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EPA Superfund
Record of Decision:

NEW LONDON SUBMARINE BASE
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NEW LONDON, CT
03/31/1998

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INTERIM
RECORD OF DECISION
FOR
DEFENSE REUTILIZATION AND MARKETING

NAVAL SUBMARINE BASE NEW LONDON
GROTON, CONNECTICUT

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY(CLEAN)CONTRACT

Submitted to:
Northern Division
Environmental Branch Code 18
Naval Facilities Engineering Command
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February 1998

<IMG SRC 98002B>

TABLE OF CONTENTS

SECTION PAGE

TABLES

FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CGS	Connecticut General Statutes
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Contaminants of Concern
CSF	Cancer Slope Factor
CTDEP	State of Connecticut Department of Environmental Protection
CTE	Central Tendency Exposure
CTO	Contract task order
CWA	Clean Water Act
DRMO	Defense Reutilization and Marketing Office
DW/WWT	Dewatering/Wastewater Treatment
ERA	Ecological Risk Assessment
FFA	Federal Facilities Agreement
FFS	Focused Feasibility Study
FS	Feasibility Study
GAC	Granular Activated Carbon
GCL	Geosynthetic Clay Liner
GRA	General Response Actions
HBL	Health Based Limit
HI	Hazard Index
HQ	Hazard Quotient
ICR	Incremental Cancer Risks
IEUBK	Integrated Exposure Uptake Biokinetic
IR	Installation Restoration
IRA	Interim Removal Action
MCL	Maximum Contaminant Levels
NCP	National Contingency Plan
NPL	National Priorities List
NSB-NLON	Navy Submarine Base New London
O&M	Operation and Maintenance
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PPE	Personal Protective Equipment
PRG	Preliminary Remedial Goal
RAB	Restoration Advisory Board
RAO	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RCSA	Regulations of Connecticut State Agency
RfD	Reference Dosage
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SCS	United States Department of Agriculture Soil Conservation Service
SSL	Soil Screening Levels
SWPC	Surface Water Protection Criteria
TBC	To be considered
TCLP	Toxicity Characteristic Leaching Procedure
TSD	Treatment, Storage, Disposal
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound

GLOSSARY

Applicable, or Relevant and Appropriate Requirements (ARARs) - The Federal and state environmental and facility siting rules, regulations, and criteria which must be met by the selected remedy under Superfund.

Asphalt/GCL cap - Cover made up of a layer of asphalt and a Geosynthetic Clay Liner (GCL) which was placed over areas of contaminated soil at DRMO in 1995. The GCL is a fabricated liner which consists of an impervious layer of bentonite clay "sandwiched" between two permeable layers of geotextile fabric.

Chemical fixation-solidification - Controlled mixing of waste material (typically soil or sludge) with selected chemicals which induce a solidification of this material and the immobilization (fixation) of certain contaminants within the solidified material.

Contaminants - Any physical, biological, or radiological substance or matter that, at a certain concentration, could have an adverse effect on human health and the environment.

Excavation - Earth removal with construction equipment such as backhoe, trencher, front-end loader, etc.

Feasibility Study (FS) - A report that presents the development, analysis, and comparison of remedial alternatives.

Groundwater - Water found beneath the earth's surface. Groundwater may transport substances that have percolated downward from the ground surface as it flows towards its point of discharge.

"Hot Spots" - Those areas of soil at DRMO where contaminant concentrations result in unacceptable risk to site workers if the site continues to be used as it presently is.

Landfilling - Controlled burial of material at a site specifically designed for this purpose.

PAHs - Polycyclical Aromatic Hydrocarbons. High molecular weight, relatively immobile, and moderately toxic solid organic chemicals featuring multiple benzenic (aromatic) rings in their chemical formula. Typical examples of PAHs are naphthalene and phenanthrene.

PCBs - Polychlorinated Biphenyls. High molecular weight, moderately mobile, and moderately to highly toxic liquid organic chemicals featuring two benzenic rings and multiple chlorine atoms in their chemical formula. In the past, PCBs were commonly used as cooling fluid in electronic transformers and, as a result, PCB contamination is relatively widespread.

Record of Decision (ROD) - An official document that describes the selected Superfund remedy for a site. The ROD documents the remedy selection process and is issued by the Navy and U.S. EPA following the public comment period.

Remedial Investigation (RI) - A report which describes the site, documents the type and distribution of contaminants detected at the site, and present the results of the risk assessment.

Responsiveness Summary - A summary of written and oral comments received during the public comment period, together with the Navy's and U.S. EPA's responses to these comments.

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

Sediment - Soil, sand, and minerals typically transported by erosion from soil to the bottom of surface water bodies, such as streams, rivers, ponds, and lakes.

Source - Area(s) of a site where contamination originates.

Surface Water - Water from streams, rivers, ponds, and lakes. For this ROD surface water means water of the Thames River.

Thermal Desorption - Removal of volatile and semivolatile contaminants (typically organic chemicals) through heating of the contaminated material with hot air, followed by capture and treatment of the removed contaminants from the exhaust gases.

Time Critical Removal Action - Site cleanup action conducted on an accelerated schedule for the rapid correction of an environmental situation of particular concern.
Vadose - Soil above the typical groundwater level.

DECLARATION FOR THE INTERIM RECORD OF DECISION

SITE NAME AND LOCATION

The Defense Reutilization and Marketing Office (DRMO) is located on the Naval Submarine Base New London (NSB-NLON), Groton, Connecticut. This Interim Record of Decision (Interim ROD) addresses the contaminated soil and groundwater at this site.

STATEMENT OF BASIS AND PURPOSE

This Interim ROD presents the following interim remedy for soil and groundwater at the DRMO:

- Institutional Controls
- Monitoring

The selected remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for the DRMO which was developed in accordance with Section 113(k) of CERCLA, and is available for public review. By implementing institutional controls and maintenance of the existing asphalt and geocomposite clay (GC) layers, the U.S. Navy plans to protect potential human receptors from adverse health effects of exposure to the underlying contaminants. By implementing monitoring, the U.S. Navy plans to verify that the contaminants in the soil are not migrating to the Thames River through the groundwater. The Connecticut Department of Environmental Protection (CTDEP) concurs with the selected remedy for DRMO.

ASSESSMENT OF DRMO

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Interim ROD, may present a current or potential threat to public health, welfare, or the environment.

The U.S. Navy has determined that remedial action is necessary for this site because the risks to potential human receptors associated with the soil at this site exceed the U.S. EPA limit of cumulative noncarcinogenic Hazard Index (HI) of 1.0 and cumulative incremental cancer risk (ICR) of 1 x 10 -6. Also the risks for these potential receptors exceed CTDEP Remediation Standards limit of 1 x 10 -6 Incremental Cancer Risk (ICR) for individual contaminants with a cumulative ICR exceeding 1 x 10 -5 and cumulative HI exceeding 1.0. Currently there are no receptors at the site that are facing a health risk although there is a potential for migration of contaminants through the groundwater and into the Thames River. This Interim ROD selects the remedy to address potential future risks.

DESCRIPTION OF THE SELECTED REMEDY

This remedial action addresses the soil and groundwater at the DRMO. A Time-Critical Removal Action at the DRMO was completed in January 1995. Contaminated soils were excavated down to the water table and disposed off site. The excavated area was backfilled and covered with a geosynthetic clayliner (GCL) and asphalt. The remainder of the DRMO, was paved with asphalt. Contaminated soil remains in place below the water table.

The U.S. Navy has determined that institutional controls and monitoring is appropriate for the contaminated soil and groundwater at this site. Potential exposure to soil and potential migration of contaminants into the groundwater are the principal threats posed by the site. This remedy involves maintenance of the existing asphalt and GCL cover on the site, records in the Base Master Plan regarding the contamination and restricting future land development at the site, installation of monitoring wells, and periodic sampling and analysis of groundwater. Land use restrictions will be placed on the property.

STATUTORY DETERMINATIONS

The remedy selected by the U.S. Navy for DRMO is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to this remedial action, and is cost-effective. However, because this remedy will result in hazardous substances remaining in the soils above health-based levels, groundwater monitoring will be implemented to assess whether the remedy is achieving long-term remedial requirements. A review of the data and site conditions will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. This remedy uses permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. The selected remedy does not satisfy the statutory preference for remedies, that employ treatment as a principal element to reduce toxicity, mobility, or volume of contaminants. Continued maintenance of the controls installed during the Time-Critical Removal Action provides adequate protection of human health and the environment from exposure to contaminated soil under current land use conditions. Protection of the environment will be assessed through groundwater monitoring to evaluate contaminant migration risks.

DECLARATION

This Interim ROD represents the selection of a remedial action under CERCLA for the DRMO. The foregoing represents the selection of a remedial action by the Department of the Navy and the U.S. EPA Region I with the concurrence of the CTDEP..

Concur and recommend for immediate implementation:

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1.0 SITE NAME, LOCATION, AND DESCRIPTION

NSB-NLON covers approximately 550 acres of land in the southeast of Connecticut in the towns of Ledyard and Groton, on the east bank of the Thames River, approximately 6 miles north of Long Island Sound. For almost 100 years, the Naval Submarine Base New London (NSB-NLON) has served as a major support center for the U.S. Atlantic fleet. The location of NSB-NLON is shown as the U.S. Naval Reservation on Figure 1-1.

The Defense Reutilization and Marketing Office (DRMO) is located adjacent to the Thames River in the northwestern section of NSB-NLON as shown on Figure 1-2. The site is located between a bedrock outcrop that runs roughly parallel to the Providence and Worcester Railroad to the east and the Thames River to the west. The site covers approximately 3 acres of land gently sloping towards the Thames River. A majority of the site is paved with an asphalt layer, and it features buildings, a weighing scale, and miscellaneous storage piles. Currently, the DRMO is used as a storage and collection facility for items such as computers, file cabinets, and other office equipment to be sold during auctions and sales held periodically during the year.

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2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

This section summarizes the land use, response history, and enforcement history for the DRMO.

2.1 LAND USE AND SITE HISTORY

For almost 100 years, the NSB-NLON has served as a major support center for the U.S. Atlantic fleet. From 1950 to 1969, the DRMO was used as a landfill and waste burning area. Non-salvageable waste items including construction materials and combustible scrap were burned along the Thames River shoreline, and the residue was pushed to the shoreline and partially covered.

At various times, metal and wood products have been stored over most of the site. Building 491, located in the northern, unpaved portion of the site was used to store miscellaneous items including batteries. Metal scrap bailing operations are performed adjacent to Building 491 on a gravel surface. Building 491 formerly housed a battery acid handling facility.

Buildings 355 and Building 479 are located in the southern, paved, portion of the site and are primarily used for storage. A large scrap yard is located north of Building 479. Details of the site are described in Section 5.0 and depicted on Figure 5-1.

Submarine batteries were previously stored in the southeast portion of the site adjacent to the railroad tracks. No evidence of leaks was observed.

2.2 RESPONSE AND ENFORCEMENT HISTORY

The U.S. Navy has placed 25 sites under the purview of the Installation Restoration Program. Depending on the characteristics of the sites, the media of concern at these sites are: soil, sediment, groundwater, surface water, and air. Records of Decision have been issued for some of these sites, and of these sites, remedial actions have been completed at several of them. The majority of the remaining sites are under various stages of remedial investigation and feasibility study preparation. Some of the sites have been classified low priority based on low risk ranking by the U.S. Navy and will not be investigated at this time.

The IRP and CERCLA. In 1975, the Department of Defense developed a program to investigate and clean up problem areas involving contamination of land and water at Federal facilities such as the NSB-NLON. That program, known as the Installation Restoration Program (IRP), is being conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly referred to as the Superfund law. In 1986, Congress passed amendments to CERCLA that contain provisions for Federal facilities. NSB-NLON was placed on the National Priorities List (NPL) of Federal Superfund sites on August 30, 1990, by the U.S. Environmental Protection Agency (U.S. EPA).

Initial Assessment Study (IAS). An IAS (Envirodyne, 1982) was conducted to identify and evaluate past hazardous waste disposal practices at NSB-NLON and to assess the associated potential for environmental contamination. The IAS recommended further investigation of several areas including the DRMO.

Federal Facility Agreement (FFA). The U.S. Navy entered into an FFA with the U.S. EPA and the Connecticut Department of Environmental Protection (CTDEP) on January 5, 1995. The FFA established roles and responsibilities of each agency, set deadlines for the investigation and cleanup of hazardous waste sites, and established a mechanism for the resolution of disputes among agencies.

