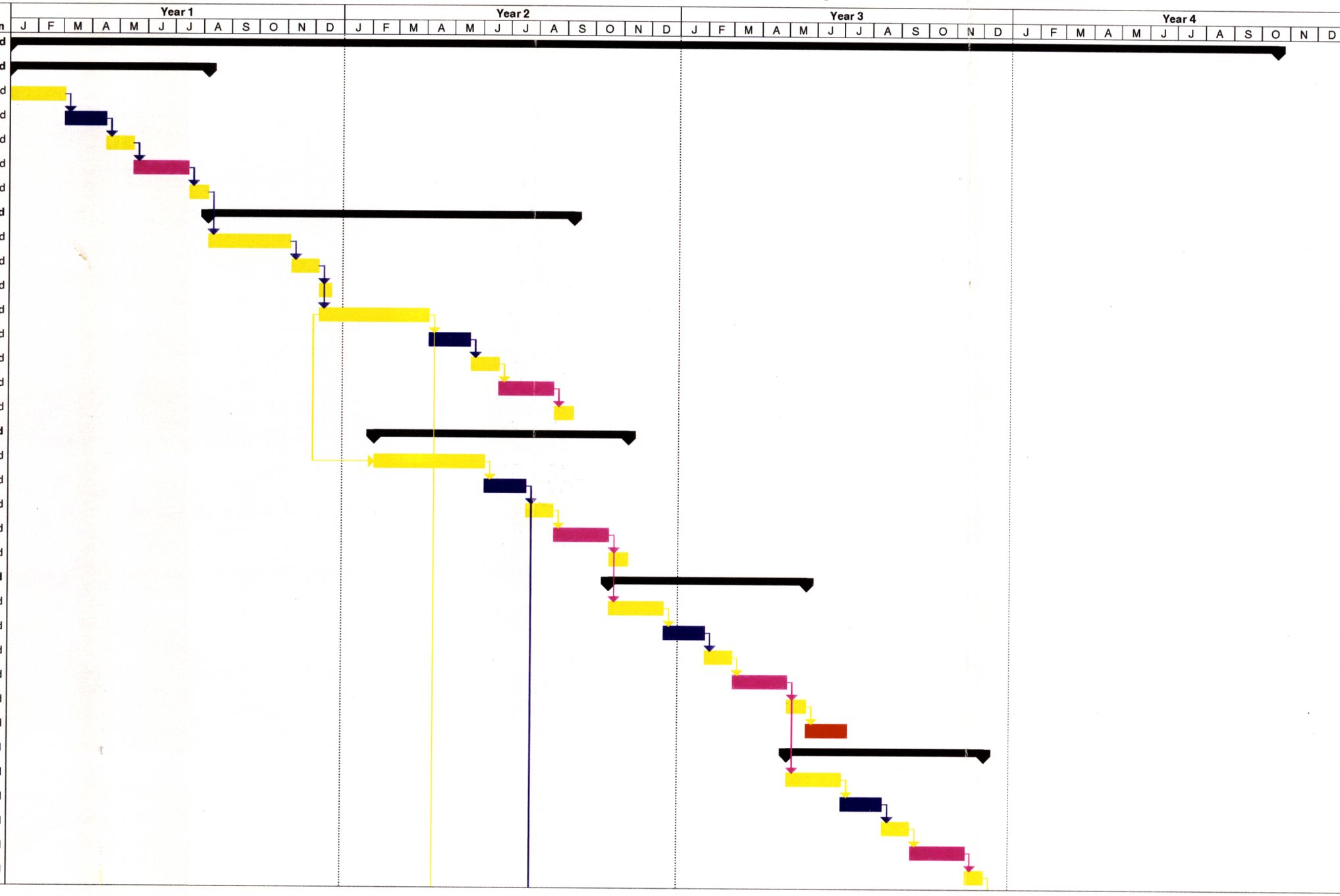

Figure 5-10
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