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U.S. DEPARTMENT OF THE NAVY
INSTALLATION RESTORATION PROGRAM

NAVAL AIR STATION, BRUNSWICK
BRUNSWICK, MAINE

PROPOSED PLAN

SITES 1 AND 3

DECEMBER 1991

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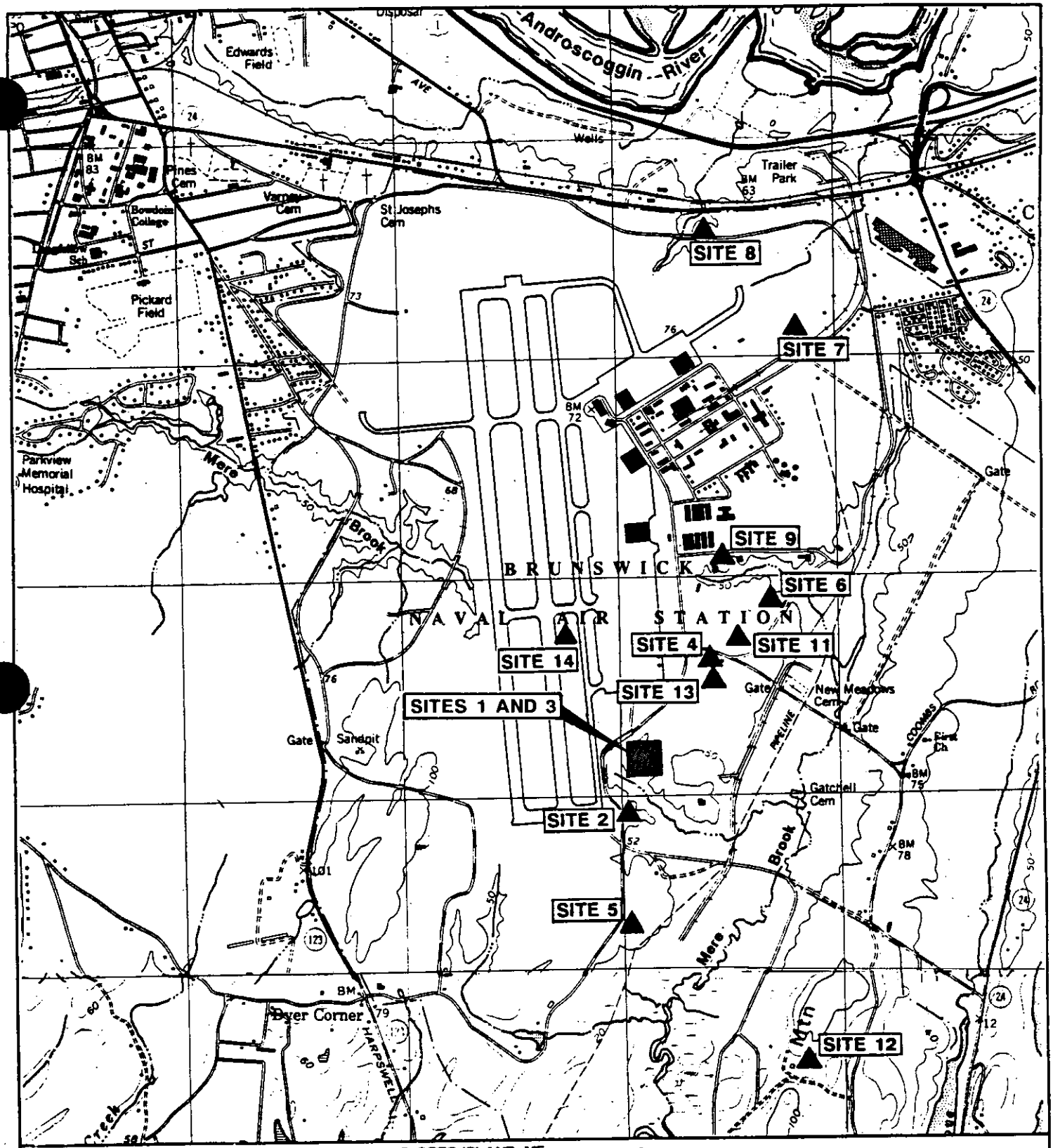
1.0 INTRODUCTION

The U.S. Navy is proposing a cleanup plan, or preferred alternative, to address **groundwater** and **leachate** contamination at two landfill sites (i.e., Sites 1 and 3) at the Naval Air Station (NAS) Brunswick in Brunswick, Maine. This Proposed Plan summarizes **remedial alternatives** developed in the Phase I **Feasibility Study (FS)** completed in August 1990 and evaluated in the Sites 1 and 3 **Focused Feasibility Study (FFS)** completed in October 1991. The Proposed Plan is a significant milestone in the **Remedial Investigation** (RI)/Feasibility Study process as it represents the transition from studying and evaluating the contamination at these sites to taking remedial actions.

In accordance with Section 117(a) of the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)**, the Navy is publishing this Proposed Plan to give the public the opportunity to review and comment on the remedial alternatives under consideration for these sites before selecting a final remedy. The Navy, in consultation with the United States Environmental Protection Agency (USEPA) and the Maine Department of Environmental Protection (MEDEP), will select the final remedy for the site after public comments have been reviewed and considered. The Proposed Plan serves to summarize the results and conclusions of the RI and FS, so that they are more easily understood. For this reason, technical terms are highlighted in bold print and defined in the glossary located at the end of this Proposed Plan.

This Proposed Plan addresses the contamination at Sites 1 and 3. The two landfill sites at NAS Brunswick are believed to be the **source** of and currently contribute to contaminated groundwater and leachate discharging to Mere Brook. Sites 1 and 3 are located in a restricted area in the central portion of NAS Brunswick (see Figures 1 and 2). Historical records indicate that the Site 1 landfill was used from 1955 to 1975. Material reportedly disposed of in this landfill included garbage, food waste, refuse, waste oil, solvents, pesticides, petroleum products, paint waste, aircraft and automobile parts and various chemicals.

Site 3 is defined as the area across from Site 1, adjacent to the access road into the Weapons Compound. Historical information reports that the Site 3 landfill was used as a disposal area from 1960 to 1973. Wastes reportedly disposed of at this site included solvents, paints, and isopropyl alcohol. Waste material was not observed



SOURCE: U.S.G.S. QUADRANGLES, BRUNSWICK, AND ORRS ISLAND, ME., 1984, 1978. 7.5 MINUTE SERIES.

LEGEND

■ APPROXIMATE LOCATION OF SITES 1 AND 3

QUADRANGLE LOCATION

N

SCALE IN FEET

0 2,000 4,000

E.C.JORDAN CO. CONSULTING ENGINEERS	SITE LOCATION MAP SITES 1 AND 3
INSTALLATION RESTORATION PROGRAM NAVAL AIR STATION BRUNSWICK, MAINE	FEASIBILITY STUDY
	4607-56 FIGURE 1

6836-03

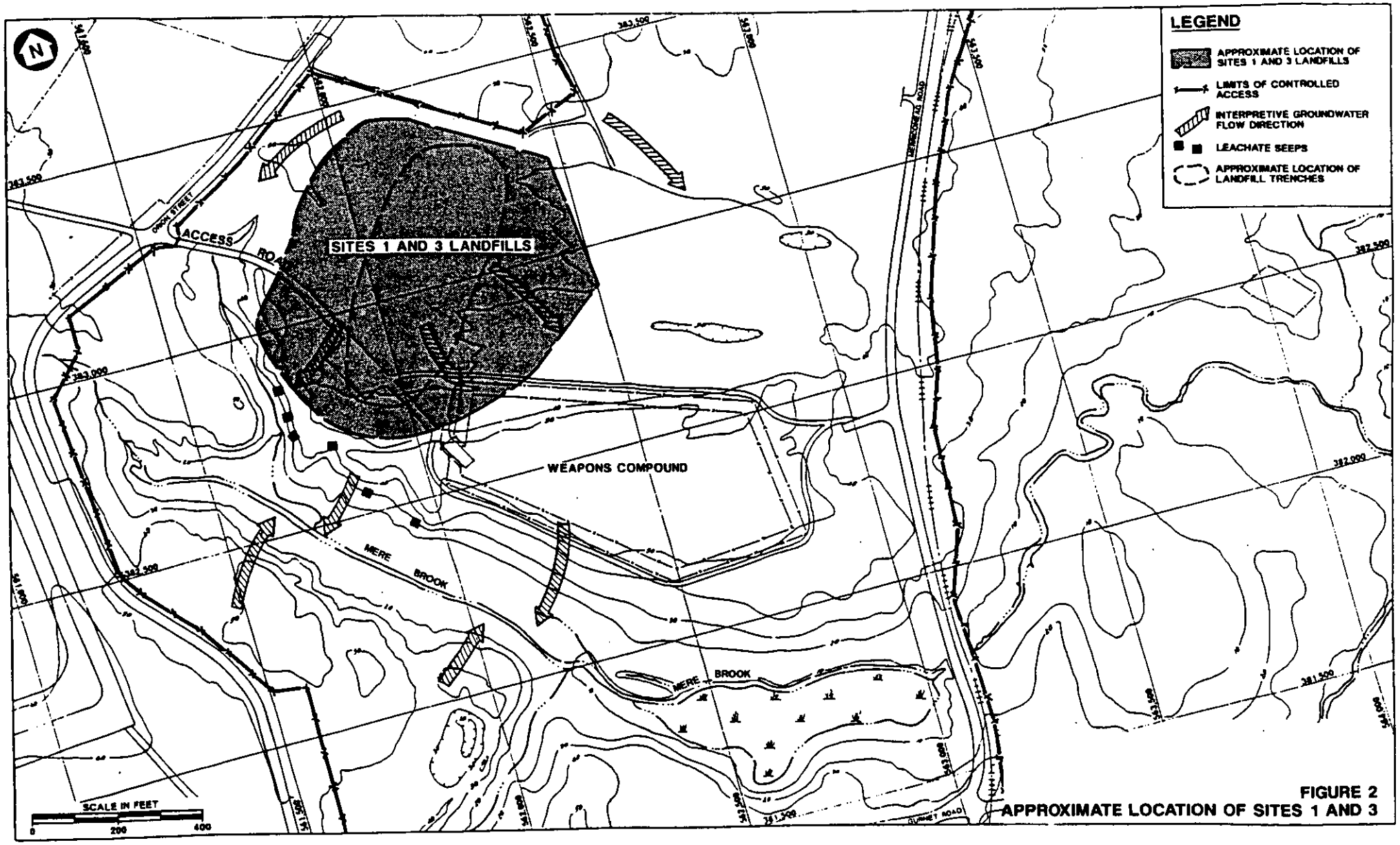


FIGURE 2
APPROXIMATE LOCATION OF SITES 1 AND 3

in test pits dug at Site 3 during the RI; only low concentrations of **pesticides** were detected in subsurface soils. Although Site 3 was originally believed to be a separate disposal area from Site 1, field sampling activities did not show a clear delineation between these two sites.