Remedial Investigations, studies, and removal action conducted to date. A Phase I Remedial Investigation (RI) (Atlantic, 1992), a Phase II RI (B&R Environmental, March 1997), and a Focused Feasibility Study (FFS, Atlantic 1993) were conducted over the course of several years, ending in March 1997. A time-critical removal action was completed in January 1995 (OHM, September 1995)wherein approximately 4,700 tons of soil contaminated with lead, polynuclear aromatic hydrocarbons (PAHs), and PCBs were excavated from the site down to the water table and disposed of at an offsite hazardous waste landfill. Contaminated soil below the groundwater level was left in place. The excavated area was backfilled with clean borrow material from an offsite location, and the area was capped with geosynthetic clay/geotextile layers and overlaid by gravel/asphalt layer. At the time of completion of the removal action, the remaining area was also paved with an asphalt layer.

Feasibility Study (FS) and Proposed Remedial Action Plan (PRAP). A draft final FS for this site (B&R Environmental, September 1997) and a PRAP (U.S. Navy and B&R Environmental, September 1997) based on this FS were prepared for this site. The scope of this FS was limited to the soil and groundwater at the site. However, this FS also addressed reduction of any adverse affects that the soil and groundwater may have on surface water in Thames River.

3.0 COMMUNITY PARTICIPATION

Throughout the history of the investigations and enforcement activities at NSB-NLON, the community has been actively involved in accordance with CERCLA Sections 113(k)(2)(B)(i-v) and 177. Community members and other interested parties have been kept abreast of site activities through informational meetings, published "fact sheets and information updates," press releases, public meetings, and Technical Review Committee (TRC)/Restoration Advisory Board (RAB) meetings.

The TRC was established in 1988 and was later (in 1994) reorganized and renamed the RAS. The RAB has been an important vehicle for community participation in the NSB-NLON IRP. The RAB consists of representatives of the U.S. Navy, U.S. EPA, CTDEP, planners and officials of neighboring towns, Navy and U.S. EPA contractors, and local residents with scientific knowledge of or interest in the sites. The RAS meets quarterly to review technical aspects of the NSB-NLON IRP and provides a mechanism for community input to the program.

To ensure that the community is well informed about NSB-NLON IRP activities, the Navy has provided and will continue to provide the public with the following sources or vehicles of information.

- Public Information Repositories. The Public Libraries in Groton and Ledyard, and the Naval Submarine Base, are the designated information repositories for the Subbase IRP.

- Key Contact Persons. The Navy has designated a Public Affairs Officer and an U.S. EPA Community Involvement Coordinator as information contacts for the Subbase. Their addresses and phone numbers are included in all information material distributed to the public, including any fact sheets and press releases. The Public Affairs Officer will maintain the site mailing list to ensure that all interested individuals receive more pertinent information on the IRP activities.

- Mailing List. To ensure that information materials reach the individuals who are interested in or affected by the IRP activities at the Subbase, the Navy maintains and will regularly update a mailing list of interested persons. Anyone interested in being placed on the list can do so by contacting the Subbase Public Affairs Officer.

- Regular Contact with Local Officials. The Navy has managed and will continue to arrange regular meetings to discuss the status of the IRP with the RAB, which includes representatives from neighboring towns. The Navy contacts other town officials on an as-needed basis.

- Press Releases and Public Notices. The Navy has issued and will continue to issue press releases to local media sources to announce public meetings and comment periods, the availability of the IRP reports and plans, and to provide general information updates as and when the Public Affairs Officer sees fit.

- Public Meetings. The Navy has held and will continue to hold informal public meetings as needed to keep residents and town officials informed about IRP activities at the Subbase and of significant milestones in the IRP. The meetings include presentations by Navy technical staff, U.S. EPA personnel, and/or support contractors for both agencies. The meetings also include a question-and answer period. Minutes of meetings during public comment periods are included in the Administrative Record for public reference.

- Fact Sheets and Information Updates. The Navy has been developing a series of fact sheets which are mailed to public officials and other interested individuals and/or used as handouts at the public meetings. Each fact sheet includes a schedule of upcoming meetings and other site activities. The fact sheets may explain why the Navy is conducting certain activities or studies, update readers on potential health risks, or provide general information on the IRP process.

A detailed formal NSB-NLON Community Relations Plan was published in February of 1994. The plan identifies issues of community interest and concern regarding the NSB-NLON. The plan also describes a program of community relations activities that the Navy will conduct during the IRP.

The activities of the community relations program outlined in this plan have the following specific objectives: (1)to keep local officials, citizens. military personnel, and the media informed of site activities; (2) to increase community awareness of the goals and procedures of the IRP; and (3) to provide opportunities for public involvement in the cleanup process.

The information in the Community Relations Plan is based upon:

- interviews with area residents and local officials conducted in Groton and Ledyard on October 2-3, 1991;

- interviews with area residents and local officials conducted by phone in September and October of 1991;

- input of the TRC/RAB which had regularly met to discuss progress at the Subbase;

- public comments and questions at public information meetings held in 1990 and 1991;

- review of Navy site files; and

- discussions held with Navy, U.S. EPA, contractors, and technical and public affairs staff.

The U.S. Navy published a notice and brief analysis of the DRMO Proposed Plan in the New London Day on September 18, 1997, and made the RI/FS Proposed Plan documents available to the public at the Groton Public Library, Groton, Connecticut, and the Bill Library, Ledyard, Connecticut.

From September 18 through October 18, 1997, the U.S. Navy held a 30-day public comment period to accept public input on the alternatives presented in the FS and the Proposed Plan, as well as other documents previously released to the public. On September 25, 1997, NSB-NLON personnel and regulatory representatives held a public meeting to discuss the Proposed Plan, answer questions and concerns regarding the site and the remedial alternative under consideration, and accept any oral comments. A transcript of this meeting is presented in Appendix A. The Navy did not receive any written comments from the public during the 30-day public comment period. Comments from CTDEP on the proposed plan were received in a letter dated October 17, 1997, a copy of which is presented in Appendix B. A Responsiveness Summary is presented in Appendix C. The Declaration of Concurrence is presented in Appendix D.

This decision document presents the selected remedial action for the DRMO at NSB-NLON, chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the National Contingency Plan. The decision for the DRMO is based on the Administrative Record.

4.0 SCOPE AND ROLE OF RESPONSE ACTION

This response action following the time-critical removal action that was completed in January 1995 as described on page 2-2. The scope of this remedial action at the DRMO addressed in this ROD is limited to the soil and groundwater. The remedial action was selected among a total of four alternatives that were retained for detailed screening in the FS for this site, including No Action.

The selected alternative is institutional controls and monitoring. Institutional controls will consist of maintenance of the existing cap with limitations to site access and restrictions on land development.

Monitoring will consist of groundwater sampling and analysis in accordance with the Groundwater Monitoring Plan (B&R Environmental, October 1997). If the concentrations of groundwater COCs are shown to exceed site-specific Surface Water Protection Criteria (SWPC), then additional action would be taken, including expansion of the scope of monitoring to include surface water and sediment sampling, followed by analysis to determine if COCs are migrating from the site to Thames River. If exceedances of volatilization criteria are detected, then additional action would be taken including determining the need for additional remedial action. Five-year site reviews will be conducted over a duration of 30 years.

5.0 SUMMARY OF SITE CHARACTERISTICS

This section presents a summary of site characteristics for the DRMO based on information generated during the Phase I and Phase II RIs. This section discusses topography, surface water, soils, geology, ecological features, and the nature and extent of contamination present at the DRMO.

5.1 TOPOGRAPHY AND SURFACE FEATURES

The DRMO topography and site features are illustrated in Figure 5-1. An exposed, bedrock highpoint, located to the east of the DRMO, slopes steeply to the west towards the site. The ground surface within the DRMO site boundaries gently slopes westward from an elevation of 8 feet above mean sea level (amsl) along the eastern boundary of the site to 4 feet amsl at the Thames River. The land is relatively flat, low lying and prone to flooding by the Thames River.

As part of the Time-Critical Removal Action, a geosynthetic clay liner (GCL) and asphalt cap were installed over an area of excavation, and the remaining portion of the DRMO was paved with asphalt. Buildings 479, 355, and 491 are located within the paved area. Figure 5-2 shows the pre-excavation and post-excavation confirmation sampling locations for this removal action at the DRMO.

5.2 SURFACE WATER FEATURES

All surface runoff from the site flows to the Thames River which is located along the western edge of the DRMO. Two storm sewer systems located along the southern boundary of the site transfer runoff from the eastern side of the Providence and Worcester Railroad to the Thames River (Atlantic, August 1992). The DRMO is within the 100-year flood plain of the Thames River.

5.3 SOIL CHARACTERISTICS

The Soil Classification Survey (SCS) Soils Map (SCS, 1983) classifies the soil at the DRMO as Udorthents Urban land complex. This classification is defined as being excessively drained to moderately drained soil that has been disturbed by cutting and filling.

To the north of the site, the soil is classified as the Hinkley Loam. This soil is found on stream terraces and outwash plains and consists of a dark, gravely sand loam. Native materials at the DRMO were most likely of this type.

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Northwest and upslope of the site, along the exposed bedrock highpoint, the soil is classified as Hollis-Charlton-Rock complex. This classification is defined as being stones and boulders intermingled with a dark, fine, sandy loam. Bedrock outcrops are prevalent.

<u>5.3.1 Geology</u>

Geologic conditions underlying the DRMO consist of a westward-thickening wedge of overburden materials (fill and natural deposits) overlying fractured metaimorphic bedrock. The upper layer of fill material is between 2 and 20 feet thick. The fill consists primarily of sand and gravel but also contains metal and wood. The fill is thickest along the Thames River (6MW2D, 6TB10, 6TB12, 6TB16, 6TB17, and 6TB19) and thinnest at 6TB13 and 6TB15. There was no evidence of fill at 6MW7S (southeast corner of site) or the 6MW6 and 6MW5 well clusters (offsite).

In most cases, the fill is underlain by clayey silt, which thickens from 2 feet along the eastern portion of the DRMO to a maximum observed thickness of 46 feet along the Thames River. The silt layer is underlain by sand and gravel, except at 6MW2D where the silt lies directly on bedrock. Upslope of the DRMO at the 6MW5 and 6MW46 well clusters, the clayey silt is missing, and 20 feet of sand and gravel rest on bedrock.

The coarse-grained natural overburden materials are generally mapped as terrace deposits along the Thames River (USGS, 1960). These terrace deposits are stratified drift of former glacial meltwater streams.

At the DRMO, the coarse-grained terrace deposits are overlain by the clayey silt, which are finer-grained river bottom sediments.

Bedrock in the northern portion of the DRMO has been mapped as the Granite Gneiss. Bedrock in the southern portion of the DRMO has been mapped as the Mamacoke Formation (USGS, 1967). These mapped formations were detected during drilling: the Granite Gneiss was encountered at 6MW5D and the Mamacoke Formation was encountered at 6MW6D. The Westerly Granite has been mapped along the eastern portion of the site, but it was not detected during drilling (Phase I RI). The bedrock at the DRMO slopes westward toward the Thames River. The slope of the bedrock surface across the DRMO is approximately 25 percent.

5.4 HYDROGEOLOGY

Groundwater is present within the overburden and bedrock underlying the DRMO. The water table is generally encountered within the fill materials at the site (between 2.5 and 10.5 feet below ground surface), with the underlying clayey silt and terrace deposits under saturated conditions. Based on the expected relative permeability of these three units (the coarse-grained fill and terrace deposits are expected to be significantly more permeable than the intervening clayey silt layer), the three deposits are considered to be separate hydrostratigraphic units. The clayey silt may function as an aquitard relative to the overlying and underlying coarser grained units.

Groundwater flow is generally from east to west, following topographic and bedrock surface slope to the Thames River. The Thames River is tidally influenced with a mean tidal range at NSB-NLON of 2.2 feet, which creates reversals in groundwater flow directions and causes water levels to fluctuate. Based on a tidal study conducted as part of an Action Memorandum for Building 31 at the Lower Base, monitoring well water levels at a distance of approximately 100 feet from the Thames River were noted to fluctuate by 1.19 feet.

Due to the proximity of the site to the river, and the demonstrated influence of tides on groundwater levels near the river at the Lower Base, it is expected that tidal fluctuations of the river locally affect groundwater levels, at least in the western portion of the DRMO.

During low tide, the hydraulic gradient of the groundwater table at NSB-NLON is towards the Thames River and will result in the highest discharge rate of groundwater to the river. During high tide, the hydraulic gradient of the groundwater is reversed and flow occurs from the river to the site, temporarily halting the discharge of groundwater from the base to the river (B&R Environmental, March 1997).