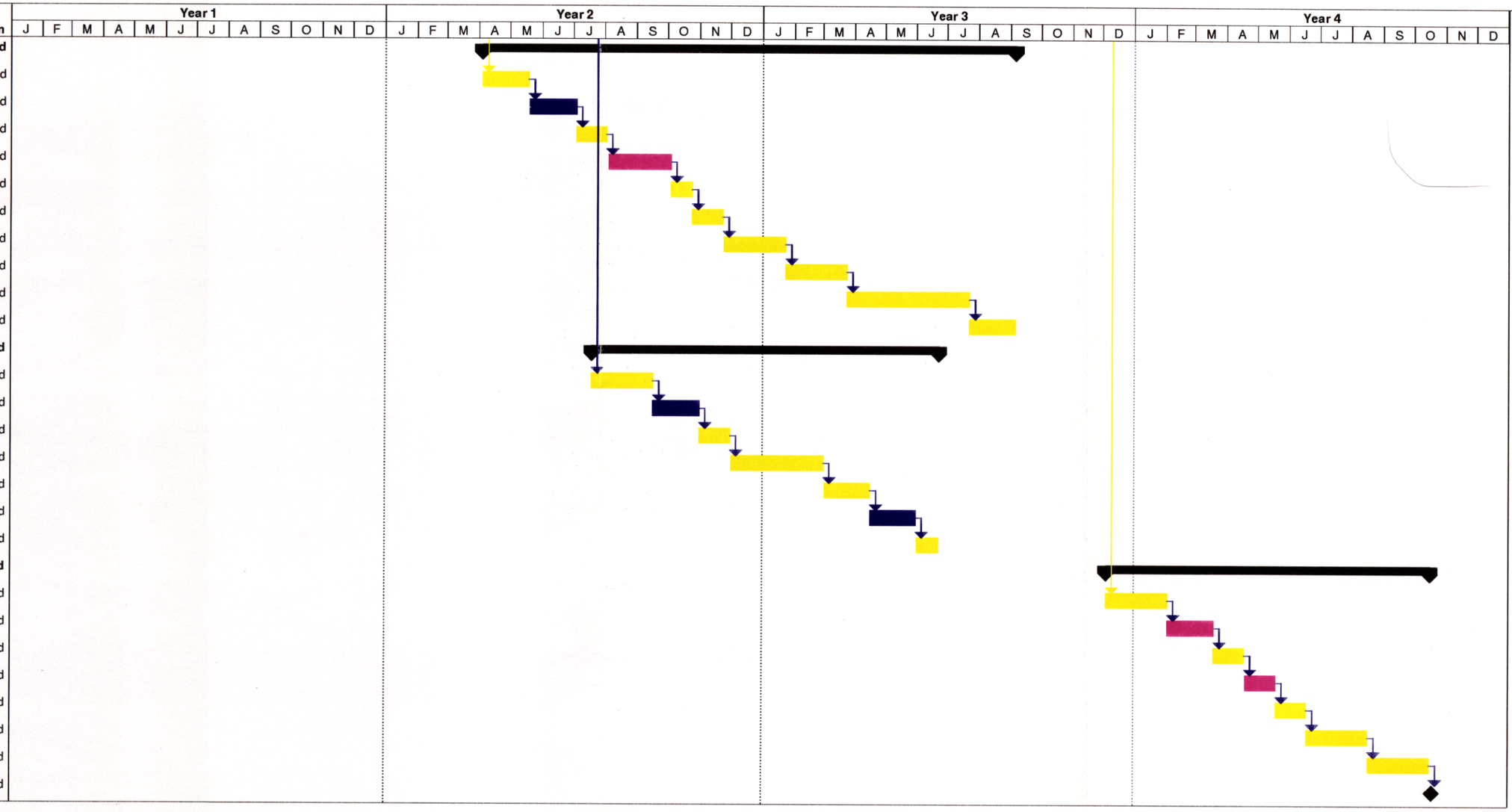
Navy Review | Agency Review | Contractor Work Progress | Summary | Milestone