Based on the proximity of the two sites, common historical land use, and hydrogeologic characteristics of the area, the impacts of past disposal practices at Sites 1 and 3 cannot be distinguished. Therefore, these areas are combined and discussed as one site (i.e., Sites 1 and 3).

The Navy's preferred alternative for Sites 1 and 3 includes constructing a **cap** over the landfills and a **slurry wall** around the waste to prevent clean water from entering the landfills. Contaminated groundwater contained by the cap and slurry wall will be pumped and treated by **ultraviolet (UV)/oxidation** to destroy the organic compounds before discharge of the treated water. The preferred alternative is described in greater detail in Section 6.0 of this document and in the FFS Sites 1 and 3 (E.C. Jordan Co., 1991b).

This Proposed Plan:

1. explains the opportunities for the public to comment on the remedial alternatives (see Page 2-1);
2. includes a brief history of the site and the principal findings of the RI (see Page 3-1);
3. provides a brief description of the preferred alternative and other alternatives evaluated in the FFS (see Page 6-1 and Page 7-1);
4. outlines the criteria used by the Navy to propose an alternative for use at the site, and briefly analyzes whether the alternatives would meet each criterion (see Page 8-1); and
5. presents the Navy's rationale for its preliminary selection of the preferred alternative for Sites 1 and 3 (see Page 9-1).

To help the public review the cleanup options for the site, this document also includes information about where interested citizens can find more detailed descriptions of the remedy selection process and the alternatives under consideration for Sites 1 and 3 at NAS Brunswick.

2.0 THE PUBLIC'S ROLE IN EVALUATING REMEDIAL ACTIONS

The Navy is offering the public the opportunity to review this Proposed Plan and comment on the remedial alternatives described herein. The following paragraphs provide information on how the public can get involved in the review process.

2.1 PUBLIC INFORMATIONAL MEETING AND PUBLIC HEARING

The Navy will hold a public informational meeting on Thursday, December 12, 1991 at 7 p.m. at the Jordan Acres Elementary School, located on Merrymeeting Road in Brunswick, Maine, to describe the preferred alternative and other alternatives evaluated in the FFS. The public is encouraged to attend the meeting to hear the presentations and to ask questions. The Navy also will hold a formal public hearing immediately following the informational meeting, to accept verbal comments on the cleanup alternatives under consideration for Sites 1 and 3. This hearing will provide the opportunity for people to formally comment on the cleanup plan after they have heard the presentations made at the public informational meeting. Comments made at the hearing will be recorded and transcribed, and a copy of the transcript will be added to the site **Administrative Record** available at the following location:

Curtis Memorial Library
23 Pleasant Street
Brunswick, Maine 04011
(207) 725-5242
Hours:
Monday-Wednesday: 9:30 a.m. - 8:00 p.m.
Thursday-Friday: 9:30 a.m. - 6:00 p.m.
Saturday: 9:30 a.m. - 5:00 p.m.

2.2 PUBLIC COMMENT PERIOD

The Navy is conducting a 30-day public comment period from December 4, 1991 to January 6, 1992, to provide an opportunity for public involvement in the cleanup decision. During the comment period, the public is invited to review this Proposed Plan and the RI and FS reports and to offer written comments to the Navy.

2.3 WRITTEN COMMENTS

If, after reviewing the information on the site, you would like to comment in writing on the Navy's preferred alternative, any of the other cleanup alternatives under consideration, or other issues relevant to the site cleanup, please deliver your comments to the Navy's Remedial Project Manager, Mr. James Shafer, at the Public Hearing or mail your written comments (postmarked no later than January 6, 1992) to:

Northern Division
Naval Facilities Engineering Command
Bldg. 77L, Code 1421
Attn: James Shafer
Philadelphia Naval Base
Philadelphia, Pennsylvania 19112

2.4 THE NAVY'S REVIEW OF PUBLIC COMMENT

The Navy will consider comments received from the public as part of the process of reaching a final decision on the most appropriate remedial alternative for cleanup of Sites 1 and 3. The Navy's final choice of a remedy will be documented in a **Record of Decision (ROD)** for the site and submitted to the MEDEP and the USEPA for review, approval, and signature. Public comment is an important part of the ROD process and will be considered in the final remedy selection. A document, called a Responsiveness Summary, that summarizes the Navy's responses to comments received during the public comment period, will be issued with the ROD. Public comment is being solicited on all of the remedial alternatives described in this proposed plan. Once the ROD is signed by the USEPA Regional Administrator, it will become part of the Administrative Record.

2.5 ADDITIONAL PUBLIC INFORMATION

Because this Proposed Plan provides only a summary description of the field investigations and the cleanup alternatives considered for Sites 1 and 3, the public is encouraged to consult the Administrative Record, which contains the RI and FS reports, for more detailed information on the sites and all of the remedial

alternatives also under consideration. The Administrative Record is available for review at the Curtis Memorial Library, at the address listed on page 2-1.

If you have any questions about the site or would like more information, you may call or write to:

Public Affairs Office
Attn: Mike L'abbé
Naval Air Station Brunswick
Brunswick, Maine 04011
(207) 921-2340

or

Shelia Eckman, Remedial Project Manager
U.S. Environmental Protection Agency
HPS-CAN1
JFK Federal Building
Boston, Massachusetts 02114
(617) 573-5784

or

Ted Wolfe, Project Manager
State of Maine Department of Environmental Protection
State House Station 17
Augusta, Maine 04333
(207) 289-2651

3.0 BASE HISTORY

NAS Brunswick is located south of the Androscoggin River between Brunswick and Bath, Maine. The NAS Brunswick is an active facility supporting the U.S. Department of the Navy's antisubmarine warfare operations in the Atlantic Ocean and Mediterranean Sea. The primary mission of the base is to operate and maintain P-3 Orion aircraft. The NAS Brunswick first became active in the 1940s during World War II, and underwent major expansion in the 1950s.

With growing awareness of the long-term effects of hazardous materials on the environment, the Department of Defense, in 1975, developed a program to address the conditions created by past events and practices. The Installation Restoration (IR) Program was designed to identify, evaluate, and remediate (clean up) former disposal and spill sites at their facilities. Originally, the Navy's part of this program was called the Navy Assessment and Control of Installation Pollutants (NACIP) Program. Early reports produced for the NAS Brunswick reflect the NACIP process and terminology. The Navy eventually adopted the program structure and terminology of the standard IR program to be consistent with regulatory programs established by new legislation.

The IR Program meets the requirements of CERCLA and the Superfund Amendments Reauthorization Act (SARA) and is conducted in several stages, including the following:

- Research is conducted in the Preliminary Assessment (PA) stage to identify potential hazardous waste sites. [This was called the **Initial Assessment Study (IAS)** under the old NACIP program.]

- Site Inspections (SI) then confirm which areas contain contamination, constituting actual "sites". [This was called the **Pollution Abatement Confirmation** (PAC) Study or Step 1A Verification under the old NACIP program.]

- Next, the RI and FS together characterize the type and distribution of contamination, establish criteria for cleanup, identify and evaluate any necessary remedial action alternatives and their costs. As part of the RI/FS, a **Risk Assessment** identifies potential effects on human health

or the environment to help evaluate the need for and effectiveness of remedial alternatives.

- A cleanup remedy is proposed and described in the Proposed Plan.
- A remedy is selected and documented in the ROD.
- The selected alternative is planned and conducted in the Remedial Design and Remedial Action stages. Monitoring then ensures the effectiveness of the effort.

In 1983, an IAS was completed detailing historical hazardous material usage and waste disposal practices, and in 1984, a PAC Study was conducted at NAS Brunswick. These studies recommended further investigation of seven of the nine hazardous waste sites originally identified in the PAC study and the RI/FS process for those seven sites began in 1987. Based on further information, two more sites were added to the RI/FS program in 1989, as were the other two sites originally identified in the IAS. Two additional sites were included in the program in 1990 bringing the total of sites to 13 that the Navy is currently studying under the IR Program (see Figure 1).

In 1987, NAS Brunswick was placed on the USEPA's **National Priorities List (NPL)**. Private-sector NPL sites are eligible for funding from the national environmental trust fund called **Superfund** and are often called Superfund sites. However, Department of Defense sites such as NAS Brunswick are funded through the Defense Environmental Restoration Account.

In 1990, the Navy entered into a Federal Facility Agreement (FFA) with the USEPA and the Maine Department of Environmental Protection regarding the cleanup of environmental contamination at NAS Brunswick. The FFA sets forth the roles and responsibilities of each agency, contains deadlines for the investigation and cleanup of hazardous waste sites, and establishes a mechanism to resolve disputes among the agencies.

In August 1990, the Navy completed a Draft Final RI and Phase I FS report. The RI report described field sampling investigations, geology, and hydrogeology, and presented contamination and risk assessments. The Draft Final Phase I FS identified remedial action objectives, and developed and screened remedial alternatives for the

nine original sites studied in the Draft Final RI. In April 1991, the Navy submitted for regulatory review the Draft Final Supplemental RI and FS reports for the additional four sites.