No clear patterns for vertical groundwater flow are evident from the water level data. At well cluster 6MW2S/2D, an upward flow gradient was observed between the fill and terrace deposits during two of the three comprehensive water level measuring rounds. At cluster 6MW3S/3D, a downward gradient was observed between the fill and terrace deposits during two of the three measurement rounds. At cluster 6MW5S/5D, an upward gradient was observed between the bedrock and terrace deposits during two of three measurement rounds, while at cluster 6MW6S/6D, a downward gradient between the fill and bedrock was observed during all three water level rounds. Vertical gradients are expected to fluctuate significantly near the river, due to tidal fluctuations and the resulting impacts on groundwater levels. Shallow overburden groundwater levels are expected to vary in response to the tides, more than deeper groundwater, due to a more direct hydraulic connection between the shallow overburden and river in comparison to deeper groundwater flow zones.

Since the underlying clayey silt layer likely acts to minimize groundwater impacts from the DRMO to the deep river bottom and alluvial deposits, the groundwater flux from the DRMO to the river was calculated from the fill only. The average hydraulic conductivity of the fill materials was calculated by taking the geometric mean of DRMO-specific hydraulic conductivities (both Phase I RI and Phase II RI) for two wells completed within the fill materials. Hydraulic conductivities from Phase I RI well 6MW2S (70 ft/day) and from Phase II RI well 6MW7S (1.9 ft/day), were used for this calculation. The average hydraulic conductivity calculated for the fill material is 11.5 feet1day. Using Darcy's equation, the associated hydraulic discharge rate was calculated to be 1,666 cubic feet/day The actual discharge rate is likely to be substantially lower than this calculated rate, as tidal effects were not considered. During periods of high tide, groundwater discharge to the river is expected to be halted as gradients reverse and the river recharges the groundwater.

The groundwater is classified as GB. This classification applies to groundwater within a historically highly urbanized area or an area of intense industrial activity and where public water supply service is available.

Such groundwater may not be suitable for human consumption without treatment due to waste discharges, spills, or leaks of chemicals or land use impacts.

5.5 ECOLOGICAL HABITAT

The DRMO site is located in the northwestern section of NSB-NLON, adjacent to the Thames River. In the past, the southern half of the DRMO was covered with asphalt, most of which was deteriorated, while the northern portion was unpaved and had a gravel surface. The site was subsequently remediated in 1995, and a GCL cap was placed over a majority of the central and northern portions of the site (OHM, September 1995). Bituminous concrete pavement was then placed over the entire area of the composite cap as well as most other open areas of the site. This section of the NSB-NLON is very well-developed and is characterized by high human activity. Because of these conditions, the DRMO provides poor habitat for wildlife and, as previously mentioned, does not constitute a critical habitat for any endangered species.

However, the site lies within the floodplain of the Thames River, which flows past the site. Potential ecological receptors occur within the river system.

5.6 SUMMARY OF NATURE AND EXTENT OF CONTAMINATION

5.6.1 DRMO Soil

The soil analytical data are summarized in Table 5-1. Since soils excavated during the Time-Critical Removal Action are no longer present at the site, they are not included in Table 5-1 and are also excluded from the following discussion of the nature and extent of contamination at the site. The sample locations are shown on Figures 5-1 and 5-2.

Several volatile organic compounds (VOCs), including carbon disulfide, vinyl chloride, monocyclic aromatics, ketones, and several halogenated aliphatics, were detected in the surface and subsurface soils at this site.

Most VOCs were detected infrequently (seven of 73 total samples) and at relatively low concentrations (less than 20 Ig/kg), with the exception of a few subsurface soil samples. The subsurface sample from boring 6TB4 in the central portion of the site (6 to 8 feet deep) contained the following halogenated aliphatics:

1,12,2-tetrachloroethane (6,400 Ig/kg), 1,1,2-trichloroethane (590 Ig/kg), 1,2-dichloroethane (1,900 Ig/kg), 1,2-dichloroethene (16,000 Ig/kg), tetrachloroethene (210 Ig/kg), trichloroethene (7,100 Ig/kg), and vinyl chloride (1,300,Ig/kg). These compounds and their degradation products are typically used in degreasing operations. Their occurrence at such concentrations was limited to the sample collected from 6TB4, Xylenes (340 Ig/kg) and acetone (350 Ig/kg) were also detected in sample 6TB4. Xylenes (5,400 Ig/kg) and 4-methyl-2-pentanone (5,100 Ig/kg) were detected in a subsurface soil sample 6TBI7 (10 to 12 feet deep), located near the Thames River.

Several semivolatile organic compounds (SVOCs), including 4-methylphenol, benzoic acid, carbazole, chlorinated benzenes, phthalates, and polynuclear aromatic hydrocarbons (PAHs) were detected in DRMO soils. PAHs were the most prevalent class of chemicals observed in the soil at this site. Soil samples collected throughout the site contained PAHs. PAHs detected most frequently (e.g., pyrene, fluoranthene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene) are relatively insoluble. Soluble PAHs (e.g., naphthalene, 2-methylnaphthalene, dibenzofuran, acenaphthalene) were also detected but were much less prevalent. The presence of PAHs may be attributable to the placement of contaminated material during land filling activities that occurred prior to construction of the DRMO, or it could be related to releases of oily materials. The higher concentrations generally occurred in the soils surrounding the area excavated during the Time-Critical Removal Action. Maximum concentrations of most PAHs in surface soils were found in the sample collected during the Time-Critical Removal Action from location 45, along the excavation sidewalls approximately 100 feet north of Building 479 in the central portion of the site. Maximum concentrations of most PAHs in subsurface soils were found in a soil sample from boring 6TB17, located approximately 60 feet further north and 50 feet east of the Thames River.

Several pesticides and polychlorinated biphenyls (PCBs) (Aroclor-1254 and Aroclor-1260) were also detected in soil samples collected at the DRMO site. Pesticides/PCBs were detected more frequently and at higher concentrations in surface soils than in subsurface soils. For example, 4,4'-DDE, endrin, endrin aldehyde, and gamma-chlordane were the pesticides detected in subsurface soils; they were each detected in less than three of 17 subsurface samples at concentrations less than 6 mg/kg. The two Aroclors were detected in subsurface soils © max= 12,000 Ig/kg Aroclor-1260) and surface soils © max = 29,100 Ig/kg Aroclor-1260) at higher concentrations than the pesticides in surface soils.

A majority of the maximum concentrations of pesticides in the surface soil samples were found in samples from locations 74 and 77, collected during the Time-Critical Removal Action near the eastern border in the central portion of the site. Although several pesticides were detected in the surface soils, concentrations of pesticides were low relative to PCB concentrations. With the exception of 4,4'-DDD (227 Ig/kg) from location 74, all pesticide concentrations were less than 65 Ig/kg. Concentrations of Aroclor-1254 and Aroclor-1260, however, ranged up to 22,400 Ig/kg and 29,100 Ig/kg, respectively, in the surface soil samples. Concentrations of PCBs were generally highest in the soils surrounding the excavation area.

The subsurface sample collected from boring 6TB20 at a depth of 4 to 6 feet was the only sample analyzed for dioxins which was not excavated during the Time-Critical Removal Action. OCDD (3.07 Ig/kg), and 1,2,3,4,6,7,8-HpCDD (0.67 Ig/kg) were detected in this sample.

Concentrations of metals were generally higher in surface soils than in subsurface soils. Maximum concentrations of all metals detected in surface and subsurface samples exceeded NSB-NLON background with the exceptions of boron (in surface soils) and aluminum (in subsurface soils). Maximum concentrations of copper, lead, sodium, and zinc in both surface and subsurface soils, and of mercury and nickel in surface soils only, exceeded NSB-NLON background levels by more than two orders of magnitude. Maximum concentrations of metals in surface soils were found in various soil samples collected in the northern half of the DRMO site. A majority of the maximum concentrations of metals in subsurface samples were found in the sample collected at a depth of 10 to 12 feet from boring 6TB17, located approximately 50 feet east of the Thames River shoreline and 40 feet north of the originally paved portion of the site. Cyanide was also detected at concentrations less than 8 mg/kg in 27 of 56 surface soil samples and one subsurface soil sample (6TB20).

Barium, cadmium, chromium, lead, mercury, selenium, and silver were detected in the Toxicity Characteristics Leaching Procedure (TCLP) analytical results of surface soil samples. With the exception of mercury, these same metals were detected in TCLP analytical results of subsurface soil samples. The volatile organic compound 1,2-dichloroethane was also detected in the TCLP analysis of the subsurface soil sample from boring 6TB20. The maximum concentration of lead in surface soils exceeded the associated Federal Toxicity Characteristic regulatory level as shown on Table 5-1. All other inorganic concentrations are below Federal Toxicity Characteristic regulatory levels.

Two pavement samples were collected in the scrap yard of the DRMO. Aroclor-1248, Aroclor-1254, and Aroclor-1260 were detected in both samples at concentrations ranging from 171 Ig/kg to 388 Ig/kg. Maximum concentrations of all three Aroclors were found in the pavement sample from boring 19. Lead was also detected in both samples at concentrations of 10.6 mg/kg and 25.0 mg/kg from borings 19 and 20, respectively.

5.6.2 DRMO Groundwater

The analytical results for groundwater samples collected during the Phase I RI and Rounds 1 and 2 of the Phase II RI are summarized in Tables 5-2 through 5-4.

Limited organic contamination was noted in these samples. Trichloroethene, 1,1-dichloroethane, and 1,2 dichloroethene (total) were detected in from one to three shallow Phase I RI samples at concentrations of 8 Ig/L or less. Maximum concentrations were all found in the sample from well 6MW4S, located in the center of the scrap yard. These same chemicals were detected, each in one shallow well sample, at concentrations of 3 Ig/L or less during Round 1 of the Phase II RI. Carbon disulfide (3 Ig/L) and 1,2-dichloroethene (total) (2 Ig/L) were also each detected in one deep well sample during Round 1. During Round 2 of the Phase II RI, 1,2-dichloroethene (total), trichloroethene, and/or vinyl chloride were detected in the samples from two shallow wells (6GW3S and 6GW8S) at concentrations of 8 Ig/L or less. Trichloroethene (2 Ig/L) was detected in deep well sample 6GW6D.

Benzoic acid (21 Ig/L) and bis(2-ethylhexyl)phthalate (10 Ig/L) (detected in the sample from well 6MW5D, located northeast (upgradient) of the DRMO site) were the only SVOCs detected during the Phase I RI. Several phthalate esters, benzoic acid, and 1,4-dichlorobenzene were detected in groundwater samples during Round 1 of the Phase II RI; each was detected in only one sample at a concentration of 5 Ig/L or less. Two PAHs were also detected, each at 1 Ig/L, in the sample from deep well 6MW2D, located near the northwest corner of Building 355. Bis(2-ethylhexyl)phthalate and phenol (0.7 Ig/L and 3 Ig/L, respectively, in sample 6GW6D) were the only semivolatiles detected in Round 2 Phase II RI samples. No pesticides or PCBs were detected in any of the groundwater samples collected from the DRMO.

Maximum concentrations of most metals detected during the Phase I RI were found in the sample from shallow well 6MW4S, located in the center of the scrap yard. Since this well was later abandoned, no further data were available for well 6MW4S. Maximum concentrations of a majority of metals detected during the Phase II RI were found in samples from wells 6MW2S and 6MW2D, located near the northwest corner of Building 355. Concentrations of metals were generally higher in deep wells than in shallow wells. Notable concentrations of arsenic (maximum of 21 Ig/L in 6GW2D), lead (maximum of 52.7 Ig/L in 6GW2S), and manganese (maximum of 1,440 Ig/L in 6GW2D) were detected in groundwater samples.

Based on the levels of uncertainty reported with results (i.e. uncertainty levels are greater than results) for gross alpha in all samples for which gross alpha was analyzed, and for gross beta in samples 6MW2S and 6MW3S, gross alpha and gross beta were considered as not detected in these samples. With this in mind, gross beta was detected in shallow well samples at concentrations ranging from 6.3 pCi/L to 180 pCi/L and in the deep well sample 6MW5D at 3.1 pCi/L. Complete gamma spectrum analysis was performed only for samples from well 6MW1S collected during Rounds 1 and 2 of the Phase II RI. Only naturally occurring potassium-40 (140 pCi/L) was detected in the Round 2 Phase II RI sample from this well.