Figure 5-10
Model Schedule - Complex IRP Site (w/Treat Study & Removal Action)
RI/FS, Proposed Plan, Decision Document, Removal Action, Treatability Study, Remedial Design and Remediation

ID	Task Name	Duration
36	**Removal Action (EE/CA)**	**372d**
37	Draft EE/CA Report	45ed
38	Navy Review	45ed
39	Draft Final EE/CA Report	30ed
40	EPA/State/Navy Review	60ed
41	Final EE/CA Report	21ed
42	RAC Bid Period	30ed
43	RAC Award Period	60ed
44	RAC Removal Action Work Plan	60ed
45	Removal Action Implemented	120ed
46	Removal Action Report	45ed
47	**Pilot Treatability Study**	**241d**
48	Draft Work Plan	60ed
49	EPA/State/Navy Review	45ed
50	Final Work Plan	30ed
51	Pilot Test Field Studies	90ed
52	Draft Pilot TS Report	45ed
53	EPA/State/Navy Review	45ed
54	Final Pilot TS Report	21ed
55	**Remedial Design (RD)**	**226d**
56	Pre-Final (100%) RD	60ed
57	EPA/State/Navy Review	45ed
58	Final Remedial Design	30ed
59	EPA/State/Navy Review	30ed
60	RAC Bid Period	30ed
61	RAC Award Period	60ed
62	RAC Work Plan/Detailed Design	60ed
63	**Remedial Action Begins**	0ed



Navy Review | Agency Review | Contractor Work Progress | Summary | Milestone

6.0 REFERENCES

The project team for the Naval Base, Norfolk IRP is led by Ms. Dianne Bailey, the Installation Restoration Coordinator (IRC) and Mr. David Forsythe, the Navy Technical Representative (NTR). The project team leaders can be contacted by telephone or telefax at:

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Navy Technical Representative
Phone: (804) 322-4783
FAX: (804) 322-4805

Documents utilized in preparing this report include:

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Versar, Inc. Site Risk and Remediation Assessment Report for the Naval Piers 1-25, Norfolk Naval Base, Norfolk, Virginia, prepared for Naval Facilites Engineering Command, June 1991.

APPENDIX A
QUANTITATIVE SITE RANKING BACK-UP DATA

Quantitative Site Ranking - Sediment Data
Site 1 - Camp Allen Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
ECOLOGICAL	
Methylene chloride	0.1035
Vinyl chloride	0.06
1,2-Dichloroethane	0.02
Trichloroethene	0.52
Benzene	0.062
Acetone	3.55
1,1-Dichloroethane	0.015
1,2-Dichloroethene, Total	0.345
Chlorobenzene	0.027
Xylenes, Total	0.004
Phenol	2.5
4-Methylphenol	19
2,4-Dimethylphenol	0.38
Tetrachloroethene	0.15
1,4-Dichlorobenzene	0.045
1,2-Dichlorobenzene	0.049
Carbazole	0.046
Benzo(a)anthracene	0.5
Chrysene	0.57
Bis(2-ethylhexyl)phthalate	5.3
Benzo(b)fluoranthene	0.67
Benzo(k)fluoranthene	0.22
Benzo(a)pyrene	0.32
Indeno(1,2,3-cd)pyrene	0.19
Benzo(g,h,i)perylene	0.17
Naphthalene	0.2
2-Methylnaphthalene	0.03
Acenaphthene	4.1
Phenanthrene	0.3
Anthracene	0.071
Fluoranthene	1.1
Pyrene	0.85
Butyl benzyl phthalate	0.17
delta-BHC	0.18
Aldrin	0.014
Heptachlor epoxide	0.00398

Quantitative Site Ranking - Sediment Data
Site 1 - Camp Allen Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
Dieldrin	0.086
4,4'-DDE	0.11
4,4'-DDD	4.2
4,4'-DDT	2.495
Endosulfan I	0.015
Endrin	0.025
Methoxychlor	0.0046
alpha-Chlordane	0.032
gamma-Chlordane	0.064
PCB-1248	0.17
PCB-1254	7.6
PCB-1260	1.5
Aluminum	13600
Antimony	16
Arsenic	590
Barium	211
Beryllium	0.76
Cadmium	180
Chromium	3000
Cobalt	216
Copper	22700
Lead	1750
Manganese	246
Mercury	19.35
Nickel	1255
Silver	110
Vanadium	542
Zinc	1020