Because the Navy is committed to providing a timely response to environmental contamination at NAS Brunswick, a strategy was developed to expedite the RI/FS process. This strategy involves identifying the sites for which enough information currently exists to proceed to the Proposed Plan phase of the process. Separate timetables have been established for completing the Final FS reports and RODs for these sites. The Navy has identified Sites 1 and 3, Site 8, and the groundwater associated with Sites 4, 11, and 13 (referred to as the Eastern Plume) as three distinct areas of contamination and believes the remedial process can be initiated. FFSs for Sites 1 and 3 and Site 8, and an FS for ten other sites (Sites 2, 4, 5, 6, 7, 9, 11, 12, 13, and 14; see Figure 1) have been submitted to the regulatory agencies for review.

A Proposed Plan for remediating the groundwater associated with the Eastern Plume has also been submitted. This Proposed Plan identifies an **interim remedial action** for groundwater contamination associated with Sites 4, 11, and 13, and includes groundwater pumping and treatment of the Eastern Plume. Because of the proximity of Sites 1 and 3 to the Eastern Plume, it is possible that groundwater treatment for both sites can occur concurrently at the same treatment facility. The contaminants detected in groundwater at Sites 1 and 3 are similar to those detected in the Eastern Plume and would be effectively treated by the proposed groundwater treatment for the Eastern Plume. The potential effects of the proposed remedial actions for Sites 1 and 3 on the remediation of the Eastern Plume include mainly the diversion of clean groundwater upgradient of Sites 1 and 3 toward the southern portion of the Eastern Plume. Design-level groundwater modeling studies will quantitatively evaluate this interaction; however, remedial actions at Sites 1 and 3 are not anticipated to adversely affect the proposed interim remedial actions for the Eastern Plume. Modifications to the preferred alternative or interim remedial action would be made if the modeling indicated adverse impacts from Sites 1 and 3 on the Eastern Plume or vice versa.

This Proposed Plan is a significant milestone in the remedial process for Sites 1 and 3. It marks the transition from the investigation phase to the remedial action phase of the RI/FS process. A summary of the RI, including the risk assessment, and FS Reports for Sites 1 and 3 are presented in the subsequent sections.

3.1 Results Of The Remedial Investigation

An RI is conducted to define the nature and distribution of contamination at a site. As part of the RI for Sites 1 and 3, the Navy conducted field activities and environmental sampling to determine the geologic and hydrologic conditions and the distribution of contamination at these site. The results of the RI are presented in Section 6.0 of the Draft Final RI report (E.C. Jordan Co., 1990). This document is part of the Administrative Record and is available for review at the Curtis Memorial Library in Brunswick, Maine.

The RI field activities included **geophysical** and **soil gas surveys** and the collection and analysis of surface soil, subsurface soil, leachate, surface water, sediment, and groundwater samples. As part of the RI, five rounds of environmental sampling were conducted at Sites 1 and 3 and a total of 24 test pits, 27 soil borings, 22 surface water and sediment locations, 5 leachate seeps and sediment locations, and 36 monitoring wells were sampled. The findings of the field study are summarized below and an interpretation of the possible health and environment effects resulting from the contamination identified during the RI is presented in Section 4.0.

3.1.1 Groundwater Flow and Subsurface Geology

Groundwater at Sites 1 and 3 occurs in the **overburden soil** and **bedrock** formations. The overburden soil at NAS Brunswick is a **stratified** formation consisting of a sand layer, a **transition** layer, and a clay layer. The sand, transition and clay layers comprise the Presumpscot Formation which occurs on top of the bedrock. The thickness of the Presumpscot Formation varies from 40 to 80 feet in the Sites 1 and 3 area, with the clay layer having a thickness of 20 to 40 feet. This unit of soil was deposited on the bedrock during the late glacial marine submergence of Southern Maine. The variability of the soil types in the Presumpscot Formation is a function of the glacial retreat and sea level changes that occurred when the soils were deposited. The **saturated thickness** of the Presumpscot Formation, or thickness of the overburden that contains groundwater, varies from 20 to 60 feet across Sites 1 and 3. RI data indicate that groundwater flows to the southwest, south, and southeast from a groundwater high in the central portion of Sites 1 and 3 and discharges into Mere Brook and adjacent tributaries (see Figure 2). Groundwater does not flow through the clay layer on top of the bedrock due to the low **permeability** of the clay; however groundwater does flow in the fractures and joints

of the bedrock itself (E.C. Jordan Co., 1990). Since groundwater does not flow through the clay layer, contaminated groundwater above the clay does not impact the bedrock **aquifer**.

3.1.2 Geophysical and Soil Gas Surveys

The geophysical and soil gas surveys were used to locate the landfills at Sites 1 and 3. The results of both surveys identified an area approximately 12 acres that was related to the landfill area (see Figure 2). This area was the focus of additional field investigations including soil boring and test pit sampling.

3.1.3 Waste Area Studies

Soil borings and test pits samples were collected to identify the contaminants present in the surface and subsurface soils at Sites 1 and 3. Contamination detected in the soil boring samples was considered to be low. Low levels of pesticides and **polychlorinated biphenyls** (PCBs) were detected in surface and shallow test pit soil samples. Pesticides typically totaled less than 0.050 **milligrams per kilogram** (mg/kg), with the exception of one test pit location where five pesticide compounds were reported with a total of 2.1 mg/kg. PCBs were also found in eight of the 52 test pit soil samples at concentrations less than 1 mg/kg. **Volatile organic compounds** (VOCs) were typically not detected in test pit soils, although a variety of **semivolatile organic compounds** (SVOCs) were identified. The VOCs tested for include compounds in common industrial solvents, fuels and degreasers that may have been disposed of in the landfills at Sites 1 and 3. A group of SVOCs called **polynuclear aromatic hydrocarbons** (PAHs) were detected in surface and shallow soils at Sites 1 and 3. The concentration of PAHs in the shallow soils was typically 1 to 8 mg/kg, with the highest value reported of 24 mg/kg. PAH compounds are components of coal and hydrocarbon fuels that survive the combustion process. The historical use of coal and fuels at NAS Brunswick may account for the presence of PAHs in soils across the base. Metals were also detected in the soils at Sites 1 and 3. The metals detected above naturally occurring background levels include arsenic, lead, and mercury.

3.1.4 Leachate Seeps, Surface Water, and Sediment

Contaminated leachate generated from the landfills at Sites 1 and 3 seeps out along the steep banks of Mere Brook and the tributary adjacent to Sites 1 and 3 (see

Figure 2). These leachate seeps typically contain trace levels of VOCs, SVOCs, and pesticides, but do not contain PCBs. One leachate seep location detected VOCs at a maximum concentration of 1.3 **milligrams per liter (mg/L)**. The leachate samples also contained **metals** and **inorganic** compounds. These same metals have been detected at trace levels in downstream surface water and sediment sampling locations.

Over 20 surface water and sediment locations were sampled along Mere Brook. Low levels of VOCs (i.e., less than 0.030 mg/L) were detected in two surface water samples. The detected concentrations of the VOCs were below levels considered to represent a risk to aquatic organisms (see Section 4.0). Elevated levels of metals were detected at two different surface water locations. These same metals have been detected in the leachate and groundwater flowing beneath Sites 1 and 3. Two of the metals, iron and zinc, were also detected at elevated concentrations in the upgradient, background sampling locations.

PAHs were detected in Mere Brook sediments adjacent to Sites 1 and 3. These compounds were also detected in Mere Brook sediment upgradient of Sites 1 and 3 from background stream sampling locations. The concentrations of PAHs in the background sampling locations are similar to those detected in sampling locations, adjacent to Sites 1 and 3. PAHs were also detected in surface and subsurface soils from the Sites 1 and 3 landfill area at concentrations ranging from 0.6 to 24 mg/kg. As stated, PAHs are components of coal and hydrocarbon fuels that survive the combustion process, and may be present from the historical and current use of coal and fuels at NAS Brunswick.

3.1.5 Groundwater

Groundwater contamination from the landfill consists primarily of VOCs, metals, and inorganic compound. The VOCs include both **chlorinated solvents** and fuel-related compounds. The concentrations of chlorinated solvents detected in groundwater typically were less than 0.2 mg/L, and total fuel-related VOCs had a maximum concentration of 1.1 mg/L. The maximum concentration of metals and inorganic compounds detected in groundwater include arsenic (107 μg/L), chromium (11 μg/L), cyanide (34 μg/L), iron (962 mg/L), lead (60 μg/L), nickel (78 μg/L), sodium (181 mg/L), and zinc (2,500 μg/L). Pesticides or PCBs were not detected in groundwater at Sites 1 and 3.

4.0 SUMMARY OF SITE RISKS

A human health risk assessment was conducted in 1990 to identify current and potential risks to human health and the environment from contamination at Sites 1 and 3. These risk assessments can be found in Appendix Q and summarized in Section 15 of the Draft Final RI Report (E.C. Jordan Co., 1990). This document is part of the Administrative Record and is available for review at the Curtis Memorial Library in Brunswick, Maine.

The risk assessments estimate the present and future potential risks to human health and the environment posed by contaminants detected in the soils, sediment, surface water and groundwater. These risks are based on contaminant levels detected at the site during the sampling events and described in the RI report (E.C. Jordan Co., 1990). The risk assessment indicated a risk to human health from ingestion of contaminated groundwater. This is not a current risk, because the groundwater beneath Sites 1 and 3 is not used as a water supply and the contaminated groundwater has not migrated off-base. However, if in the future, the base or residents were to use the groundwater as a drinking water supply, such use could pose a long-term health risk. The chemicals of concern in the groundwater include chlorinated solvents and metals. The presence of these chemicals in the environment is a concern, because some of these compounds are potential **carcinogens** and long-term exposure may cause adverse health effects.