TABLE 5-1

SUMMARY OF SOIL ANALYTICAL RESULTS
DRMO, NSB-NLON GROTON, CONNECTICUT

Analyte	Surface Soils (<2 Feet) (1) Frequency of Detection	Concentration Range	Location of Maximum Detection	Subsurface Soils (>2 Feet) (2) Frequency of Detection	Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/kg)						
1,1,2,2-Tetrachloroethane	1/56	1.78	DRMO-35	1/17	6400	6TB4
1,1,2-Trichloroethane	0/56	-	ND(3)	1/17	590	6TB4
1,1 -Dichloroethane	3/56	1.38-6.25	DRMO-35	0/17	-	ND
1,1 -Dichloroethene	0/56		ND	1/17	13	6TB4
1,2-Dichloroethane	2/56	1.25-6.68	DRMO-40	2/17	79-1900	6TB4
1,2-Dichloroethene (total)	0/14	-	ND	2/17	2-16000	6TB4
2-Butanone	7/56	2.35-14.4	DRMO-40	0/17	-	ND
2-Hexanone	1/56	3.03	DRMO-42	0/17	-	ND
4-Methyl-2-pentanone	1/56	1.21	DRMO-42	1/17	5100	6TB17
Acetone	30/56	1.87-1630	DRMO-72	2/17	78-350	6TB4
Benzene	2/56	1.13-6.41	DRMO-40	1/17	7	6TB4
Carbon disulfide	4/56	1-5.37	DRMO-60	3/17	2-48	6TB4
Chloroethane	1/56	1.55	DRMO-35	0/17	-	ND
Chloroform	0/56	-	ND	1/17	14	6TB4
Ethylbenzene	3/56	1.22-9.07	DRMO-45	1/17	44	6TB4
Methylene chloride	39/56	2-427	DRMO-75	2/17	17-41	6TB16
Styrene	4/56	1.28-2.59	DRMO-35	0/17	-	ND
Tetrachloroet	12/56	1-14.7	DRMO-74	4/17	5-210	6TB4
Toluene	15/56	1-12.2	DRMO-36	3/17	1-43	6TB4
Trichloroethene	26/56	1-93.1	DRMO-44	6/17	1-7100	6TB4
Vinyl chloride	1/56	1.66	DRMO-35	1/17	1300	6TB4
Xylenes, total	10/56	0.992-29.7	DRMO-45	2/17	340-5400	6TB17
SEMIVOLATILE ORGANICS (ug/kg)						
1,2,4-Trichlorobenzene	2/56	4820-4940	DRM0-63	0/16	-	ND
1,3-Dichlorobenzene	1/56	1060	DRMO-35	0/16	-	ND

TABLE 5-1

SUMMARY OF SOIL ANALYTICAL RESULTS
DRMO, NSB-NLON GROTON CONNECTICUT

Analyte	Surface Soils (<2Feet)(1) Frequency of Detection	Surface Soils (<2Feet)(1) Concentration Range	Surface Soils (<2Feet)(1) Location of Maximum Detection	Subsurface Soils (>2Feet)(2) Frequency of Detection	Subsurface Soils (>2Feet)(2) Concentration Range	Subsurface Soils (>2Feet)(2) Location of Maximum Detection
2-Methylnaphthalene	8/56	48.7-8360	DRMO-67	4/16	42-44000	6TB17
4-Methylphenol	1/56	209	DRMO-54	1/16	790	6TB4
Acenaphthene	6/56	286-13700	DRMO-45	3/16	49-52000	6TB4
Acenaphthylene	11/56	286-13700	DRMO-45	1/16	89	6MW2
Anthracene	30/56	39-29300	DRMO-45	5/16	37-41000	6TB17
Benzo(a)anthracene	36/56	100-43700	DRMO-45	9/16	72-5000	6TB17
Benzo(a)pyrene	31/56	188-40600	DRMO-45	6/16	74-31000	6TB17
Benzo(b)flouranthene	36/56	150-786000	DRMO-45	10/16	24-39000	6TB17
Benzo(g,h,i)perylene	22/56	62.4-11000	DRMO-43	4/15	370-9400	6TB17
Benzo(k)fluoranthene	28/56	47-19400	DRMO-43	7/15	20-25000	6TB17
Benzoic acid	2/9	9300-12000	6SS3	2/10	32-220	6MW7S
Bis(2-ethylhexyl)phthalate	37/56	179-12500	DRMO-45	2/16	120-7700	6MW4
Butyl benzyl phthalate	1/56	423	DRMO-52	0/16	-	ND
Carbazole	9/47	46-14200	DRMO-45	1/8	26000	6TB17
Chrysene	37/56	93-47100	DRMO-45	11/16	100-4300	6TB17
Dibenzo(a,h)anthracene	1/56	1160	DRMO-37	1/15	130	6MW2
Dibenzofuran	6/56	82-14300	DRMO-45	1/16	46000	6TB17
Fluoranthene	42/56	66-95100	DRMO-45	11/16	36-100000	6TB17
Fluorene	9/56	214-19200	DRMO-45	3/16	66-70000	6TB17
Indeno(1,2,3-cd)pyrene	22/56	60.3-9290	DRMO-43	4/15	26-9800	6TB17
Naphthalene	6/56	228-23700	DRMO-45	2/16	6500-87000	6TB17
Phenanthrene	34/56	55-96900	DRMO-45	9/16	79-160000	6TB17
Pyrene	44/56	140-174000	DRMO-45	12/16	47-89000	6TB17
PESTICIDES/PCBs(ug/kg)						
4,4'-DDD	3/56	9.3-227	DRMO-74	0/17	-	ND
4,4'-DDE	3/56	10.5-35.9	DRMO-74	1/17	4.1	6TB9

TABLE 5-1

SUMMARY OF SOIL ANALYTICAL RESULTS
DRMO, NSB-NLON GROTON, CONNECTICUT

	Surface Soils (<2Feet)(1)			Subsurface Soils (>2Feet)(2)		
Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency Of Detection	Concentration Range	Location of Maximum Detection
4,4'-DDT	7/56	1.42-63.4	DRMO-74	0/17	-	ND
Aroclor-1254	36/56	75-22400	DRMO-72	3/17	72-440	6TB20
Aroclor-1260	33/56	120-29100	DRMO-35	6/17	110-12000	6TB2
Delta-BHC	1/56	5.09	DRMO-77	0/17	-	ND
Dieldrin	1/56	4.68	DRMO-77	0/17	-	ND
Endosulfan II	2/56	2.24-25.4	DRMO-74	0/17	-	ND
Endosulfan	2/56	28.0-37.9	DRMO-60	0/17	-	ND
Endrin	2/56	10.6-12.5	DRMO-77	1/17	4.4	6MW2D
Endrin aldehyde	4/47	2.56-6.06	DRMO-74	2/9	5.6-5.8	6TB9
Endrin ketone	3/56	3.21-31.9	DRMO-77	0/17	-	ND
Gamma-Chlordane	2/56	2.77-20.4	DRMO-74	1/17	2.5	6TB20
Heptachlor	5/56	0.96-20.7	DRMO-74	0/17	-	NO
DIOXINS(ug/kg)						
1,2,3,4,6,7,8-HpCDD	-	-	NA(4)	1/1	0.67	6TB20
OCDD	-	-	NA	1/1	3.07	6TB20
INORGANICS (mg/kg)						
Aluminum	56/56	2430-18900	DRMO-46	17/17	4880-12100	6TB16
Antimony	35/45	0.0249-134	DRMO-63	3/7	4.1-7	6MW3D
Arsenic	55/56	0.31-164	DRMO-75	17/17	1.1-7.5	6MW1
Barium	56/56	17.9-934	DRMO-40	17/17	28-212	6TB17
Beryllium	56/56	0.119-24.9	DRMO-36	14/17	0.22-16.8	6TB17
Boron	1/5	2.9	6TB11	4/9	15.6-96.2	6TB17
Cadmium	54/56	0.175-126	DRMO-40	12/17	0.45-6.4	6MW4
Calcium	56/56	500-16300	DRMO-48	17/17	981-21400	6TB17
Chromium	56/56	4.42-1210	DRMO-63	15/17	6.2-139	6MW4
Cobalt	54/56	1.69-179	DRMO-48	16/17	3.5-130	6TB17

TABLE 5-1

SUMMARY OF SOIL ANALYTICAL RESULTS
DRMO, NSB-NLON GROTON, CONNECTICUT

Analyte	Surface Soils (<2 Feet) (1)			Subsurface Soils (>2 Feet) (2)		
	Frequency of Detection	Concentrationl Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
Copper	56/56	6.37-8730	DRMO-49	17/17	10.6-4980	6TB17
Cyanide	27/56	0.0264-7.68	DRMO-69	1/14	0.15	6TB20
Iron	56/56	3590-103000	DRMO-48	17/17	6480-65800	6TB17
Lead	56/56	2.9-5980	DRMO-77	17/17	2.3-2140	6TB17
Magnesium	56/56	1080-7190	6SS3	17/17	1820-6670	6TB16
Manganese	56/56	56.7-1260	DRMO-40	17/17	126-673	6TB17
Mercury	55/56	0.0033-20.7	DRMO-46	9/15	0.12-0.78	6TB20
Nickel	56/56	608-6520	DRMO-48	17/17	6.5-374	6TB17
Potassium	56/56	608-6520	6SS3	17/17	1050-6280	6MW7S
Selenium	17/56	0.112-0.773	DRMO-40	2/17	1-5.3	6TB17
Silver	33/56	0.021-24.3	DRMO-63	0/17	-	ND
Sodium	53/56	41.2-4220	DRMO-78	16/17	117-5860	6TB4
Thallium	15/56	0.0145-0.64	6TB23	0/17	-	ND
Vanadium	56/56	6.26-368	DRMO-52	17/17	9-63.8	6MW4
Zinc	56/56	12.5-28300	6TI32	17/17	25.6-14900	6TB17
TCLP (mg/L)						
Barium (100.0)	10/10	0.18-1.4	6MW4	9/9	0.073-1.3	6MW4
Cadmium (1.0)	6/10	0.011-0.25	6MW4	3/9	0.019-0.087	6MW4
Chromium (5.0)	6/10	0.008-0.11	6TB2	4/9	0.0077-0.11	6MW5S
Lead (5.0)	6/10	0.11 -6.2	6SS3	3/9	0.2-0.87	6MW4
Mercury (0-2)	1/10	0.0077	6MW2	0/9	-	ND
Selenium (1.0)	1/10	0.1	6MW5S	1/9	0.1	6MW1
Silver (5.0)	5/10	0.0082-0.012	6TB1	2/9	0.01-0.029	6MW5S
1,2-Dichloroethane (0.5)(6)	0/1	-	ND	1/1	0.028	6TB20

TABLE 5-1

SUMMARY OF SOIL ANALYTICAL RESULTS
DRMO, NSB-NLON GROTON, CONNECTICUT
PAGE 5 OF 5

Analyte	Surface Soils (<2 Feet) (1)			Subsurface Soils (>2 Feet) (2)		
	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection
MISCELLANEOUS PARAMETERS						
Ash (%)	-	-	NA	2/2	81.4-85.8	6TB16
Cation ex. capacity (meq/100g	-	-	NA	2/2	9.3-21	6TB16
pH	-	-	NA	2/2	7.69-7.76	6TB20
Specific gravity (g/cm3)	-	-	NA	2/2	2.1-2.2	6TB20
Total organic carbon (mg/kg)	-	-	NA	3/3	600-8400	6TB20

NOTES:
1 Includes samples 6MW1 (0-2), 6MW2 (0-2),6TI38 (0-2)(field duplicate of 6MW2(0-2)),6MW4(0-2),6MW5S(0-2),6SS3, 6 duplicate of 6SS3)6SS4,6TBI(0-2).6TB2(0-2),6TB3(0-2),6TB8(0-1),6TB11(-02),6TB12(0-2),6TB20(0-1),6TB23(0-1), 16144-32,16144-35 through-55 16144-41 is a field duplicate of 16144-40),16144-56,16144-DUP (field duplicate of 16144-60, through-82) 17144-64 is a field duplicate of 16144-63, 16144-82 is a field duplicate of 16144-74). Maximum concentrations are used for the evaluation of field duplicates and are counted as one sample. Excavated samples are not included in the summary. Surface soil samples were collected during the Phase I RI (September to November 1990), the FFS (October 1993), and the Time Critical Removal Action (November to December 1994).
2 Includes samples 6MWI(4-6),6MW6(4-6)(field duplicate of 6MW1(4-6)),6MW2(2-4),6MW2D-0406,6MW3D-0406,6M 6MW5S(8-10),6MW7S-0709,6TB1(2-4),6TB2(2-4),6TB3(6-8),6TB4(6-8),6TB8(4-6),6TB9(2-4),6TB10(4-6),6TB16(16-18), 6TB16(8-10),6TB17(10-12),6TB37(10-12)(field duplicate of 6TB17(10-12)), and 6TB20(4-6). Maximum concentrations are used for evaluation of field duplicates and are counted as one sample. Excavated samples are not included in the summary. Subsurface soil samples were collected during the Phase I RI (September to October 1990), FFS (October 1993), and Phase
3 Not Detected.
4 Not Analyzed.
5 Values in parentheses represent Federal Toxicity Characteristic Regulatory Level (58 FR 46049)
6 NA - Not Applicable.