Quantitative Site Ranking - Surface Water
Site 1 - Camp Allen Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
ECOLOGICAL	
Vinyl chloride	22
1,2-Dichloroethane	8
Chloroform	24
Bromodichloromethane	6
Tricloroethene	45
Benzene	12
Tetrachloroethene	6
Carbon disulfide	3
Xylenes, total	3
1,1-Dichloroethane	3
1,2-Dichloroethene	46
Phenol	0.9
4-Methylphenol	3
2,4-Dimethylphenol	2
Acenaphthene	0.7
Bis(2-ethylhexyl)phthalate	7
delta-BHC	0.025
Dieldrin	0.027
4,4'-DDE	0.069
Endrin	0.07
4,4'-DDD	0.26
alpha-Chlordane	0.015
gamma-Chlordane	0.024
Arochlor-1254	0.44
Heptachlor epoxide	0.006
Aluminum	20300
Arsenic	64.2
Barium	409
Chromium	104
Cobalt	13.2
Copper	446
Lead	800
Manganese	697
Mercury	3.9
Nickel	57
Silver	12
Vanadium	103
Zinc	1860

Quantitative Site Ranking - Soil Data
Site 1 - Camp Allen Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
CARCINOGENIC	
Methylene chloride	0.2
Vinyl chloride	0.016
Benzene	0.25
Trichloroethene	3.1
2-Methylphenol	6.4
Benzo(a)anthracene	0.165
Chrysene	0.166
Bis(2-ethylhexyl)phthalate	17
Benzo(b)fluoranthene	0.1725
Benzo(k)fluoranthene	0.1555
Benzo(a)pyrene	0.165
Indeno(1,2,3-cd)pyrene	0.151
Benzo(g,h,i)perylene	0.1495
Isophorone	0.68
delta-BHC	0.0014
Heptachlor epoxide	0.0027
Aldrin	0.0091
Dieldrin	1.5
4,4'-DDE	0.02
4,4'-DDD	3.8
4,4'-DDT	0.016
alpha-Chlordane	0.0026
gamma-Chlordane	0.0038
PCB-1254	9.5
Arsenic	70
Beryllium	5.6
Chromium	869
NONCARCINOGENIC	
Acetone	1.9
Carbon Disulfide	0.022
1,1,1-Trichloroethane	0.063
Toluene	3000
Ethylbenzene	45
Xylenes, Total	340
1,2-Dichloroethene	4.3
1,2-Dichlorobenzene	6.5

Quantitative Site Ranking - Soil Data
Site 1 - Camp Allen Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
Diethyl phthalate	0.195
2,4-Dimethylphenol	41
4-Methylphenol	5.5
Phenol	13
Naphthalene	32
2-Methylnaphthalene	21
Fluorene	1.3
Acenaphthene	0.49
Phenanthrene	0.37
Fluoranthene	0.1765
Pyrene	0.18
Butyl benzyl phthalate	0.025
Endrin	0.0027
Endosulfan I	0.078
Aluminum	15500
Antimony	8
Barium	1480
Cadmium	55.9
Cobalt	18.3
Copper	477
Lead	683
Manganese	128
Mercury	0.77
Nickel	84.1
Selenium	5.7
Silver	0.49
Vanadium	149
Zinc	2570