A human health risk assessment was also conducted based on assumed future land use of Sites 1 and 3 as a residential area. This scenario represents the worst case exposure conditions because it is unlikely that the landfill areas will ever be developed for residential purposes. The risk assessment evaluated exposure to contaminants through (1) direct contact and incidental ingestion of soil, (2) direct contact with sediment from Mere Brook, (3) direct contact with sediment from the leachate seeps, (4) direct contact with surface water from Mere Brook, and (5) direct contact with surface water from the leachate seeps. Even under these unlikely exposure conditions the risks to human health were not considered significant. The cancer risks were at the low end or below the USEPA target risk range of 10^{-6} to 10^{-4} and all noncarcinogenic risks were below a hazard index of 1.0. Contaminants are not present in the soils, sediment or surface water at Sites 1 and 3 at concentrations that are considered to cause adverse health effects.

The environmental risk assessment concluded that the contaminated groundwater was impacting the environment near Mere Brook. Mere Brook flows next to Sites 1 and 3 (see Figure 2) and groundwater flowing from the landfill areas discharges to the brook and flows out along the banks as leachate seeps.

Iron and zinc were detected in the surface water of Mere Brook adjacent to Sites 1 and 3 at levels exceeding their **Ambient Water Quality Criteria** (AWQC). These criteria are chemical concentrations in water that were developed to protect the organisms that live in aquatic environments. Concentrations of iron and zinc were also detected at concentrations greater than their AWQC upstream of the Sites 1 and 3, suggesting that other areas are impacting the stream. The runways located upstream of Sites 1 and 3 are the suspected source of the levels of iron and zinc. If upstream sources of contamination which can be attributed to past disposal are identified, these newly identified sites would fall under CERCLA authority and would be included in the Navy's IR program.

The environmental risk assessment concludes that iron and zinc in the portion of Mere Brook adjacent to Sites 1 and 3 may cause some adverse impacts to aquatic organisms. The concentrations of iron and zinc downgradient of Sites 1 and 3 and at monitoring locations in Harpswell Cove are below their respective AWQCs. All other contaminants in Mere Brook were detected below levels considered to present an ecological risk. The selected remedy for Sites 1 and 3 will eliminate the discharge of contaminated groundwater from the Landfill areas to Mere Brook. This will result in a decrease in the amount of iron and zinc in Mere Brook.

Mercury has been detected in the sediment around these leachate areas. Because some environmental receptors (e.g., earthworms, small birds and rodents), may feed in these areas they may be exposed to mercury. Long-term exposure to mercury from these area may cause adverse impacts to these organisms. All other contaminants in the sediment around the leachate areas were detected below levels considered to present an ecological risk.

Actual or threatened releases of hazardous substances from this Site, if not addressed by the preferred alternative or one of the other active measures considered, may represent a current or potential risk to public health, welfare, or the environment.

For a complete explanation of risks posed by contamination at Sites 1 and 3, please refer to the Draft Final RI, Supplemental RI, and Focused Feasibility Study Reports. These reports are available at the information repository at Curtis Memorial Library in Brunswick, Maine.

5.0 PROPOSED CLEANUP OBJECTIVES AND LEVELS

Using the information gathered during the RI and FS, the Navy identified remedial response objectives for cleanup at Sites 1 and 3. The cleanup objectives are as follows:

1. to reduce the generation and migration of contaminated groundwater;

2. to minimize any future negative impact to Mere Brook and the sediment in the leachate seeps resulting from the discharge of contaminated groundwater and leachate;

3. to reduce the potential risk associated with ingestion of contaminated groundwater;

To meet these objectives, the Navy has proposed site-specific cleanup levels for the metals and VOCs detected in groundwater. These cleanup levels are set at a concentration that is protective of human health and the environment. The Navy's long-term cleanup goals for reducing contamination in groundwater at NAS Brunswick are to meet **Maximum Contaminant Levels (MCLs), Maximum Contaminant Level Goals (MCLGs)**, or risk-based guidance levels for compounds for which drinking water standards have not been set. MCLs are drinking water standards established by the USEPA. The State of Maine has established **Maximum Exposure Guidelines (MEGs)** that define the maximum permissible level of a contaminant in water that is consumed as drinking water. The MEGs typically are set at the same concentration as the MCL. However, for some compounds, the MEGs are set at a more stringent concentration. Because all the VOCs and contaminants of concern in the groundwater at Sites 1 and 3 have MCLs, these concentrations were used as the target cleanup level. As such, the remedial alternative selected for Sites 1 and 3 must achieve the MCL for all contaminants in the groundwater.

However, to ensure that the selected remedy provides an adequate level of protection to human health and is consistent with the states cleanup criteria for groundwater, the Navy has agreed to conduct a risk assessment at the completion of the groundwater remediation. If the residual cancer risks are greater than 10^{-4}, the Navy will implement additional remedial actions. In addition, the Navy has agreed to

implement institutional controls to prevent the ingestion of groundwater while the remedial action is in place. The institutional controls will remain until the residual cancer risk decreases to 10^{-5}.

Cleanup goals have also been set for the contaminated sediment around the leachate seep areas. Mercury was the only contaminant of concern in the leachate sediment. Because there are no standards for contaminants in sediment, the cleanup level for the mercury is a risk-based level considered to be protective of the environment. Actual remediation of contaminated sediment is not part of the preferred alternative. However, because the cap and slurry wall will effectively reduce contaminant migration from Sites 1 and 3 to the brook, the proposed remedial alternative will indirectly reduce contaminant concentration in the sediment near the current leachate seep locations. The contaminated leachate seeps will cease to flow as the groundwater feeding the seeps drops below the seep elevation. The sediment associated with the leachate seeps will no longer receive contamination and will decrease in concentration through natural degradative and stream erosional processes. The proposed clean-up levels for Sites 1 and 3 are presented in Table 1.

TABLE 1
PROPOSED CLEAN-UP LEVELS FOR SITES 1 AND 3

PROPOSED PLAN: STIES 1 AND 3
NAS BRUNSWICK

MEDIUM	MAXIMUM CONCENTRATION	TARGET CLEAN-UP LEVEL	RATIONALE
Human Health			
Groundwater			
Arsenic	107 μg/L	50 μg/L	MCL[1,3]
Vinyl Chloride	180 μg/L	2 μg/L	MCL[4]
Methylene Chloride	460 μg/L	5 μg/L	MCL (p)
1,2-Dichloroethylene (cis)	140 μg/L	70 μg/L	MCL[3]
1,2-Dichloroethylene (trans)	140 μg/L	100 μg/L	MCL[3]
Chromium (total)	11 μg/L	100 μg/L	MCL (p)[2]
Lead	60 μg/L	5 μg/L (at source)	MCL
Nickel	78 μg/L	100μg/L	MCL (p)[2]
Ecological			
Leachate soil/sediment			
Mercury	3.3 mg/kg	1 mg/kg	Risk-based

NOTES:
MCL = Maximum Contaminant Level
MCL(p) = Proposed Maximum Contaminant Level
mg/kg = milligrams per kilogram
μg/L = micrograms per liter
[1] = The MCL for arsenic is currently under review; USEPA 1991a.
[2] = MCL(p) is equal to MCLG.
[3] = USEPA 1991b.
[4] = MEG for Vinyl Chloride is 0.2 μg/L

6.0 THE NAVY'S PREFERRED ALTERNATIVE

The Navy's selection of the preferred cleanup alternative for Sites 1 and 3, as described in this Proposed Plan, is the result of a comprehensive evaluation and screening process. The Draft Final Phase I FS for the site was conducted to identify remedial technologies and develop alternatives that could address the contamination at the site. The Draft Final FS and FFS reports for Sites 1 and 3 describes all the alternatives developed, and the process and criteria used by the Navy to evaluate each alternative. For details on the Navy's screening methodology, see the Phase I FS Report (E.C. Jordan Co., 1990) and for details on the evaluation process, see the FFS Report (E.C. Jordan Co., 1991b). The following sections describe the preferred alternative and the other alternatives developed by the Navy for Sites 1 and 3.

The Draft Final FFS report describes and evaluates six alternatives, these include:

1. No Action;
2. Minimal Action;
3. Containment (cap, slurry wall, and groundwater extraction and treatment);
4. Passive Groundwater Collection and Treatment;
5. Cap and Groundwater Extraction and Treatment; and
6. Cap and Passive Groundwater Collection and Treatment.

These alternatives represent a range of actions from no-action to containment, groundwater extraction and treatment. The No Action alternative is included to comply with the **National Oil and Hazardous Substances Contingency Plan** (NCP) and to use as a baseline to measure the effectiveness of the other alternatives. All but the No Action and Minimal Action alternatives, provide some type of groundwater collection and treatment system. For each treatment alternative, the groundwater treatment strategy is the same. However, two different water treatment technologies were evaluated in the FFS report (i.e., UV/oxidation and **air stripping**). (For details on the Navy's evaluation of these alternatives, see the FFS Report [E.C.

Jordan Co., 1991b]). The following paragraphs describe the Navy's preferred alternative.

Preferred Alternative: Containment and Groundwater Treatment

The Navy's preferred alternative is designed to contain the buried waste and minimize the migration of contaminants from the landfill by reducing the amount of water flowing through the waste. This alternative would include the following components:

- vertical hydraulic barrier (slurry wall)
- horizontal hydraulic barrier (cap)
- groundwater extraction wells
- water treatment
- discharge of treated water
- institutional controls and deed restrictions
- environmental monitoring

The slurry wall would be placed around the landfill and extend into the underlying clay layer (see Figure 3). The proposed depth of the slurry wall ranges from approximately 28 to 62 feet below ground surface (bgs). The slurry wall would also be keyed approximately 3 to 5 feet into the natural clay formation and would divert clean groundwater flow around the site, preventing groundwater contact with the landfill waste material. Because the slurry wall would be sealed into the underlying relatively impermeable clay, and would have a permeability of 10^{-6} to 10^{-7} cm/sec, minimal groundwater would flow beneath or through the wall. The location of the slurry wall in Figure 3 was estimated by computer simulation of the groundwater flow system. The actual placement of the wall would depend on further geotechnical exploration in the area. The geotechnical studies will be part of the pre-design efforts.