TABLE 5-2

SUMMARY OF PHASE I GROUNDWATER ANALYTICAL RESULTS (UNFILTERED)
DRMO, NSB-NLON GROTON, CONNECTICUT

Analyte	Shallow Wells (1) Frequency of Detection	Shallow Wells (1) Concentration Range	Shallow Wells (1) Location of Maximum Detection	Deep Wells (2) Frequency of Detection	Deep Wells (2) Concentration Range	Deep Wells (2) Location of Maximum Detection
VOLATILE ORGANICS (ug/L)						
1,1-Dichloroethane	1/5	2	6MW4S	0/1	-	ND(3)
1,2-Dichloroethene (total)	3/5	1-2	6MW4S	0/1	-	ND
Trichloroethene	3/5	1-8	6MW4S	0/1	-	ND
SEMIVOLATILE ORGANICS (ug/L)						
Benzoic acid	0/5	-	ND	1/1	21	6MW5D
Bis(2-ethylhexyl)phthalate	0/5	-	ND	1/1	10	6MW5D
INORGANICS (ug/L)						
Arsenic	3/5	3.35-18.6	6MW4S	0/1	-	ND
Barium	4/5	27.9-86.2	6MW4S	1/1	33.9	6MW5D
Cadmium	3/5	2.1-4	6MW4S	0/1	-	ND
Calcium	5/5	6970-1700001	6MW4S	1/1	10600	6MW5D
Copper	5/5	8-355	6MW4S	1/1	9.4	6MW5D
Iron	5/5	102-4880	6MW5S	0/1	-	ND
Lead	1/5	3.4	6MW5S	0/1	-	ND
Magnesium	5/5	1270-396000	6MW4S	1/1	1000	6MW5D
Manganese	5/5	20.1-1000	6MW5S	1/1	84.5	6MW5D
Mercury	5/5	-	ND	1/1	0.3	6MW5D
Nickel	2/5	11.7-23.2	6MW4S	0/1	-	ND
Potassium	5/5	3230-123000	6MW4S	1/1	3460	6MW5D
Selenium	4/5	9.9-23.5	6MW4S	0/1	-	ND
Sodium	5/5	7470-3350000	6MW4S	1/1	14600	6MW5D
Zinc	5/5	11.25-356	6MW4S	1/1	13.8	6MW5D

NOTES:
1 Includes samples 6MW1S,6MW2S,6MW3S,6MW6S(field duplicate of 6MW3S),6MW4S,and 6MW5S.
Duplicate sample results are averaged and counted as one sample.
2 Includes sample 6MW5D.
3 ND - Not Detected

TABLE 5-3

SUMMARY OF ROUND 1/PHASE II GROUNDWATER ANALYTICAL RESULTS
DRMO NSB-NLON GROTON, CONNECTICUT

	Shallow Wells (1)						Deep Wells(2)					
Analyte	Frequency Of Detection	Unfiltered Concentration Range	Location of Maximum Detection	Frequency of Detection	Filtered Concentration Range	Location of Maximum Detection	Frequency of Detection	Unfiltered Concentration Range	Location of Maximum Detection	Frequency of Detection	Filtered Concentratio Range	Location of Maximum Detection
VOLATILE ORGANICS												
1,1-Dichloroethane	1/6	3	6MW8S	-	-	NA (3)	0/3	-	ND(4)	-	-	NA
1,2-Dichloroetlmm (total)	1/6	1	6MW3S	-	-	NA	1/3	2	6MW3D	-	-	NA
Carbon disulfide	0/6	-	ND	-	-	NA	1/3	3	6MW2D	-	-	NA
Trichtoroeth	1/6	2	6MW3S	-	-	NA	0/3	-	ND	-	-	NA
SEMIVOLATILE ORGANICS												
1,4-Dichlorobenzene	1/5	0.5	6MW7S	-	-	NA	0/3	-	ND	-	-	NA
Benzo(g.h,i)perylene	0/5	-	ND	-	-	NA	1/3	1	6MW2D	-	-	NA
Benzoic acid	1/5	1	6MW3S	-	-	NA	0/3	-	ND	-	-	NA
Bis(2-ethylhexyl)phthalate	1/5	4	6MW7S	-	-	NA	0/3	-	ND	-	-	NA
Di-n-butyl phthalate	1/5	1	6MW3S	-	-	NA	0/3	-	ND	-	-	NA
Di-n-octyl phthalate	0/5	-	ND	-	-	NA	1/3	5	6MW3D	-	-	NA
Diethyl phthalate	1/5	2.5	6MW7S	-	-	NA	0/3	-	ND	-	-	NA
Dimethyl phthalate	1/5	0.9	6MW7S	-	-	NA	0/3	-	ND	-	-	NA
Indeno(1,2,3-cd)pyrene	0/5	-	ND	-	-	NA	1/3	1	6MW2D	-	-	NA
INORGANICS												
Aluminum	3/5	27.05-2090	6MW2S	0/5	-	ND	2/3	1140-19300	6MW2D	0/3	-	ND
Arsenic	2/5	2-4.3	6MW2S	1/5	4.2	6MW2S	1/3	15.6	6MW2D	0/3	-	ND
Barium	5/5	10.3-75.4	6MW6S	4/5	11.5-73.3	6MW6S	3/3	29.1-288	6MW3D	2/3	156-270	6MW3D
Boron	4/5	474.5-1560	6MW2S	4/5	483.5-1560	6MW2S	3/3	101-2370	6MW2D	3/3	89.8-2420	6MW2D
Cadmium	1/5	2.6	6MW6S	0/5	-	ND	0/3	-	ND	3/3	-	ND
Calcium	5/5	24700-140000	6MW2S	5/5	23900-140000	6MW2S	3/3	23400-274000	6MW3D	3/3	22600-275000	6MW3D
Chromiun	1/5	6.3	6MW2S	0/5	-	ND	1/3	47.6	6MW2D	1/3	3.2	6MW2D
Cobalt	0/5	-	ND	0/5	-	ND	2/3	4.6-14.3	6MW2D	0/3	-	ND
Copper	3/5	4.1-50.4	6MW2S	3/3	2-3.4	6MWIS	1/2	63.1	6MW2D	2/2	3.2-18	6MW3D
Iron	5/5	129-3170	6MW2S	2/5	144-536	6MW3S	3/3	6880-39400	6MW2D	3/3	2670-3990	6MW3D
Lead	3/5	1.6-52.7	6MW2S	0/5	-	ND	2/3	45.6-50.9	6MW2D	1/3	2.4	6MW3D
Magnesium	5/5	6890-411000	6MW2S	5/5	5630-411000	6MW2S	3/3	11000-729000	6MW3D	3/3	10900-726000	6MW3D
Manganese	4/5	14.3-602	6MW7S	4/5	5.5-606	6MW7S	3/3	852-1340	6MW2D	3/3	693-1060	6MW3D
Mecury	1/5	0.21	6MW2S	1/5	0.2	6MW1S	0/3	-	ND	0/3	-	ND
Nickel	0/5	-	ND	1/5	10.4	6MW3S	2/3	19.8-32.9	6MW2D	2/3	10.8-12.9	6MW3D
Potassium	5/5	4440-187000	6MW2S	5/5	4000-184000	6MW2S	3/3	7450-364000	6MW2D	3/3	6890-373000	6MW3D
Sodium	5/5	54100-3800000	6MW2S	5/5	5700-387000	6MW2S	3/3	87900-6490000	6MW3D	3/3	7400-750000	6MW3D

TABLE 5-3

SUMMARY OF ROUND 1/PHASE II GROUNDWATER ANALYTICAL RESULTS
DRMO NSB-NLON GROTON, CONNECTICUT

	Shallow Wells (1)						Deep Wells (2)					
Analyte	Frequency of Detection	Unfiltered Concentration Range	Location of Maximum Detection	Frequency of Detection	Filtered Concentratio Range	Location of Maximum Detection	Frequency of Detection	Unfiltered Concentration Range	Location of Maximum Detection	Frequency of Delection	Filtered Concentratio Range	Location of Maximum Detection
Vanadium	2/5	28-42.4	6MW2S	2/5	12.6-19.5	6MW3S	½	64.2	6MW2D	0/1	-	ND
Zinc	2/5	4.8-81.9	6MW2S	1/5	3.7	6MW1S	1/3	113	6MW2D	1/3	22.2	6MW3D
MISCELLANEOUS PARAMETERS												
BOD (mg/L) (5)	1/1	46.8	6MW3S	-	-	NA	-	-	NA	-	-	NA
COD (mg/L) (6)	1/1	198	6MW3S	-	-	NA	-	-	NA	-	-	NA
Hardness as CaC0 3(mg/	3/3	84-1600	6MW3S	-	-	NA	3/3	112-4800	6MW3D	-	-	NA
Total organic carbon(mg/	1/1	3.3	6MW3S	-	-	NA	-	-	NA	-	-	NA
Total phosphorus (mg/L)	1/1	0.73	6MW3S	-	-	NA	-	-	NA	-	-	NA
TSS (mg/L) (7)	1/1	8	6MW3S	-	-	NA	-	-	NA	-	-	NA
Oil & grease (mg/L)	1/1	700	6MW3S	-	-	NA	-	-	NA	-	-	NA

NOTES:

1 Includes samples 6GW1S,6GW2S, 6GW3S, 6GW6S, 6GW7S, 6GW7S-D (field duplicate of6GW7S), and 6GW8S. Duplicate sample results are averaged and counted as one sample.
2 Includes samples 6GW2D, 6GW3D, and 6GW6D
3 Not Analyzed.
4 Not Detected.
5 BOD - Biochemical Oxygen Demand.
6 COD - Chemical Oxygen Demand.
7 TSS - Total Suspended Solids.

TABLE 5-4

SUMMARY OF ROUND 2/PHASE II GROUNDWATER ANALYTICAL RESULTS
DRMO, NSB-NLON GROTON, CONNECTICUT

	Shallow Wells (1)						Deep Wells (2)					
Analyte	Frequency of Detection	Unfiltered Concentration Range	Location of Maximum Detection	Frequency Of Detection	Filtered Concentration Range	Location of Maximum Detection	Frequency Of Detection	Unflitered Concentration Range	Location of Maximum Detection	Frequency Of Detection	Filtered Concentration Range	Location of Maximum Detection
VOLATILE ORGANICS (ug/L)												
1,2-Dichloroethene(total)	2/6	2-8	6MW8S	-	-	NA 3	0/3	-	ND	-	-	NA
Trichloroethene	2/6	4-6	6MW3S	-	-	NA	1/3	2	6MW6D	-	-	NA
Vinyl chloride	1/6	5	6MW8S	-	-	NA	0/3	-	ND	-	-	NA
SEMIVOLATILE ORGANICS (ug/L)												
Bis(2-Ethylhexyl)phthlate	0/5	-	ND	-	-	NA	1/3	0.7	6MW2D	-	-	NA
phenol	0/5	-	ND	-	-	NA	1/3	3	6MW6D	-	-	NA
INORGANICS (ug/L)												
Aluminum	0/5	-	ND	1/5	327	6MW2S	2/3	88.85-806	6MW2D	0/3	-	ND
Antimony	0/3	-	ND	1/5	5.7	6MW3S	0/2	-	ND	0/3	-	ND
Arsenic	3/5	10-20	6MW1S	1/5	14	6MW2S	2/3	2.65-21	6MW2D	1/3	12	6MW2D
Barium	1/5	94.4	6MW7S	3/5	25.5-116	6MW7S	3/3	28.6-242	6MW3D	3/3	13.35-297	6MW3D
Beryllium	0/5	-	ND	0/5	-	ND	1/3	1	6MW3D	O/3	-	ND
Boron	4/5	1280-1880	6MW2S	4/5	1360-1940	6MW2S	3/3	87.4-2340	6MW2D	3/3	85.5-2410	6MW3D
Calcium	5/5	19300-176000	6MW2S	5/5	19200-178000	6MW2S	3/3	15150-268000	6MW3D	3/3	13400-326000	6MW3D
Colbalt	0/5	-	ND	1/5	3	6MW6D	1/3	11.6	6MW6D	1/3	3.5	6MW3D
Copper	3/5	4.7-6.8	6MW2S	2/5	4.8-31.9	6MW2D	1/3	9.7	6MW2D	2/3	5.2-21.2	6MW3D
Iron	5/5	8.7-235	6MW7S	4/5	5.7-361	6MW7S	3/3	5690-44550	6MW6D	3/3	67.55-14100	6MW3D
Magnesium	5/5	4610-538000	6MW2S	5/5	4370-602000	6MW1S	3/3	8490-949000	6MW3D			
Manganese	3/5	23-1010	6MW7S	4/5	1.2-1130	6MW7S	3/3	649-1440	6MW2D	3/3	18.65-1460	6MW3D
Nickel	0/5	-	ND	0/5	-	ND	1/3	24.1	6MW6D	1/3	17.5	6MW3D
Potassium	5/5	3010-210000	6MW2S	5/5	3220-224000	6MW2S	3/3	14500-313000	6MW2D	3/3	14500-317000	6MW2D
Sodium	5/5	50600-5160000	6MW2S	5/5	48200-5540000	6MW2S	3/3	09500-756000	6MW3D	3/3	10000-773000	6MW3D
Vanadium	1/4	7.6	6MW2S	2/4	4.9-5.1	6MW3S	1/2	5.45	6MW6D	1/2	3.1	6MW3D
Zinc	1/5	11	6MW7S	2/5	7.1-16.1	6MW1S	2/3	4.2-105	6MW6D	0/3	-	ND
MISCELLANOUS PARAMETERS												
Ammonia,as nitrogen(m	1/1	3.1	6MW3S	-	-	NA	-	-	NA	-	-	NA
COD (mg/L) (5)	1/1	312	6MW3S	-	-	NA	-	-	NA	-	-	NA
Hardness as CaCO 3(mg/	5/5	72-3150	6MW2S	-	-	NA	3/3	70-4700	6MW3D	-	-	NA
Total organic carbon (mg/	1/1	2.5	6MW3S	-	-	NA	-	-	6MW3D	-	-	NA