Quantitative Site Ranking - Groundwater Data
Site 1 - Camp Allen Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
CARCINOGENIC	
1,4-Dichlorobenzene	3
Vinyl chloride	3300
1,1-Dichloroethene	37
1,2-Dichloroethane	450
Benzene	410
Trichloroethene	1800
Tetrachloroethene	620
N-Nitrosodiphenylamine	1
Bis(2-chloroethyl)ether	8
2-Methylphenol	1800
Bis(2-ethylhexyl)phthalate	13
Aldrin	0.026
Dieldrin	0.043
Heptachlor epoxide	0.14
delta-BHC	0.014
4,4'-DDD	0.14
4,4'-DDE	0.047
4,4'-DDT	0.016
gamma-Chlordane	0.007
Arsenic	309
Beryllium	18.5
Chromium	774.5
NONCARCINOGENIC	
Chlorobenzene	48
Acetone	2600
1,1-Dichloroethane	89
1,2-Dichloroethene	6100
1,1,1-Trichloroethane	30
Toluene	5400
Xylenes, total	250
Phenol	1800
1,2,4-Trichlorobenzene	0.5
1,2-Dichlorobenzene	16
4-Methylphenol	21000
2,4-Dimethylphenol	1400
Naphthalene	4

Quantitative Site Ranking - Groundwater Data
Site 1 - Camp Allen Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
2-Methylnaphthalene	8
Acenaphthene	76
Fluorene	0.5
Phenanthrene	0.9
Pyrene	0.8
Endrin	0.031
Aluminum	610000
Antimony	31
Barium	7270
Cadmium	45.9
Cobalt	202.5
Copper	380
Lead	1020
Manganese	4880
Mercury	3
Silver	5
Vanadium	1610
Zinc	1550

Quantitative Site Ranking - Sediment Data
Site 2 - NM Slag Pile
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
ECOLOGICAL	
Beryllium	0.4
Cadmium	8.2
Chromium	47
Copper	1300
Lead	250
Nickel	51
Zinc	510

Quantitative Site Ranking - Surface Water Data
Site 2 - NM Slag Pile
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
ECOLOGICAL	
Copper	230
Lead	120
Zinc	300

Quantitative Site Ranking - Soil Data
Site 2 - NM Slag Pile
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
CARCINOGENIC	
Beryllium	3.1
Chromium	320
NONCARCINOGENIC	
Cadmium	57
Copper	3500
Lead	42
Nickel	1200
Zinc	3000

Quantitative Site Ranking - Sediment Data
Site 3 - Q-Area Drum Storage Yard
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
ECOLOGICAL	
DDD	653
DDE	369
alpha-Chlordane	15900
gamma-Chlordane	17600
Aluminum	4760
Arsenic	5.64
Barium	68.5
Cadmium	1.37
Chromium	32.4
Cobalt	12.8
Copper	120
Iron	26400
Lead	350
Manganese	322
Mercury	0.396
Nickel	9.16
Silver	0.604
Vanadium	60.6
Zinc	225

Quantitative Site Ranking - Soil Data
Site 3 - Q-Area Drum Storage Yard
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
CARCINOGENIC	
Methylene chloride	530
1,1-Dichloroethene	5
Chloroform	270
Bromodichloromethane	52
Trichloroethene	29
Benzene	2
Tetrachloroethene	150
1,1,2,2-Tetrachloroethane	30
1,4-Dichlorobenzene	140
Benzo(a)anthracene	170
Chrysene	160
Bis(2-ethylhexyl)phthalate	980
Benzo(b)fluoranthene	110
Benzo(a)pyrene	140
NONCARCINOGENIC	
Acetone	690
1,2-Dichloroethene	1500
1,1,1-Trichloroethane	1
4-Methylphenol	650
2,4-Dimethylphenol	3600
Toluene	140
Xylenes, total	21
Phenanthrene	47
Fluoranthene	360
Pyrene	490
Phenol	410

Quantitative Site Ranking - Groundwater Data
Site 3 - Q-Area Drum Storage Yard
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
CARCINOGENIC	
Vinyl chloride	34
Methylene chloride	780
1,1-Dichloroethene	140
1,2-Dichloroethane	430
Chloroform	60
Carbon tetrachloride	120
Bromodichloromethane	120
Trichloroethene	560
Tetrachloroethene	4800
Arsenic	337
Beryllium	33
Chromium	1120
NONCARCINOGENIC	
Acetone	1300
Carbon disulfide	7
1,1-Dichloroethane	540
1,1,1-Trichloroethane	1100
Antimony	97
Barium	173
Cadmium	96
Copper	261
Lead	516
Mercury	0.38
Nickel	472
Selenium	90
Silver	12
Zinc	1580