A low-permeability cap would be placed over the landfill area to reduce the amount of rainfall infiltration. The cap would also extend over the slurry wall. The cover system would be designed to meet appropriate guidance and sound engineering practices. The cover system would include a vegetative top cover layer, a drainage layer, a bottom hydraulic barrier and a gas venting system. The permeability of the cover system would be 10^{-7} cm/sec. The proposed cap would cover approximately 11.6 acres, encompassing most of the area designated as Sites 1 and 3. A small

EASTERN PLUME TREATMENT PLANT

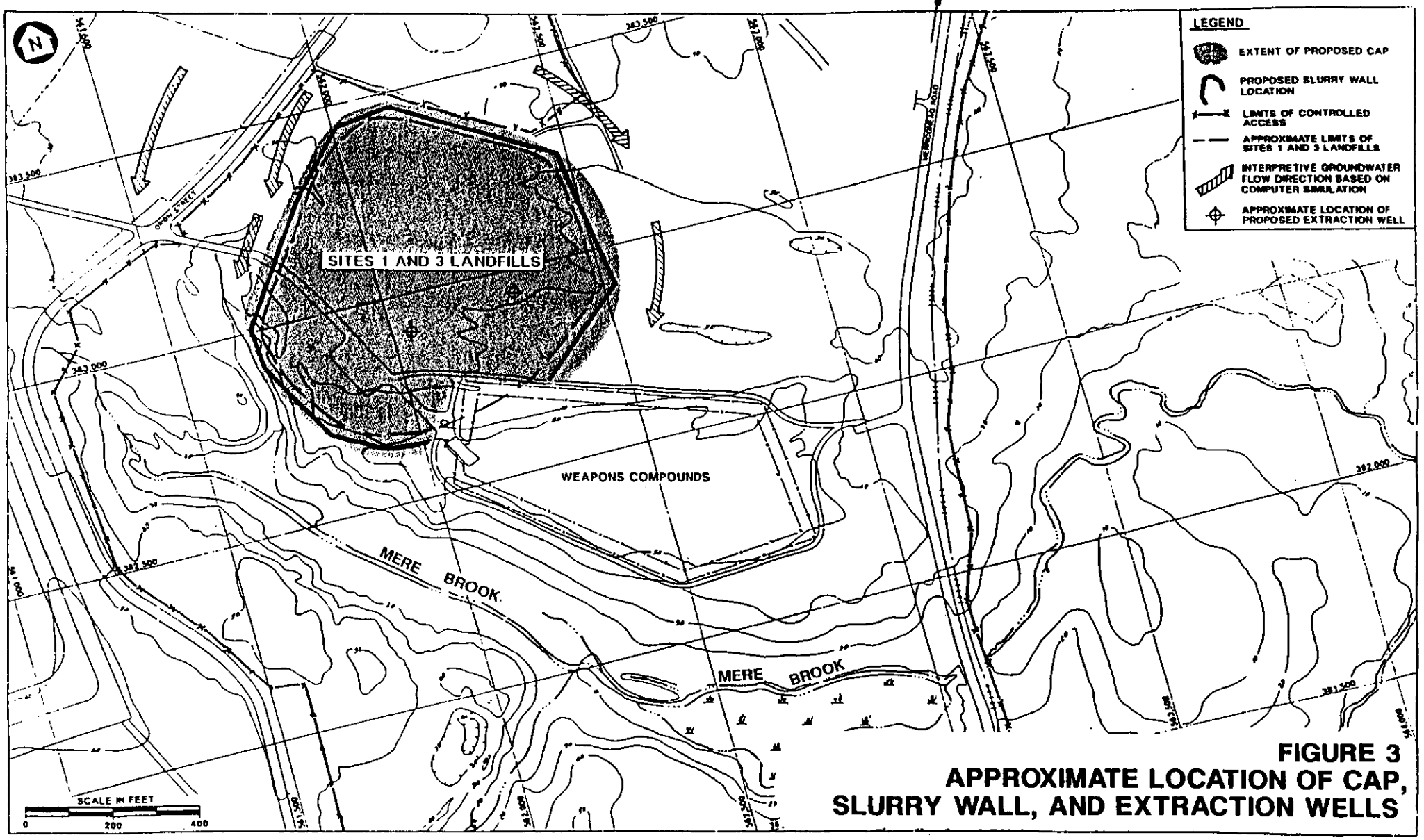


FIGURE 3
APPROXIMATE LOCATION OF CAP, SLURRY WALL, AND EXTRACTION WELLS

portion (less than 0.3 acres) of Site 1 located within the Weapons Compound was not included in the cover system. Although waste has been uncovered in this area, much of it is assumed to have been removed during construction. Only a small area within the Weapons Compound is believed to contain waste and computer simulations of groundwater flow did not show a difference between the effects of a cap including or excluding this area. Therefore, the cap will not extend into the Weapons Compound, and will comply with the security regulations for this area of the base. Should the Weapons Compound be decommissioned, the Navy would evaluate the need for extending the cap and slurry wall to include that portion of the Weapons Compound which is also part of the landfill area.

The combined effect of the cap and slurry wall would reduce the groundwater table to a level below the depth of waste. The cover system would require little maintenance and periodic post-closure inspections would be conducted to ensure proper integrity. All repairs to the cover system would be made, as necessary, based on these inspections. The cap and slurry wall components of the remedial alternative would effectively contain the contaminated waste material and reduce the amount of contaminated groundwater produced.

A groundwater extraction system would be installed and designed to remove contaminated groundwater trapped beneath the cap and within the slurry wall (see Figure 3). Approximately 16 million gallon of water would be removed and treated. Capturing this contaminated water would prevent it from discharging to Mere Brook. These extraction wells would decrease the time required for this water to drain naturally.

The extracted groundwater would be pumped to a proposed treatment plant for the treatment of dissolved metals. The removal of metals is critical to both the protection of human health and the overall effectiveness of the groundwater treatment process. Inorganic contaminants of concern would be removed during this treatment process along with other metals (i.e., iron and manganese) that may clog the VOC treatment process. A chemical would be added to groundwater to **oxidize** the metals making them less soluble. A polymer would then be added to aid in **flocculating**, or agglomerating, the precipitated metal oxide particles into larger particles that will settle out of solution more easily. The **precipitated** metal oxides would be separated from the water by allowing the water to remain in a quiescent tank, called a clarifier, for a period of time. The water would then be polished by **filtration** to remove any remaining particles. The solid material from the clarifier

would be pressed to remove excess water and then shipped to a hazardous waste disposal facility if determined to be hazardous, or to an off-site solid waste landfill if determined to be nonhazardous. The water extracted from the solids would then be cycled through the on-site groundwater treatment system.

Once the metals were removed, the water would be treated to remove VOCs. The organic contaminants of concern would be destroyed using a technology known as UV/oxidation. This technology destroys organic compounds by exposing them to a chemical **oxidant** (i.e., hydrogen peroxide) in the presence of UV light. The contaminated groundwater would be mixed with the oxidant and pumped into a reactor (or series of reactors) where the water would be exposed to UV light. The UV light speeds up the destruction of organic compounds. The resulting **effluent** would be sampled to ensure that the water meets appropriate discharge standards. (See Figure 4 for a diagram of the water treatment system.)

It is possible that contaminated groundwater from Sites 1 and 3 will be pumped to a treatment plant and treated concurrently with groundwater from the Eastern Plume. This scenario is considered feasible because of the similar contaminants (i.e., VOCs), the low flow rate of groundwater from Sites 1 and 3, and the short duration of time (estimated to be 370 days) that would be required to pump and treat the groundwater remaining beneath the cap and within the slurry wall. At this time, contaminated leachate seeps will cease to flow, as the groundwater feeding the seeps will be below the seep elevation. Any groundwater flowing towards these areas would be clean water diverted by the slurry wall around the waste material. The sediments associated with the leachate seeps will no longer receive contamination from the seeps and will decrease in concentration via natural degradative processes and erosive stream processes. Removal (i.e., excavation) of the contaminated sediments was considered, however, is not included as part of the remedial action, because of the severe ecological damage that would result from bringing heavy machinery and equipment into this area. The adverse ecological impacts from removing the sediment would outweigh the potential benefits incurred from this action.

An FS describing the alternatives for the Eastern Plume has been submitted to the regulatory agencies for review. A Proposed Plan for an Interim Remedial Action for the Eastern Plume has been submitted and also describes the concurrent water treatment scenario. The Proposed Plan for the Eastern Plume will be subject to the same public review and comment as this Proposed Plan.