TABLE 5-4

SUMMARY OF ROUND 2/PHASE II GROUNDWATER ANALYTICAL RESULTS
DRMO, NSB-NLON GROTON, CONNECTICUT

	Shallow Wells (1)						Deep Wells (2)					
	Unfiltered			Filtered			Unfiltered			Filtered		
Analyte	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum Detection	Frequency of Detection	Concentration Range	Location of Maximum
Total phosphorus (mg/L)	1/1	1	6MW3S	-	-	NA	-	-	NA	-	-	NA
TSS (mg/L)(5)	1/1	1	6MW3S	-	-	NA	-	-	NA	-	-	NA
Oil & grease (ug/L)	1/1	500	6MW3S	-	-	NA	-	-	NA	-	-	NA

NOTES:
1 Includes samples 6GW1S-2, 6GW2S-2, 6GW3S-2, 6GW6S-2, 6GW7S-2, and 6GW8S-2.
2 Includes samples 6GW2D-2, 6GW3D-2, SGW6D-2, and 6GW6D-D-2 (field duplicate of 6GW6D-2). Duplicate sample results are averaged and counted as one sample.
3 Not Analyzed.
4 Not Detected.
5 COD - Chemical Oxygen Demand.
6 TSS - Total Suspended Solids.

5.6.3 DRMO Surface Water

A surface water sample was collected in the Thames River. No organic chemicals were detected in the surface water sample. Several metals were detected including aluminum, calcium, copper, iron, magnesium, manganese, potassium, selenium, sodium, and zinc. Based on the levels of uncertainty reported with the laboratory results (i.e., uncertainty levels are greater than results), gross alpha and gross beta were considered as not detected in this sample.

6.0 SUMMARY OF SITE RISKS

A baseline risk assessment provides the basis for taking action and indicates the exposure pathways that need to be addressed by the remedial action. It serves as the baseline indicating what risks could exist if no action were taken at the site. This section of the Interim ROD reports the results of the baseline risk assessment conducted for the site.

A human health and ecological risk assessment was performed to estimate the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminants in various media at DRMO. The human health risk assessment procedure followed the most recent guidance from the U.S. EPA (U.S. EPA, December 1989 and March 25, 1991) and regional guidance (U.S. EPA Region I, June 1989, August 1994, and August 1995). The ecological risk assessment used numerical criteria from regulatory-based standards and guidance provided by various government agencies in the U.S. and Canada against which contaminant concentrations were compared to arrive at quantitative risk levels. The ecological risk assessment also use U.S. EPA-approved methodology for estimating potential risks to terrestrial receptors via food-chain modeling.

The risk assessment followed a four step process: (1) conceptual model development and contaminant identification, which identified those chemicals which, given the specifics of the site, were of significant concern; (2) exposure assessment, which identified actual or potential exposure pathways, characterized the potentially exposed populations, and determined the extent of possible exposure; (3) toxicity assessment, which evaluated the type and magnitude of adverse health and ecological effects due to exposure to the contaminants; and (4) risk characterization, which integrated the three earlier steps to summarize the potential and actual non-carcinogenic (toxic) and carcinogenic (cancer causing) risks posed by contaminants at the site, and uncertainties inherent in the risk assessment process.

6.1 CONTAMINANT IDENTIFICATION

The chemicals evaluated for the DRMO are as follows:

Non-carcinogenic PAHs	Carcinogenic PAHs	PCBS (Aroclors 1260,1254 and hexachlorobiphenyl)
Other SVOCs (12 compounds: primarily phthalates and phenols	Pesticides 7 compounds and derivatives)	Inorganics (25 constituents)
BTEX Compounds (All BTEX compounds)	Chlorinated VOCs (13 compounds)	Other VOCs (9 compounds)

Notes: PAHs: Polynuclear Aromatic Hydrocarbons
PCBs: Polychlorinated Biphenyls
BTEX: Benzene, Toluene, Ethylbenzenes, and Xylenes
VOCs: Volatile Organic Compounds
SVOCs: Semivolatile Organic Compounds

Concentrations of detected chemicals were compared to benchmark concentrations for human health concern, especially the U.S. EPA Region III risk-based concentrations (RBCs). Those analytes with concentrations exceeding the benchmarks were selected as chemicals of concern (COCs). A similar process was carried out for ecological receptors using published ecological benchmarks.

Details of the COC selection process and exposure point concentrations are presented in the Phase II RI (B&R Environmental, March 1997).

COCs were selected by comparing the maximum concentrations to Region III residential soil screening levels. The list of potential COCs for soil at the DRMO consist of:

- VOCs: 1,1,2,2-tetrachloroethane and vinyl chloride.

- PAHs: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

- PCBs: Aroclors-1254 and -1260 and hexachlorobiphenyl

- Dioxins: 1,2,3,4,5,6,7,8-HpCDD and OCDD.

- Metals: antimony, arsenic, barium, beryllium, cadmium, chromium, lead, manganese, mercury, nickel, thallium, vanadium, and zinc.

Vinyl chloride, 1,1,2,2-tetrachloroethane, dibenz(a,h)anthracene, and dioxins were retained as COCs for the "all soil" (soil from depths of 0 to 10 feet) category only. Dioxins were not found at detectable levels in the surface soil samples.

Maximum soil detections were also compared to U.S. EPA's Soil Screening Levels (SSLs) for migration to groundwater in the Phase II RI. Maximum site concentrations exceeded SSLs (Generic SSLs, Soil Screening Guidance: U.S. EPA/540/R-95/128; May 1996) for antimony, arsenic, barium, cadmium, chromium, lead, mercury, nickel, silver, thallium, zinc, 1,1-dichloroethane, 1,2-dichloroethene (total), 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane, tetrachloroethene, vinyl chloride, methylene chloride, trichloroethene, 1,2,4-trichlorobenzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, carbazole, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, Aroclor-1254, Aroclor-1260, hexachlorobiphenyl, and dieldrin. These chemicals may migrate to groundwater and potentially impact water quality.

For groundwater, all data from both shallow and deep wells were used to identify potential COCs. The following chemicals were retained as COCs for this medium:

- Halogenated aliphatic hydrocarbons (1,2-dichloroethene, trichloroethene, and vinyl chloride).
- 1,4-Dichlorobenzene
- Bis(2-ethylhexyl)phthalate
- Indeno(1,2,3-cd)pyrene
- Metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, lead, manganese, selenium, and vanadium)

For screening purposes, concentrations of these chemicals were compared to Federal Maximum Contaminant Levels (MCLs). This comparison showed that maximum detections of trichloroethene, vinyl chloride, bis(2-ethylhexyl)phthalate, antimony, and lead exceeded primary MCLs. Antimony, which was not detected in the unfiltered samples, was selected as a COC in the Phase II RI because the concentration of this chemical in filtered sample 6GW3S exceeded the risk-based screening level.

Although groundwater COCs were identified in the Phase II RI as a concern, the human health risk assessment did not identify any chemicals in the groundwater as being of concern to potential human receptors because total risks for each exposure scenario were within acceptable U.S. EPA limits. Critical to this conclusion is the fact that the groundwater at this site is classified as GB, and is therefore not a drinking-water source. Groundwater concentrations were also compared to CTDEP's Surface Water Protection Criteria (SWPC) using a site-specific dilution factor that was considered appropriate for discharge of the groundwater to Thames River, and no COCs emerged from the comparison. Also, because there is no anticipated contact between potential ecological receptors and groundwater, no COCs were identified in the groundwater for ecological risks.

One site surface water sample, 6SW1. was collected during the Phase I RI. Aluminum, copper, iron, manganese, selenium, zinc, and several primary inorganic human nutrients were detected at varying concentrations in this sample. All detections were below the risk-based COC screening criteria for tap water ingestion and National Ambient Water Quality Criteria (NAWQC). No COCs were identified in the Phase II RI for surface water, indicating that potential exposure to this medium would result in minimal risks.

6.2 EXPOSURE ASSESSMENT

Based on information obtained through site visits, inspections, and discussions with personnel at the DRMO or those involved in future planning for the area, the following potential receptors were identified:

- Full-time employees exposed to surface soil up to a depth of 2.0 feet below ground surface (bgs)

- Construction workers exposed to all soil to a depth of 10 feet bgs ("all soil") and groundwater
- Older child trespassers exposed to surface soil up to a depth of 2.0 feet bgs
- Future residents exposed to all soil to a depth of 10 feet bgs
- Terrestrial vegetation, soil invertebrates, and terrestrial vertebrates exposed to surface soil

Note that the only current human receptor at this site is the full-time employee. Another potential current (albeit unlikely) receptor is an older child resident: of the base who might trespass on the site despite existing fencing and security. Currently, there are no significant ecological receptors at the site.

Although this future land use scenario is extremely unlikely, the possibility of the DRMO site being used for residential purposes was considered for the determination of human health risks. This was done because the DRMO site constitutes riverfront real estate and since traditionally this kind of property has been highly desirable for residential development such a future land use scenario cannot be completely ruled out. Under such a residential scenario, removal of the asphalt layer (either by artificial forces or natural degradation) could result in significant exposure of potential ecological receptors to surface soil.

Intake of each COC by each potential receptor (human or ecological) was estimated by incorporating site-specific soil concentrations into standard equations developed by the U.S. EPA (U.S. EPA, December 1989 and March 1991). The resulting intakes were expressed as milligrams of analyte per kilogram of body weight per day. The major assumptions about exposure frequency and duration are presented in the Phase II RI Report (B&R Environmental, March 1997).

6.3 TOXICITY ASSESSMENT

The toxicity assessment examines information concerning the potential human health effects and ecological effects from exposure to COCs. The toxicity assessment provides, for each COC, a qualitative review of potential human health effects and ecological effect and a quantitative estimate of the relationship between the magnitude(dose) and type of exposure and the severity and/or probability of human health effects. The toxicological evaluation involves a critical review and interpretation of toxicity data from epidemiological, clinical, animal, and in vitro studies, as well as structural-activity relationship assessments. The available toxicological data base is used by the U.S. EPA to derive cancer slope factors (CSFs) for carcinogenic effects and Reference Doses (RfDs) for noncarcinogenic effects. CSFs and RfDs are published by the U.S. EPA in references listed in the Phase II RI (B&R Environmental, March 1997). These toxicity values are integrated with the exposure assessment (intake) to characterize the potential for the occurance of adverse health effects.

The COCs for ecological receptors are selected based on the comparison between chemicals detected in the site media and predicted body burdens in concentrations greater than regulation-based criteria (such as ambient water quality criteria), ecotoxicological guidance provided by agencies such as U.S. EPA. the Ontario Ministry of the Environment (OME). Oakridge National laboratories (ORNL), National Oceanic and Atmospheric Administration (NOAA), etc. At the DRMO, all of the sources listed above were used, as quoted in Section 3.4 of the Phase II R (B&R Environmental, March 1997).

6.4 RISK CHARACTERIZATION

This section on risk characterization summarizes the results of the risk assessment from the Phase II RI (B&R Environmental, March 1997). Details are provided in the Phase II RI. The first part presents a summary of the human health risk characterization. The second part presents a summary of the ecological risk characterization.

<u>6.4.1 Summary of Human Health Risk Characterization</u>

Estimated exposure (intake) values were integrated with toxicity values (CSFs and RfDs) through a series of calculations, to develop Hazard Indices (HIs) and Incremental Cancer Risks (ICRs) for noncarcinogenic and carcinogenic risks, respectively. In order to determine if potentially significant risks exist for human receptors, quantitative estimates of risk were compared to "acceptable" levels of risk. Estimated HIs were compared to unity (1.0). Estimated ICRs were compared to the U.S. EPA target risk range of 1E-4 to 1E-6. According to State of Connecticut's Soil Remediation Regulations, direct exposure criteria to potential receptors do not apply because the soil is beneath a cap or pavement and is considered to be inaccessible, and the pollutant mobility criteria for protection of groundwater do not apply since the soil is located below the seasonal high water table.