Quantitative Site Ranking - Soil Data
Site 5 - Pesticide Disposal Site
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
CARCINOGENIC	
Benzo(a)anthracene	26
Chrysene	0.67
Benzo(b)fluoranthene	1.3
Benzo(k)fluoranthene	1.3
Benzo(a)pyrene	0.71
Indeno(1,2,3-cd)pyrene	0.39
Benzo(g,h,i)perylene	0.36
NONCARCINOGENIC	
Fluoranthene	0.54
Pyrene	0.51
Butyl benzyl phthalate	160

Quantitative Site Ranking - Groundwater Data
Site 5 - Pesticide Disposal Site
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
CARCINOGENIC	
Chromium	0.05
NONCARCINOGENIC	
Cadmium	0.02
Lead	0.17
Nickel	0.00041
Zinc	0.24
Phenol	0.01

Quantitative Site Ranking - Sediment Data
Site 6 - CD Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
ECOLOGICAL	
Methylene chloride	0.03
Trichloroethene	0.013
1,4-Dichlorobenzene	0.18
Carbazole	22
Benzo(a)anthracene	52
Chrysene	48
Bis(2-ethylhexyl)phthalate	0.12
Benzo(b)fluoranthene	54
Benzo(k)fluoranthene	22
Benzo(a)pyrene	38
Indeno(1,2,3-cd)pyrene	14
Dibenz(a,h)anthracene	3.9
Benzo(g,h,i)perylene	12
Acetone	0.27
1,2-Dichloroethene, Total	0.009
Chlorobenzene	0.14
Xylenes, Total	0.002
Phenol	0.08
1,3-Dichlorobenzene	0.021
1,2-Dichlorobenzene	0.38
1,2,4-Trichlorobenzene	0.26
Naphthalene	1.3
2-Methylnaphthalene	1.8
Acenaphthylene	0.028
Acenaphthene	11
Fluorene	15
Phenanthrene	100
Anthracene	32
Fluoranthene	130
Pyrene	76
Butyl benzyl phthalate	0.03
Aldrin	0.0018
Heptachlor epoxide	0.00098
Dieldrin	0.12
4,4'-DDE	0.18
4,4'-DDD	0.033

Quantitative Site Ranking - Sediment Data
Site 6 - CD Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
4,4'-DDT	0.11
alpha-Chlordane	0.011
gamma-Chlordane	0.0049
PCB-1248	0.094
PCB-1254	0.052
PCB-1260	0.094
Endosulfan I	0.00019
Methoxychlor	0.0016
Aluminum	13700
Arsenic	49.2
Barium	401
Beryllium	0.99
Cadmium	2.4
Chromium	166
Cobalt	17.5
Copper	495
Lead	861
Manganese	779
Mercury	1
Nickel	337
Silver	5.1
Vanadium	114
Zinc	696

Quantitative Site Ranking - Surface Water
Site 6 - CD Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
ECOLOGICAL	
1,2-Dichlorobenzene	2
1,4-Dichlorobenzene	1
4-Methylphenol	0.8
Dieldrin	0.035
4,4'-DDD	0.016
Aluminum	176000
Arsenic	25.1
Antimony	22.5
Barium	1420
Chromium	299
Cobalt	128
Copper	425
Lead	712
Manganese	6780
Mercury	0.74
Nickel	253
Silver	7.2
Vanadium	1180
Zinc	2640
Cyanide	25.1
Chloride	5250000
Alkalinity	290000