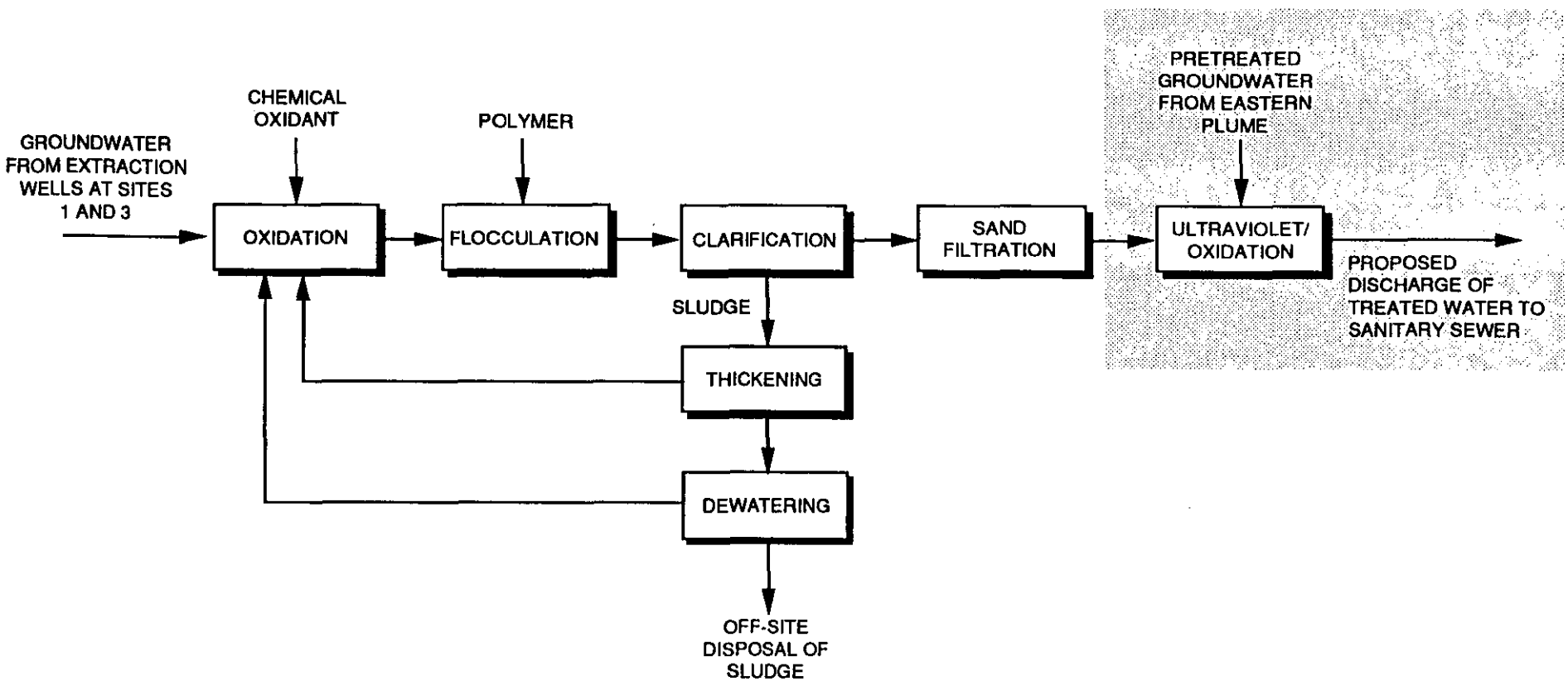


FIGURE 4
SCHEMATIC FLOW DIAGRAM FOR WATER TREATMENT

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If the Navy can obtain a permit, discharge of the treated water would be through a new sewer connection from the UV/oxidation treatment building to the public sewer system for conveyance to the local **publicly owned treatment works (POTW)**. The treated water would meet all the **pretreatment** requirements to ensure that the treated water does not interfere with the normal operations of the POTW. All other applicable standards would also be met before any treated water would be discharged to the sewer system. In addition, it would be determined that the POTW has the capacity to receive the volume of water being treated. Final treatment and disposal would occur at the POTW.

If the POTW is unable to accept the pretreated water, it could be recycled back into the aquifer by **upgradient recharge** or discharged to surface water on base. For either the aquifer recharge or the discharge to surface water option, the water would be treated to meet appropriate requirements or standards. For upgradient recharge, the water would be treated to drinking water standards (i.e., MCLs) before discharge. For discharge to surface water, the Navy would be required to obtain a **National Pollutant Discharge Elimination System (NPDES)** permit, and meet the requirements outlined in it. If either aquifer recharge or discharge to surface water is selected as the discharge option, the final discharge requirements (i.e., actual treatment levels and location of discharge) would be identified and submitted for regulatory approval before implementation.

Because the source of contamination (i.e., waste material) is left untreated on-site, institutional controls and long-term environmental monitoring would be necessary. The institutional controls would be aimed at limiting contaminant exposure by reducing groundwater use in the area. Because this area of NAS Brunswick is serviced by a public water supply, it is unlikely that the groundwater would be used for domestic purposes. Institutional controls and deed restrictions would also be required to limit future land development in this area.

The long-term environmental monitoring program would monitor groundwater flow and quality. Surface water, sediment, and leachate seeps would also be sampled and analyzed for the contaminants of concern. Data collected under this program would provide information necessary to assess the effectiveness of the cap and slurry wall at diverting clean water around the site and preventing further contamination of groundwater. In addition, the monitoring program would assess the dispersion and degradation of contamination that has already emanated from the landfill. The monitoring program will be submitted for regulatory review and will identify the

sampling locations and sampling frequency. At a minimum, the environmental monitoring program would continue for 30 years.

Five-year reviews would also be required as part of the environmental monitoring program. In addition to making recommendations regarding future remedial actions, the five-year reviews would assess the performance of the containment system. The Navy will also conduct a risk assessment as part of the five-year review to ensure protection of public health and the environment. The results of the risk assessment will be used to determine the need for additional remedial actions.

Estimated Time for Design and Construction: 2.5 years
Estimated Time for Operation: 1 year (Groundwater Extraction Only)
Estimated Capital Cost: $3,874,000
Estimated Operations and Maintenance Costs (net present worth): $1,432,000
Estimated Total Cost (net present worth): $7,842,000

7.0 OTHER ALTERNATIVES EVALUATED IN THE FEASIBILITY STUDY

The public is also invited to comment on the other five alternatives that the Navy developed and evaluated. Each of these alternatives is briefly described below and discussed in more detail in the Draft Final FFS Report (E.C. Jordan Co., 1991b).

7.1 NO ACTION

This alternative was developed and evaluated in the FFS to serve as a baseline for comparison with the other remedial alternatives under consideration. Under the No Action Alternative, no active measures would be taken to reduce or contain contamination emanating from the landfills. No costs would be incurred if this alternative were implemented. This alternative would not meet the cleanup objectives for the site.

7.2 MINIMAL ACTION

This alternative would consist of the following components:

- institutional controls and deed restrictions
- environmental monitoring

Under the Minimal Action Alternative no actions would be taken to reduce or contain contamination emanating from the landfill. Institutional controls would consist of posting warning signs around the landfill and near the leachate seeps (the site is currently fenced and access is limited). Restrictions on future development would be incorporated into the property deed to limit land use should the base be decommissioned.

The environmental monitoring program would monitor the migration and discharge of contaminated groundwater to Mere Brook. In addition to groundwater, surface water, sediment, and leachate seeps would also be sampled and analyzed for the contaminants of concern. The environmental monitoring program would be submitted for regulatory review and would include a proposed sampling frequency. Data collected under this program would provide information necessary to assess the

dispersion and degradation of contamination emanating from the landfill. The environmental monitoring program would continue for 30 years.

Estimated Time for Design and Construction: 6 months
Estimated Time for Operation: 30 years
Estimated Capital Cost: $10,000
Estimated Operation and Maintenance Cost (net present worth): $788,000
Estimated Total Cost (net present worth): $1,147,000

7.3 GROUNDWATER COLLECTION/TREATMENT

This alternative consists of the following components:

- groundwater collection
- groundwater treatment
- discharge of treated water
- institutional controls and deed restrictions
- environmental monitoring

Contaminated groundwater would be collected by either a downgradient collection trench surrounding the site or extraction wells placed within the landfill. The collection trench would be placed below ground surface to a depth of approximately 25 feet. A perforated PVC pipe would allow water to flow to centrally located sump pumps. The collected water would be pumped and treated at a treatment plant. If an extraction system were used, it would be designed to contain and collect the contaminated groundwater before it discharges to Mere Brook.

Collected groundwater would be treated using the same pretreatment technologies described for the preferred alternative and treatment options described in the FFS report. Air stripping and UV/oxidation are the process options for VOC removal that were retained after alternative screening. The UV/oxidation process for groundwater treatment was described in the Preferred Alternative in Section 6.0. Air stripping is another method frequently used to remove VOCs from groundwater and is effective for removing the contaminants of concern for Sites 1 and 3: vinyl chloride, 1,2-DCE, and methylene chloride and was evaluated as part of the FFS. During the air stripping process, contaminated water contacts large volumes of clean air. Contaminated water enters the top of the air stripping tower and trickles down

through the packing material, while air enters at the bottom. The contaminants are transferred from the liquid phase to the gas phase and carried off with the effluent air.

Design of the column is essentially dictated by the column fluid dynamics and the desired removal efficiencies for the compounds of concern. A computer program (i.e., Airstrip), which models the dynamics of the air stripping process, was used as part of the preliminary design effort. The design calls for an 18-foot-high by 2-foot-diameter column with plastic packing material.

An estimated 1.9 lb/day of total VOCs would be expected from air stripper emissions at Sites 1 and 3. This emission rate was calculated based on preliminary design parameters for the air stripping unit (i.e., water and air flow rates and initial concentrations) and the maximum concentration of VOCs detected in the landfill area.

Because Maine is in a non-attainment area for ozone, off-gas treatment using vapor phase carbon (VPC) would be required if air stripping was selected as the treatment technology. Vendor information indicates a usage rate of 8,000 lb/day of VPC for contaminants in the air effluent and the associated flow rates if controls had to be placed on air stripper emissions. This extremely high usage rate is due to the fact that both methylene chloride and vinyl chloride do not adsorb well to activated carbon. The other VOCs would be effectively removed by the VPC. Off-gas incineration is another treatment option for air-stripping that may be effective at treating vinyl chloride. However, this technology cannot be used at Sites 1 and 3 because of the sites' proximity to the Weapons Compound.

Both metals and VOC treatment would occur in the same treatment plant. Based on groundwater modeling, it is estimated to take between 18 and 73 years to collect and treat the groundwater to the cleanup levels. Greater than 610 million gallons of water are estimated to require treatment. Because of the time required to treat the groundwater and the amount of water to be treated, this alternative could not be combined with the groundwater treatment proposed for the Eastern Plume, and a separate treatment facility would be constructed.

Treated water would be discharged to the POTW, or reinjected or discharged to surface water as described above for the preferred alternative. The reinjection system would introduce treated water into the aquifer upgradient of the landfill.

Institutional controls would be required in this alternative as described for the preferred alternative because the untreated waste would remain on-site. Deed restrictions would be enacted if the NAS Brunswick was excessed in the future. An environmental monitoring program would be implemented to assess the effectiveness of the pumping system at capturing the contaminated groundwater. The environmental monitoring program would be submitted for regulatory review and would include a proposed sampling frequency.