<IMG SRC 98002B>

The following paragraphs summarize the estimated cumulative risks, and Table 6-1 presents a summary of the estimated risks. Both validated and unvalidated data were used in this risk assessment. Multiple potential receptor groups were considered for the DRMO including an older child trespasser, construction worker, future residents, and full-time employees. Carcinogenic risks, as quantified by lifetime Incremental Cancer Risks (ICRs), were compared to the U.S. EPA's target risk range of 1E-4 to 1E-6. Most cumulative ICRs were either less than 1E-6 or within the U.S. EPA's target risk range. An exception was a cumulative ICR of 1.4E-4 for residents under the Reasonable Maximum Exposure(RME) scenario which assumes exposure to maximum concentrations of contaminants. In this case, potential risks are attributable to ingestion of soil containing PAHs, PCBs, dioxins, arsenic, and beryllium, as well as dermal contact with PCBs and inhalation of fugitive dust containing chromium. In general, exposure to soil contributes the most to the cumulative cancer for at receptors. COCs for exposure to soil include PCBs (Aroclors), and PAHs [especially benzo(a)pyrene] with somewhat less risk from certain inorganic contaminants; (arsenic and beryllium).

Noncarcinogenic risks, as quantified by Hazard Indices (HIs), was compared to unity (1.0). For all receptors considered, the cumulative HIs under the RME scenario exceeded 1.0. HIs did not exceed unity for any receptor under, the Central Tendency Exposure (CTE) scenario which assumes exposure to average concentrations of contaminants. Most risks stem from ingestion of and dermal contact with soils. The majority of the risk is contributed by the PCBs. Most of the remaining risks are attributable to antimony, cadmium, and, to some extent, chromium in soil. Exposure to lead in the soil at the DRMO was addressed in the Phase II RI using the U.S. EPA IEUBK model for lead uptake from soil. Although the conclusion in the Phase II RI was that blood levels would be below the level of concern (Ig/dL) for a child receptor, higher soil concentrations (by over an order of magnitude) were detected in the unvalidated data from the confirmation sampling of the January 1995 time-critical removal action. The previously reported Phase II RI concentrations estimated blood lead levels of roughly half of the level of "concern" (10 Ig/dL). However, because of the higher levels of lead reported in the confirmation sampling data for the January 1995 time-critical removal action (which remains unvalidated) it is expected that the corresponding blood lead levels could be several times higher than the level of "concern" (10 Ig/dL), and therefore, it is now concluded that lead is a COC for the soil at the DRMO.

Table 6-2 identifies the complete list of human health COCs in surface and subsurface soils for the potential receptors of concern. This table presents a list of those contaminants that contributed under the RME to either a cumulative hazard index exceeding 1.0 of a cumulative ICR exceeding 1E-4 or both. The RME was chosen conservatively to be the potential exposure to receptors of concern for estimating remediation goals.

TABLE 6-2

SUMMARY OF HUMAN HEALTH COCs FOR REMEDIATION GOAL DEVELOPMENT
DRMO
NSB-NLON, GROTON, CONNECTICUT

Potential Human Receptor	COCS	
	Noncarcinogenic Effects	Carcinogenic Effects
Full-time Employee	Aroclors	None (1)
Construction Worker	Aroclors, Cadmium, and Hexachlorobiphenyl	None (1)
Older Child Trespasser	Aroclors	None (1)
Child/Adult Resident	Aroclors, Cadmium and Hexachlorobyiphenyl	Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Hexachlorobiphenyl, Arochlors, Dioxins, Arsenic, Beryllium and Chromium

Note:

1 No carcinogenic COCs were identified for these potential receptors because estimated cumulative ICRs were within the acceptable range of 1E-06 and 1E-04.

6.4.2 Remediation Goals for Human Health Protection

Using risk values based on the analyte concentrations with validated and unvalidated data and for "all soil" data from 0 to 10 feet bgs, remediation goals were calculated for the protection of potential human receptors at NSB-NLON. The COCs that require remediation goals are those presented in Table 6-2. Initially, all exposure pathways (considering all receptors, media, and routes of exposure) with Incremental Cancer Risks (ICRs) of more than 1E-06 and/or Hazard Indices (HIs) of more than 1.0 were identified. If the risk or hazard values approached these levels, the relevant scenarios were also included for initial consideration. For each scenario, individual chemicals which contributed at least 1E-6 to the ICR or 0.1 to the HI were selected. If the risk or hazard values approached these levels, the contributing chemicals were also included in the remediation goal calculations. Upon further consideration, the ICR level of 1E-4, established by U.S. EPA as representing an unacceptable risk, was used instead to initially screen potential cancer risks for development of remediation goals. No groundwater COCs were identified for human health protection, as discussed in Section 6.4.1.

The groundwater at this site is classified as GB quality, which implies that the groundwater is not suitable for human consumption without treatment, and where a public water supply from another source is available. Therefore, remediation goals were not developed for the protection human receptors from consumption of groundwater.

Site-specific remediation goals were calculated using the following equation:

Exposure Concentration/Calculated Risk Value = Remediation Goal/Desired Risk Level

Solving for the Remediation Goal, the equation becomes:

Remediation Goal = (Exposure Concentration) (Desired Risk Level)/Calculated Risk Value

For example, assuming that the total ICR (ingestion and dermal routes) for an employee exposed to Aroclors in surface soil was 1.86E-6 (B&R Environmental, March 1997) and that the soil concentration was 0.35 mg/kg, the remediation goal at the 1E-6 level would be calculated as follows:

Remediation Goal = (0.35 mg/kg) (1E-6)/1.86E-6 = 0.19 mg/kg

Remediation goal calculations are presented in Appendix A of the FS (B&R Environmental, September 1997) under Preliminary Remediation Goal calculations.

The final remediation goals for soil COCs were selected by identifying chemicals which contributed at least a 1E-06 risk to an overall ICR of more than 1E-4 and/or a major portion of an overall HI greater than 1.0. Typically the COCs for non-carcinogenic risk contributed an HQ approaching or greater than 1.0. The following remediation goals were developed for the COCs identified during the human health risk assessment:

Soil remediation goals For Full-Time Employee:

- Aroclors (1254 and 1260) 10 mg/kg

Soil remediation goals For Construction Worker:

- Aroclors (1254 and 1260) 6 mg/kg
- Cadmium 84 mg/kg

Soil remediation goals For Older Child Trespasser:

- Aroclors (1254 and 1260) 10 mg/kg

Soil remediation goals For Future Resident:

- Benzo(a)anthracene 2 mg/kg
- Benzo(a)pyrene 0.2 mg/kg
- Benzo(b)fluoranthene 2 mg/kg
- Dibenzo(a,h)anthracene 0.2 mg/kg
- Indeno(1,2,3-cd)pyrene 2 mg/kg
- Aroclors(1254 and 1260) 0.35 mg/kg
- Hexachlorobiphenyl 0.35 mg/kg
- Dioxins (HpCDD & OCDD) 0.00059 mg/kg
- Arsenic 0.96 mg/kg
- Beryllium 0.35 mg/kg
- Cadmium 67 mg/kg
- Chromium 11 mg/kg

6.4.3 Summary of Ecological Risk Assessment

An ecological risk assessment was performed for the DRMO during the Phase II RI following the procedures described in Section 3.4 of the Phase II RI report (B&R Environmental, March 1997). The ecological risk assessment for the DRMO began with an evaluation of contaminants in soils. Inorganic COCs were identified as those chemicals with average concentrations exceeding background concentrations and published benchmark values protective of terrestrial vegetation, soil invertebrates, the short-tailed shrew, and the red-tailed hawk. Organic COCs were identified as those chemicals where concentrations exceeded benchmark values. Potential risks to terrestrial vegetation, soil invertebrates, and terrestrial vertebrates were then evaluated. For each COC, the potential risks were estimated by dividing the soil concentration (maximums for RME and averages for CTE) by the benchmark values to arrive at Hazard Quotients (HQs). The HQs determined for this site are summarized in Tables 6-3 through 6-6. Chemicals associated with the DRMO were considered to represent a risk to receptors if the HQs exceeded 1.0. Total risks to terrestrial receptors are expressed in terms of Hazard Indices (His), which are a sum of chemical-specific HQs for each potential pathway of exposure. These risks to potential terrestrial receptors are summarized in Tables 6-5 and 6-6. Results of these comparisons indicate that terrestrial receptors are potentially at risk under both RME and CTE conditions.

The ecological risk assessment concluded that exposure to surface soils could adversely impact terrestrial ecological receptors, using highly conservative estimates. However, the DRMO does not provide a suitable ecological habitat (due to the presence of paving, buildings, cap, etc.), and actual risks to ecological receptors are likely to be much less than those calculated for this area. It is unlikely that ecological receptors will utilize this area, essentially eliminating the possibility that these receptors will be exposed to these chemicals. Furthermore, the presence of the cap effectively eliminates direct contact with soil at the site. When the current site conditions are factored into this evaluation, it is concluded that soil at the DRMO represents little potential risk to ecological receptors, If the cap is destroyed in the future due to artificial or natural forces, then there would be a potential risk to ecological receptors.

Sediment toxicity tests conducted during the Phase II RI, indicated that conditions at a sediment sampling point collected near the DRMO (EC-T3504) may adversely impact sensitive benthic macroinvertebrates. It is not known if contaminant migration from the DRMO is the cause of these conditions. The major ecological concern is potential future transport of contaminated soils or groundwater to the Thames River.

6.4.4 Remediation Goals for Protection of Ecological Receptors

Under the current land use the ecological receptor exposure risks for the DRMO are low. However, under a future land use scenario, removal of the asphalt cap could be anticipated allowing ecological receptors to be exposed to surface soil. Therefore, remediation goals for soil at the DRMO were derived from values presented in either the Area A Downstream/OBDA FS (B&R Environmental, July 1997) or the ORNL database (ORNL, 1996) of toxicological benchmarks for ecological risk assessment. The value for DDT/DDD was derived using a risk-based approach to calculate a site-specific value which is protective of terrestrial receptors such as the short-tailed shrew (B&R Environmental, July 1997). The remediation goal for zinc was based on a screening value determined to be protective of terrestrial plants (ORNL, 1996; Will and Suter, 1994). All other soil remediation goals presented were derived by ORNL and were chosen by comparing the ORNL benchmarks for plants, microorganisms, and earthworms in soils to calculate remediation goals for wildlife. The most conservative value was selected as the soil remediation goal (Efroymson et al., 1996). Remediation goals were only developed for COCs determined to contribute the major portion of the cumulative risk to the ecological receptors, as listed below:

- Aluminum 50 mg/kg (Efroymson, et al., 1996 (plant))
- Antimony 5 mg/kg (Efroymson, et al., 1996 (plant))
- Boron 0.5 mg/kg (Efroymson, et al., 1996 (plant))
- Cadmium 3 mg/kg (Efroymson, et al., 1996 (plant))
- Chromium 0.4 mg/kg (Efroymson, et al., 1996 (earthworm))
- Cobalt 20 mg/kg (Efroymson, et al., 1996 (plant))
- Copper 50 mg/kg (Efroymson, et al., 1996 (earthworm))
- Lead 50 mg/kg (Efroymson, et al., 1996 (plant)
- Mercury 0.128 mg/kg (Efroymsog, et al., 1996 (shrew))
- Silver 2 mg/kg (Efroymson, et al., 1996 (plant))
- Thallium 1 mg/kg (Efroymson,et al., 1996 (plant))
- Vanadium 2 mg/kg (Efroymson, et al., 1996 (plant))
- Zinc 50 mg/kg (Will and Suter, 1994 (plant))
- DDTR 5 mg/kg (B&R Environmental, July 1997 (shrew))

6.4.5 Remediation Goals for Protection of Surface Water

Contaminants present in the groundwater could migrate to the Thames River during tidally influenced fluctuation of water table elevations. Contaminants present in the vadose zone soil could also migrate via infiltration into the groundwater and periodic flooding (albeit at minimal levels because of the existing asphalt cap on site), followed by migration to the Thames River. Surface water protection criteria (SWPC) for contaminant levels in groundwater were developed using State of Connecticut Surface Water Criteria and a site-specific dilution factor that was estimated to be 100. Contaminant concentrations in the groundwater did not exceed these SWPCs; therefore, remediation goals were not developed for groundwater.