Quantitative Site Ranking - Soil Data
Site 6 - CD Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
CARCINOGENIC	
Methylene chloride	0.006
Tetrachloroethene	0.002
2-Methylphenol	0.04
Carbazole	0.054
Benzo(a)anthracene	0.2
Chrysene	0.24
Bis(2-ethylhexyl)phthalate	10
Benzo(b)fluoranthene	0.22
Benzo(k)fluoranthene	0.14
Benzo(a)pyrene	0.18
Indeno(1,2,3-cd)pyrene	0.13
Dibenz(a,h)anthracene	0.062
Benzo(g,h,i)perylene	0.14
Heptachlor	0.00099
Aldrin	0.0033
Dieldrin	0.0065
4,4'-DDE	0.035
4,4'-DDD	0.021
4,4'-DDT	0.01
alpha-Chlordane	0.007
gamma-Chlordane	0.011
PCB-1242	0.023
PCB-1260	0.032
Arsenic	75.7
Beryllium	2.1
Chromium	1000
NONCARCINOGENIC	
Acetone	0.033
Carbon Disulfide	0.009
Xylenes, Total	0.009
Phenol	0.034
Naphthalene	0.31
2-Methylnaphthalene	0.17
Fluorene	0.053
Acenaphthene	0.1
Phenanthrene	0.74

Quantitative Site Ranking - Soil Data
Site 6 - CD Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
Anthracene	0.12
Fluoranthene	0.66
Pyrene	0.57
Endrin	0.0048
Methoxychlor	0.039
Aluminum	31600
Antimony	103
Barium	688
Cadmium	50.4
Cobalt	18.1
Copper	3090
Lead	3220
Manganese	1900
Mercury	0.84
Nickel	521
Selenium	0.92
Silver	182
Vanadium	349
Zinc	6220
Cyanide	1.4

Quantitative Site Ranking - Groundwater Data
Site 6 - CD Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
CARCINOGENIC	
1,4-Dichlorobenzene	13
N-Nitrosodiphenylamine	6
Carbazole	0.9
Bis(2-ethylhexyl)phthalate	9
Dieldrin	0.018
4,4'-DDD	0.016
4,4'-DDT	0.02
gamma-Chlordane	0.006
Arsenic	42.6
Beryllium	4.4
Chromium	154
NONCARCINOGENIC	
Chlorobenzene	1000
Phenol	3
2-Chlorophenol	8
1,3-Dichlorobenzene	5
1,2-Dichlorobenzene	11
4-Methylphenol	1
2,4-Dimethylphenol	0.5
Naphthalene	3
2-Methylnaphthalene	1
Acenaphthene	6
Diethyl phthalate	7
Fluorene	1
Phenanthrene	2
Anthracene	1
Fluoranthene	2
Pyrene	2
Butyl benzyl phthalate	0.55
Aluminum	92500
Antimony	33.6
Barium	1940
Cadmium	11.9
Cobalt	98.1
Copper	534
Lead	864

Quantitative Site Ranking - Groundwater Data
Site 6 - CD Landfill
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
Mercury	1.1
Nickel	138
Vanadium	240
Zinc	3780
Chloride	300000
Alkalinity	1700000

Quantitative Site Ranking - Soil Data
Site 19 - Buildings V60/V90
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
CARCINOGENIC	
Bis(2-ethylhexyl)phthalate	2.7
Benzo(a)anthracene	150
Chrysene	170
Benzo(b)fluoranthene	200
Benzo(k)fluoranthene	170
Benzo(a)pyrene	150
Indeno(1, 2, 3-cd)pyrene	75
Benzo(g, h, i)perylene	66
Arsenic	5.1
Beryllium	0.23
Chromium	17
NONCARCINOGENIC	
Naphthalene	31
Phenanthrene	280
Anthracene	47
Fluoranthene	240
Pyrene	250
Fluorene	46
Aluminum	4900
Barium	41
Cadmium	7.7
Cobalt	2.7
Copper	51
Lead	252
Manganese	133
Mercury	20
Nickel	7.2
Silver	0.88
Vanadium	2.1
Zinc	464
Cyanide	4.96