Estimated Time for Design and Construction: 2.5 years
Estimated Time for Operation: 18 to 73 years
Estimated Capital Cost: $2,710,000
Estimated Operation and Maintenance Cost (net present worth): $6,821,000
Estimated Total Cost (net present worth): $12,938,000

7.4 CAP/GROUNDWATER EXTRACTION/TREATMENT

This alternative would consist of the following components:

- cap
- groundwater extraction
- groundwater treatment
- discharge of treated water
- institutional controls and deed restrictions
- environmental monitoring

The cap would be constructed over the landfill as described in the preferred alternative. The groundwater extraction system would consist of groundwater extraction wells placed within the landfill to contain and collect the contaminated groundwater before it discharges to Mere Brook. Based on groundwater modelling it is estimated to take between 18 and 73 years to achieve cleanup goals in the groundwater. Greater than 610 million gallons of water is estimated to require treatment.

Groundwater would be treated and discharged as described for the Groundwater Collection/Treatment Alternative. Because waste would remain on-site, institutional controls and deed restrictions would be required as described in the preferred alternative. Results of the environmental monitoring program would provide information necessary to assess the performance of the groundwater extraction system. The environmental monitoring program would be submitted for regulatory review and would include a proposed sampling frequency.

Estimated Time for Design and Construction: 2.5 years
Estimated Time for Operation: 18 to 73 years
Estimated Capital Cost: $3,152,000
Estimated Operation and Maintenance Cost (net present worth): $7,066,000
Estimated Total Cost (net present worth): $13,591,000

7.5 CAP/ GROUNDWATER COLLECTION/TREATMENT

This alternative would consist of the following components:

- cap
- groundwater collection
- groundwater treatment
- discharge of treated water
- institutional controls and deed restrictions
- environmental monitoring

This alternative is the same as the Cap/Groundwater Extraction/Treatment Alternative with the exception that a downgradient interceptor trench would be used to collect contaminated groundwater rather than an extraction well system. The collection trench would be the same as that described for the Groundwater Collection/Treatment Alternative. As with the Groundwater Collection/Treatment Alternative, between 18 and 73 years would be required to achieve groundwater cleanup goals and greater than 610 million gallons of water would require treatment. Results of the environmental monitoring program would provide information necessary to assess the performance of the groundwater extraction system. The environmental monitoring program would be submitted for regulatory review and would include a proposed sampling frequency.

Estimated Time for Design and Construction: 2.5 years
Estimated Time for Operation: 18 to 73 years
Estimated Capital Cost: $3,965,000
Estimated Operation and Maintenance Cost (net present worth): $6,821,000
Estimated Total Cost (net present worth): $14,744,000

8.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

In FS reports conducted for remediating hazardous waste sites under CERCLA, the USEPA requires that remedial alternatives be evaluated using nine criteria. The nine criteria are used to select a remedy that meets the national Superfund program goals of protecting human health and the environment, maintaining long-term protection, and minimizing untreated waste. Definitions of the nine criteria and a summary of the Navy's evaluation of the proposed remedial action using the nine criteria are provided below:

8.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Overall Protection of Human Health and the Environment addresses how an alternative as a whole will protect human health and the environment. This includes an assessment of how public health and environmental risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

The preferred alternative would provide overall protection to human health and the environment by reducing contaminant concentrations in groundwater, surface water, stream sediments, leachate seeps, and leachate sediment to levels protective of human health and the environment. The other treatment alternatives would also provide a similar degree of protection. However, the preferred alternative has one important advantage over the other treatment alternatives, it includes an upgradient slurry wall which would divert groundwater around the landfill and lower the groundwater table to below the level of the buried waste. The waste material would be contained resulting in a lower volume of contaminated groundwater to be extracted and treated compared to the other alternatives. The time required to achieve the remedial action objectives for the preferred alternative is estimated to be about 1 to 2 years, while the other treatment alternatives are estimated to require between 18 and 73 years to achieve the objectives. The time required for the last three alternatives is comparable because they all rely on natural flushing and degradation to reduce contaminant levels in the landfilled waste material.

The No Action and Minimal Action alternatives were not designed to achieve the cleanup objectives.

8.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

Compliance with **Applicable or Relevant and Appropriate Requirements (ARARs)** addresses whether or not a remedy complies with all State and Federal environmental and public health laws and requirements that apply or are relevant and appropriate to the conditions and cleanup operations at a specific site. If an ARAR cannot be met, the reasons must be clearly stated and a waiver may be required.

With the exception of the No Action and Minimal Action alternatives, all the other alternatives would meet all ARARs. The No Action and Minimal Action alternatives would allow the continued release of contaminants from the landfill to the groundwater and discharge to Mere Brook. The other alternatives include groundwater treatment and will achieve chemical-specific ARARs.

Final treatment standards for groundwater would be based on achieving the discharge requirements. These could be MCLs or other more stringent requirements, depending on the final discharge of the groundwater. All work conducted at the site would be in accordance with Occupational Safety and Health Administration requirements.

8.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Long-term Effectiveness and Permanence refers to the ability of an alternative to maintain reliable protection of human health and the environment over the time required to achieve the cleanup goals.

The preferred alternative would be effective in diverting groundwater flow around the waste and limiting the amount of rainwater infiltrating the landfill. These components will effect the amount of contaminated groundwater generated. The volume of contaminated groundwater remaining beneath the cap would be extracted or collected and treated before it discharges to Mere Brook. The remedial action objectives would be achieved in approximately 1 to 2 years. The contaminant source would not be remediated in this alternative.

The other treatment alternatives would also meet the remedial action objectives because contaminated groundwater would also be extracted or collected and treated before discharge to Mere Brook. Each of these treatment options would provide a permanent remedy but would require between 18 and 73 years to achieve the remedial action objectives.

Neither the No Action Alternative nor the Minimal Action Alternative would meet the remedial action objectives. The site would continue to pose a risk to both humans and the environment.

8.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Reduction of Toxicity, Mobility, or Volume through treatment are three principal measures of the overall performance of an alternative. The 1986 Superfund amendments emphasize that, whenever possible, USEPA should select a remedy that uses a treatment process to permanently reduce the level of toxicity of contaminants at the site, the spread of contaminants away from the source of contamination (i.e., mobility), and the volume or amount of contamination at the site.

The preferred alternative would reduce the toxicity, mobility, and volume of contaminated groundwater through treatment. An estimated 16 million gallons of contaminated groundwater, which would otherwise discharge to Mere Brook, would be extracted and treated.

The other treatment alternatives, reduce toxicity and mobility through treatment, however they rely on natural flushing to decrease contaminant levels in groundwater and require long-term treatment of contaminated groundwater to achieve the remedial objectives. Because groundwater would continue to contact the waste, a much greater volume of water would require treatment in each of these three alternatives (greater than 610 million gallons). None of the proposed alternatives include the removal of the source material. Such an action is considered to be impracticle given the large volume of waste material.

The No Action and Minimal Action Alternative would not achieve reduction of toxicity, mobility, or volume of contaminants because no treatment would be involved.

8.5 SHORT-TERM EFFECTIVENESS

Short-term Effectiveness refers to the possible adverse impacts on human health or the environment that may result during the construction and implementation of an alternative.

The four treatment alternatives have been evaluated equally for short-term effectiveness. Impacts to the public would result from locally increased truck traffic necessary for transportation of construction equipment and materials. Environmental impacts would be minimal and limited to the removal of trees to facilitate construction activities. If treated water is discharged to Mere Brook, possible impacts would be minimized through the use of engineering controls. These controls would limit temperature, volume, and the velocity of the discharged water.

The No Action and Minimal Action alternatives would not result in any additional adverse impacts to the public and the environment.

8.6 IMPLEMENTABILITY

Implementability refers to the technical and administrative feasibility of an alternative, including the availability of materials and services needed to implement the alternative.

All of the alternatives evaluated in the FFS are implementable. All the necessary construction services are available. Hazardous waste disposal sites able to accept hazardous waste from Superfund sites have been identified. These disposal sites would be used if the metal sludge generated during pretreatment of groundwater was determined to be hazardous. Coordination with base security would be required to obtain access to the secured area to conduct monitoring and construction activities.

8.7 COST

Cost includes the capital (up-front) cost of implementing an alternative as well as the cost of operating and maintaining the alternative over the long term, and net present worth of both capital and operation and maintenance costs.

The capital, operation and maintenance, and total cost for each alternative is provided as part of the site description in the preceding sections on "The Navy's Preferred Alternative" and "Other Alternatives Evaluated in the FS."

Although the preferred alternative does not have the lowest estimated capital cost of the four treatment alternatives, it does have the lowest operation and maintenance cost and total cost. This is due to the fact that groundwater treatment would not have to be carried out for as nearly as long in the preferred alternative than for the other treatment alternatives.

8.8 STATE ACCEPTANCE

State Acceptance addresses whether, based on its review of the RI/FS and Proposed Plan, the State concurs with, opposes, or has no comment on the alternative the Navy is proposing as the remedy for the site.

The State of Maine has reviewed this Proposed Plan and has provided comments and recommendations. The State may comment further after it has had an opportunity to review comments received during the public comment period.

8.9 COMMUNITY ACCEPTANCE

Community Acceptance addresses whether the public concurs with the Navy's Proposed Plan. Community acceptance of this Proposed Plan will be evaluated based on comments received at the upcoming public meetings and during the public comment period.

8.10 SUMMARY

Of the nine criteria, protection of public health and compliance with all ARARs are requirements that must be met by all remedies. The Navy balances its consideration of alternatives with respect to long-term effectiveness and permanence; reductions of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. State and community concerns are considered in the

selection of a remedy. Consideration of USEPA, State, and community comments may prompt the Navy to modify aspects of the remedial action or decide that another alternative provides a more appropriate balance.

9.0 NAVY'S RATIONALE FOR PROPOSING THE PREFERRED ALTERNATIVE

Based on current information and analysis of the RI and FS reports, the Navy believes that the preferred containment and groundwater treatment alternative for Sites 1 and 3 is consistent with the requirements of the Superfund law and its amendments, specifically Section 121 of CERCLA, and to the extent practicable, the NCP. Except for the No Action and Minimal Action alternatives, all of the alternatives presented in this Proposed Plan would provide overall protection of human health and the environment. In the Navy's analysis, the preferred alternative identified in the Proposed Plan is more readily implementable than and comparable in cost to the other alternatives considered. In addition, the preferred alternative would achieve the best balance among the criteria used by USEPA to evaluate the alternatives. The preferred alternative would provide short- and long-term protection of human health and the environment, would attain all Federal and state applicable or relevant and appropriate public health and environmental requirements, would reduce the mobility and toxicity of contaminated groundwater and would use permanent solutions to the extent practicable.

Administrative Record: A file established and maintained in compliance with Section 113(K) of CERCLA consisting of information upon which the lead agency bases its final decisions on the selection of cleanup method(s) for a Superfund site. The Administrative Record should be established at or near the site and made available to the public.

Air Stripping: A treatment method used to remove volatile organic compounds (VOCs) from contaminated water by inducing air flow through the water to transfer VOCs from the water to the air. The air stream is typically treated to ensure regulatory compliance.

Ambient Water Quality Criteria (AWQL): Contaminant concentrations in water that are considered to be protective of aquatic receptors.

Applicable or Relevant and Appropriate Requirements (ARARs): ARARs include any State or Federal statute or regulation that pertains to protection of public health and the environment in addressing certain site conditions or using a particular cleanup technology at a Superfund site. USEPA must consider whether a remedial alternative meets ARARs as part of the process for selecting a cleanup alternative for a Superfund site.

Aquifer: A layer of rock or soil that can supply usable quantities of groundwater to wells and springs. Aquifers can be a source of drinking water and provide water for other uses as well.

Bedrock: The layer of rock located below the glacially deposited soil and rock under the ground's surface. Bedrock can be either solid or fractured (cracked); fractured bedrock can support aquifers.

Cap: A multi-layer soil cover system consisting of one or more materials which reduce the flow of water through the cap. The cap is also graded to promote runoff of rainfall or snowmelt.

Carcinogens: A chemical which causes or induces cancer.

Chlorinated Solvents: Chlorine-containing compounds used in industry to clean or remove paint or grease from metal surfaces.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A Federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act (SARA). The act created a special tax that goes into a Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program, USEPA can either: (1) pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work or (2) take legal action to force parties responsible for site contamination to clean up the site or pay back the Federal government for the cost of the cleanup.

Effluent: Wastewater (treated or untreated) that flows out of a treatment plant, sewer, or industrial outfall.

Feasibility Study (FS) Report: Report that summarizes the development and analysis of remedial alternatives.

Filtration: Separation of suspended solids during wastewater treatment by passing the water through a porous medium such as sand.

Flocculating: Agglomerating suspended particles into a mass large enough to settle out of solution by gravity. A chemical flocculant (e.g., polymer) can be added and the water slowly mixed to enhance flocculation.

Focused Feasibility Study (FFS): A feasibility study that evaluates a limited number of alternatives for a specific area of a site.

Geophysical Survey: Site investigation techniques (e.g. magnetometer, ground penetrating radar) that do not require invasive activity. These techniques are used to characterize subsurface conditions (e.g., buried drums or utilities, surface of bedrock).

Groundwater: Water found beneath the earth's surface that fills pores in soil and cracks in bedrock to the point of saturation. Groundwater may transport substances which have percolated downward from the ground surface as it flows toward its point of discharge.

Initial Assessment Study (IAS): Field investigations which confirm the presence of hazardous materials at a site.

Inorganic: Class of naturally occurring compounds that includes metals, cyanide, nitrates, sulfates, chlorides, carbonate, bicarbonate and other oxide complexes.

Remedial Action: An option evaluated to address the source or migration of contaminants at a Superfund site to control or prevent further migration. This action is not intended to be the final remedy for the site, but must be consistent with the ultimate remedy chosen.

Leachate: Contaminated liquid resulting from water flushing through a **source** area. Leachate can be produced when rainfall percolates through the landfill. Leachate seeps are small amounts of water flowing from the sides of the stream embankment. They are typically orange-red in color due to the amount of iron in the water.

Maximum Contaminant Levels (MCLs): The maximum permissible level of a contaminant in water that is consumed as drinking water. These levels are determined by USEPA and are enforceable standards applicable to all public water supplies.

Maximum Contaminant Level Goal (MCLG): The maximum level goal of a contaminant in drinking water at which no known or anticipated adverse effect on human health will occur. EPA establishes MCLGs under the Safe Drinking Water Act at threshold levels with a margin of safety for non-carcinogens, and a zero level for carcinogens where the threshold level is not known.

Maximum Exposure Guideline (MEG): The maximum permissible level of a contaminant in water that is consumed as drinking water. These levels are determined by the State of Maine and applicable to all public water supplies in Maine. The MEG typically coincides with the federal MCL for each regulated contaminant, however, risk based calculations have resulted in some specific MEG's that are set at a more stringent level than the MCL.

Metals: Naturally occurring elements.

Milligrams per Kilogram (mg/kg): A unit of measure used to describe levels of contamination on a weight per weight basis, and is used to describe contaminant levels in soils. One milligram per kilogram of contaminant is equal to one one thousandth of a gram of contaminant in one kilogram of material (i.e., soil). The mg/kg term is also known as a part per million.

Milligram per Liter (mg/L): A unit of measurement used to describe levels of contamination. One milligram per liter of a contaminant is equal to one thousandth of a gram in one liter of water. This unit of measure is also known as one part per million.

National Oil and Hazardous Substances Contingency Plan (NCP): The federal regulation that guides determination of the sites to be corrected under the Superfund program and the program to prevent or control spills into surface waters or other portions of the environment.

National Pollutant Discharge Elimination System (NPDES): A provision of the Clean Water Act which prohibits discharge of pollutants into water unless a permit is issued by the USEPA or state.

National Priorities List (NPL): USEPA's list used to prioritize uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund.

Net Present Worth: The amount of money necessary to secure the promise of future payment, or series of payments, at an assumed interest rate.

Overburden Soil: Refers to the soil overlying the bedrock layer.

Oxidant: A substance containing oxygen that removes electrons, or oxidizes, another substance, changing its form.

Oxidize: To remove electrons from a substance. When dissolved iron is oxidized, for example, it changes to a more insoluble form.

Permeability: Property of soil that measures the ability of water to pass through.

Pesticides: Substance or mixture of substances intended to prevent, destroy, repel or mitigate pests.

Pollution Abatement Confirmation (PAC) Study: A study conducted to confirm the presence of hazardous constituents or hazardous waste.

Polychlorinated Biphenyls (PCBs): A group of organic chemicals used since 1926 in electric transformers as insulation and coolants, in lubricants, carbonless copy paper, adhesives, and caulking compounds. USEPA banned most uses of PCBs in 1979. PCBs are persistent in the environment because they do not break down to new and less harmful chemicals. If ingested by humans or animals, PCBs can be stored in fatty tissues. Acute and chronic exposure can cause liver damage. PCBs have also caused cancer in lab animals and have adversely affected the survival rate and reproductive success of fish.

Polynuclear Aromatic Hydrocarbons (PAHs): A group of organic chemicals typically formed during the combustion of hydrocarbon fuels, but can also exist naturally in the environment. PAHs are found in high concentrations in urban or industrial areas, or in the vicinity of airports. PAHs are relatively immobile in the environment. Some PAHs are believed to cause cancer, while others have not been observed to produce adverse health effects.

Precipitate: To remove solids from liquid waste so that the hazardous solid portion can be disposed of safely. Also, those solids which have been precipitated.

Pretreatment: Treatment of wastewater performed prior to discharge to a public sewer system.

Publicly Owned Treatment Works (POTW): A wastewater treatment facility that is owned by a state, municipality, or intermunicipal or interstate agency.

Record of Decision (ROD): A public document that explains the cleanup alternative to be used at a NPL site. The ROD is based on information and technical analysis generated during the RI/FS and on consideration of the public comments and community concerns in the Responsiveness Summary.

Remedial Alternatives: Cleanup options developed for a site to address contamination and contaminated media at the site.

Remedial Investigation (RI): The RI determines the nature and extent and composition of contamination at a hazardous waste site, and directs the types of cleanup options that are developed in the FS.

Risk Assessment: Evaluation and estimation of the current and future potential for adverse human health or environmental effects due to exposure to contaminants.

Saturated Thickness: The vertical thickness of the soil zone in which all of the pore spaces are filled with water.

Semivolatile Organic Compounds (SVOC): A group of chemical compounds having a molecular weight greater than 100. These compounds are heavier than and generally less volatile than VOCs. PAHs are SVOCs. Some SVOCs are believed to cause cancer.

Slurry Wall: A vertical barrier constructed of a mixture of sands, silts, and clays. The slurry wall is used to reduce groundwater flow into a system by imposing a pressure gradient.

Source: Area at a hazardous waste site from which contamination originates.

Stratified: Layered.

Superfund: The program operated under CERCLA and SARA that funds and carries out the USEPA solid waste emergency and long-term removal activities.

Soil Gas Survey: Technique used to measure the concentration of contaminants in the void spaces of near-surface soils.

Transition: Soil unit consisting of varying layers of sands, silts, and clays.

Ultraviolet (UV)/Oxidation: Water treatment process in which organic contaminants are permanently destroyed by an oxidant (such as hydrogen peroxide) in the presence of UV light.

Upgradient Recharge: The processes by which water is added to the zone of saturation upgradient of the source, either directly into a formation, or indirectly by way of another formation. Upgradient means in the direction from which groundwater flows.

Volatile Organic Compound (VOC): A group of chemical compounds composed primarily of carbon and hydrogen that are characterized by their tendency to

evaporate (or volatilize) into the air from water or soil. VOCs include substances that are contained in common solvents and cleaning fluids. Some VOCs are believed to cause cancer.

E.C. Jordan Co., 1990. "Draft Final Remedial Investigation Report NAS Brunswick;" Portland, Maine; August 1990.

E.C. Jordan Co., 1991a. "Draft Final Supplemental Remedial Investigation Report NAS Brunswick;" Portland, Maine; August 1991.

E.C. Jordan Co., 1991b. "Focused Feasibility Study Sites 1 and 3 NAS Brunswick;" Portland, Maine; October 1991.