Quantitative Site Ranking - Surface Water Data
Site 18 - Former NM Waste Disposal Area
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
ECOLOGICAL	
Cadmium	64
Chromium	184
Cyanide	70
Phenol	90

Quantitative Site Ranking - Groundwater Data
Site 18 - Former NM Waste Disposal Area
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
CARCINOGENIC	
Chromium	160
NONCARCINOGENIC	
Cadmium	43
Cyanide	42
Phenol	276

Quantitative Site Ranking - Soil Data
Site 20 - Building LP-20
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
CARCINOGENIC	
Methylene chloride	0.006
Tricloroethene	0.007
Arsenic	20.9
Beryllium	0.22
Chromium	111.89
NONCARCINOGENIC	
Acetone	4.5
Carbon Disulfide	0.007
1,1-Dichloroethane	0.007
1,2-Dichloroethene	0.029
Toluene	55
Ethylbenzene	4.4
Xylenes, Total	8.4
Antimony	16.16
Copper	7.88
Lead	9.77
Nickel	10.42
Zinc	31.55

Quantitative Site Ranking - Groundwater Data
Site 20 - Building LP-20
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (ug/L)
CARCINOGENIC	
Vinyl chloride	520
1,1-Dichloroethene	370
Trichloroethene	13000
Tetrachloethene	81
Benzene	14
2-Methylphenol	2
Arsenic	25.3
Beryllium	5.8
Chromium	187
NONCARCINOGENIC	
1,1-Dichloroethane	330
1,2-Dichloroethane	5500
1,1,1-Trichloroethane	550
Toluene	3400
Xylenes, total	250
Phenol	250
4-Methylphenol	53
2,4-Dimethylphenol	0.5
Naphthalene	46
Acenaphthene	14
Fluorene	1
Phenanthrene	5
Antimony	29.7
Copper	67.1
Lead	94.8
Nickel	103
Zinc	165

Quantitative Site Ranking - Soil Data
Site 22 - Camp Allen Salvage Yard
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
CARCINOGENIC	
1,2-Dichloroethane	0.004
Methylene chloride	0.017
Tricloroethene	0.028
Tetrachloroethene	0.004
2-Methylphenol	0.041
1,4-Dichlorobenzene	0.15
Benzo(a)anthracene	0.22
Chrysene	0.33
Bis(2-ethylhexyl)phthalate	2
Benzo(b)fluoranthene	0.35
Benzo(k)fluoranthene	0.22
Benzo(a)pyrene	0.21
Indeno(1,2,3-cd)pyrene	0.11
Dibenz(a,h)anthracene	0.039
Benzo(g,h,i)perylene	0.14
Dieldrin	0.01
4,4'-DDE	0.4
4,4'-DDT	0.26
alpha-Chlordane	0.0056
gamma-Chlordane	0.0068
PCB-1254	28
PCB-1260	6
Arsenic	25.1
Beryllium	0.66
Chromium	85.9
NONCARCINOGENIC	
Acetone	0.14
Carbon Disulfide	0.007
2,4-Dimethylphenol	1.6
Toluene	0.001
Xylenes, Total	0.002
1,1-Dichloroethane	0.007
4-Methylphenol	0.099
Naphthalene	0.24
2-Methylnaphthalene	0.15
Fluorene	0.064

Quantitative Site Ranking - Soil Data
Site 22 - Camp Allen Salvage Yard
Naval Base Norfolk, Virginia

Parameter	Measured Concentration (mg/kg)
Acenephthylene	0.088
Acenaphthene	0.1
Phenanthrene	0.44
Anthracene	0.12
Fluoranthene	0.41
Pyrene	0.8
Butyl benzyl phthalate	0.22
Endrin	0.0017
Methoxychlor	7340
Aluminum	7340
Antimony	42.5
Barium	166
Cadmium	43.5
Cobalt	66.2
Copper	5860
Lead	1390
Manganese	264
Mercury	3.9
Nickel	121
Selenium	1.2
Silver	10.3
Vanadium	26.6
Zinc	1530