Remediation goals were developed for contaminants present in the soil that could potentially leach into the groundwater and enter the Thames River. An allowable soil value was calculated to be protective of the surface water by taking a ratio of the maximum SWPC divided by the Safe Drinking Water Act Maximum Contaminant Level (MCL) or a Health Base Limit (HBL) for SSL development and multiplying by the Federal pollutant mobility criteria (U.S. EPA, May 1996) adjusted by a site-specific dilution factor of 10. COCs for this scenario were identified when maximum concentrations exceeded these allowable values. The following are the allowable soil values (remediation goals) that were developed for the COCs identified in the soil to be protective of the surface water from contaminants leaching from the soil:

- Benzoic Acid 8.4 mg/kg
- Benzo(a)anthracene 27 mg/kg
- Benzo(a)pyrene 28 mg/kg
- Benzo(b)fluoranthene 75 mg/kg
- Barium 160 mg/kg
- Cadmium 48 mg/kg
- Chromium 209 mg/kg
- Silver 6.12 mg/kg
- Zinc 13,200 mg/kg
- Aroclors-1254/1260 0.38 mg/kg
- Hexachlorobiphenyl 0.38 mg/kg
- 4,4'-DDD 0.08 mg/kg

TABLE 6-3

**MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VEGETATION
BASED ON RME AND CTE EXPOSURE, DRMO
NSB-NLON, GROTON, CONNECTICUT**

Chemical of Concern	Hazard Quotient (RME)	Hazard Quotient (CTE)
Aluminum	2.0E+2	1.6E+2
Antimony	3.8E+0	1.5E+0
Boron	5.8E+0	3.3E+0
Cadmium	1.4E+0	1.0E+0
Chromium	2.8E+1	2.1E+1
Copper	2.9E+0	1.4E+0
Mercury	2.9E+0	1.3E+0
Silver	3.1E+0	Not Evaluated
Vanadium	1.7E+1	1.3E+1
Zinc	5.7E+2	4.5E+1

TABLE 6-4

**MAJOR CONTRIBUTORS TO RISK FOR SOIL INVERTEBRATES
BASED ON RME AND CTE EXPOSURE, DRMO
NSB-NLON, GROTON, CONNECTICUT**

Chemical of Concern	Hazard Quotient (RME)	Hazard Quotient (CTE)
Copper	9.7E+0	4.6E+0
Lead	7.7E+0	2.6E+0
Zinc	5.7E+0	Not Evaluated
Chromium	1.1E+0	Not Evaluated

TABLE 6-5

MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VERTEBRATES
RME SCENARIO, DRMO
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-tailed Shrew	Antimony	3.4E+2	37.4
	Vanadium	7.2E+1	7.9
	Zinc	2.4E+2	26.4
	Lead	5.6E+1	6.1
	All others	2.0E+2	22.2
	Total Receptor HI	9.2E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	4.7E+2	51.5
	Food	4.5E+2	48.5
	Water	0.0E+0	0.0
	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Red-tailed Hawk	Zinc	1.7E+2	88.9
	4,4'-DDT	3.3E+0	1.7
	Antimony	7.8E+0	4.2
	4,4'-DDD	2.8E+0	1.5
	All others	6.9E+1	3.7
	Total Receptor HI	1.9E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	5.9E+1	31.4
	Food	1.3E+2	68.6
	Water	0.0E+0	0.0

NOTES:

HI - Hazard Index
COC - Contaminant of Concern

TABLE 6-6

MAJOR CONTRIBUTORS TO RISK FOR TERRESTRIAL VERTEBRATES
CTE SCENARIO, DRMO
NSB-NLON, GROTON, CONNECTICUT

Receptor	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Short-Tailed Shrew	Antimony	1.4E+2	58.8
	Zinc	1.9E+1	8.2
	Lead	1.9E+1	8.1
	Thallium	1.9E+1	8.0
	All others	4.0E+1	16.9
	Total Receptor HI	2.4E+2	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	1.3E+2	56.5
	Food	1.0E+2	43.5
	Water	0.0E+0	0.0
	Chemicals of Concern	Total HI per COC for all Pathways	% Contribution of COC to Total Receptor HI
Red-Tailed Hawk	Zinc	1.3E+1	73.7
	Antimony	3.1E+0	17.5
	Thallium	7.0E-1	3.9
	Cobalt	4.0E-1	2.2
	All others	4.8E-1	2.7
	Total Receptor HI	1.8E+1	
	Pathway	Total HI per Pathway	% Contribution of Pathway to Total Receptor HI
	Soil	8.0E+0	44.6
	Food	9.9E+0	55.4
	Water	0.0E+0	0.0

NOTES:

HI - Hazard Index
COC - Contaminant of Concern

6.4.6 Discussion of Uncertainty Factors

Uncertainties in human health risk assessment arise from:

- Selection of COCs
- Exposure assessment
- Toxicological evaluation
- Risk characterization

Uncertainty in the selection of COCs is associated with the quality of the predictive data bases and the procedures used to include or exclude constituents as chemicals of concern.

Uncertainty associated with the exposure assessment is associated with the values used as input variables for a given intake route, the methods used and the assumptions made to determine exposure point concentrations, and the predictions regarding future land use and population characteristics.

Uncertainty in the toxicity assessment is associated with the quality of the existing data to support dose-response relationships, and the weight-of-evidence used for determining the carcinogenicity of chemicals of concern.

Uncertainty in risk characterization is associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier activities. For the purpose of this risk assessment, the use of unvalidated data adds considerable uncertainty because this new data shows higher contaminant concentrations, and therefore greater potential risks. However, since the data are unvalidated, it is not clear whether these greater potential risks reflect actual site conditions. Also, the exposure assessment assumes that surface soil is accessible to potential receptors, which is conservative because the entire site is paved, and it is likely to be maintained in paved condition in the foreseeable future.

While the procedures for human health risk assessment are somewhat standardized and consequently the uncertainty factors are controlled, the procedures for ecological risk assessment are less standardized. The following discussion summarizes these uncertainty factors and states the salient assumptions for ecological risk assessment (ERA).

In order to understand how useful or appropriate the results of the ERA are, the uncertainties associated with the assessment need to be considered. Uncertainties from fairly well-known sources, like errors in sampling and measurement, will affect the assessment. More serious uncertainties may stem from lesser-known sources, such as how available environmental contaminants are for uptake by exposed plants and animals, and how well toxicological studies on laboratory subjects relate to organisms in nature. A brief outline of the uncertainties in the ERA includes:

Sources of error or variability:

- Sampling and measurement
- Data handling and analysis

Incomplete knowledge of the relationship between measured contaminant concentrations and actual exposure to contaminants:

- Spatial and temporal factors (e.g.,lack of feeding in areas of highest or lowest contaminant concentrations)
- Availability of contaminants for uptake by organisms
- Transfer of contaminants in food chains

Incomplete knowledge of toxicology:

- Use of non-native organisms and unnatural situations in experiments
- Applicability of length of the experiment and the effects measured
- Effects of toxicant mixtures

For the most part, assumptions are made corresponding to uncertainties in the ERA. The following list of assumptions may help clarify the nature of the uncertainties:

Sampling and Data Handling

Errors in the design of the sampling program, performance of sampling, analytical measurement, data handling, and data analysis do not have a significant effect on the results of the ERA. Therefore, assumptions are not relevant to this aspect of the input.

Exposure

- Proportion of site size to individual's home range is an adequate exposure factor
- Animals are exposed throughout the year
- No degradation or loss of contaminants from system
- 100 percent of each contaminant is available for uptake by organisms
- Contaminant transfer from one level of a food chain to the next is adequately described by a single factor

Toxicology

- Experimental conditions apply adequately to those at DRMO
- Toxicants do not affect each others' actions via synergistic or antagonistic effects

6.5 CONCLUSION

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Interim ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

7.0 REMEDIAL ACTION OBJECTIVES AND DEVELOPMENT OF ALTERNATIVES

This section describes the remedial action objectives and the development of alternatives. Alternatives were developed in the FS for contaminated soil and groundwater to meet remedial action objectives for these media.

7.1 STATUTORY REQUIREMENTS/RESPONSE OBJECTIVES

Under its legal authorities, the U.S. Navy's primary responsibility at NPL sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including: a requirement that the U.S. Navy's remedial action, when complete, must comply with all federal and more stringent state environmental standards, requirements, criteria or limitations under an environmental or facility siting law, unless a waiver is granted; a requirement that the U.S. Navy select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a preference for remedies in which treatment that permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances is a principal element over remedies not involving such treatment. Remedial alternatives were developed to be consistent with these Congressional mandates.

Based on preliminary information relating to types of contaminants, environmental media of concern, and potential exposure pathways, RAOs were developed to aid in the development of alternatives. These remedial action objectives were developed to mitigate existing and future potential threats to public health and the environment. These remedial action objectives are as follows:

- Prevent exposure (unacceptable risk) to receptors under either a current industrial or future, although unlikely, residential land use scenario either through institutional controls and/or removal/treatment/disposal

- Prevent unacceptable risk to ecological receptors in the Thames River from potential migration of contaminants

ESTIMATED VOLUMES OF CONTAMINATED MEDIA

For remedial action purposes, preliminary volumes of contaminated media were estimated from samples that contained contaminants at concentration levels that exceeded Remediation Goals for current industrial land use and future residential land use. Based on the known extent of contamination, the following are the estimated areas and volumes of contaminated soil:

	Estimated Area (sq ft)	Average Depth (ft)	Estimated Volume (cu yd)
Current Industrial Land Use	11,230	6 to 10	3,150
Future Residential Land Use	105,800	6 to 10(1)	13,570

NOTES:

1 Depths include existing clean cover of 3 feet thickness from post-removal action backfill. A 1:1 sideslope is assumed for stability during excavation.

7.2 TECHNOLOGY SCREENING AND ALTERNATIVE DEVELOPMENT

CERCLA and the NCP have set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements, a list of potential technologies were screened for effectiveness, implementability, and cost in attaining the remedial action objectives for contaminated soil and groundwater. A range of alternatives were developed from the technologies that were retained from screening.

The FS developed a range of alternatives considering the CERCLA statutory preference for a treatment that reduces the toxicity, mobility, or volume of the hazardous substances. This range included an alternative that removes or destroys hazardous substances to the maximum extent feasible, eliminating or minimizing to the degree possible the need for long-term management. This range also included an alternative that removes the threat posed by the contaminated media at the site with little or no treatment onsite but disposes of the material at an offsite facility where the material would be managed in a manner that would minimize any risk of threat to human health or release to the environment. The range also includes an alternative that involves little or no treatment onsite but provides protection through engineering or institutional controls, and a no action alternative.

8.0 DESCRIPTION OF ALTERNATIVES

This section provides narrative summary of the alternatives that were evaluated in the FS (B&R Environmental, September 1997). The alternatives were as follows: (1) No Action, (2) Institutional Controls and Monitoring, (3) "Hot Spots" Excavation, Offsite Disposal, Institutional Controls, and Monitoring, (4) Alternative 4 - Excavation, Onsite Treatment (thermal desorption & fixation-solidification), and Offsite Disposal

8.1 ALTERNATIVE 1 - NO ACTION

No action is required for this alternative. This alternative is required by the National Contingency Plan (NCP) and is used as a baseline comparison with other alternatives. At the DRMO this alternative would still include the existing cap but with no maintenance of that cap. This alternative is typically not selected unless the risks of doing nothing are acceptable to human health and environment. At this site the No Action alternative would result in contamination being left in place which would be a continued threat to human health and the environment.

This alternative would not comply with the following key Applicable or Relevant or Appropriate Requirements (ARARs):

- Connecticut Department of Environmental Protection (CTDEP) Remediation Standard Regulations (direct exposure criteria would be applicable in the future if the existing cap deteriorates and the contaminated soil is no longer considered "inaccessible.")

- Federal Executive Order regarding Floodplain Management (applicable because the site is within the 100 year flood plain of Thames River)

- Federal Coastal Zone Management Act (applicable because the site is present in a coastal zone)

There are no costs associated with this alternative.

8.2 ALTERNATIVE 2 - INSTITUTIONAL CONTROLS AND MONITORING

Alternative 2 would consist of two major components in addition to the existing cap: (1) institutional controls and (2) monitoring.

Institutional controls would include maintenance of the existing cap and implementation of limits to site access and land use restrictions. These controls would eliminate or reduce pathways of exposure to contaminants at the site.

Monitoring would include regular groundwater sampling and analysis in accordance with the Groundwater Monitoring Plan (B&R Environmental, October 1997). If groundwater COCs concentrations are shown to exceed site-specific Surface Water Protection Criteria (SWPC), and Volatilization Criteria, the scope of this monitoring would be expanded to include surface water and river sediment sampling and analysis to determine if COCs are migrating from the DRMO to the Thames River and if additional action is required. Finally, monitoring would include 5-year reviews for the life of the project, i.e., 30 years.

This alternative would comply with the location-specific Applicable or Relevant or Appropriate Requirements, particularly:

- Executive Order regarding Floodplain Management (applicable because the site is within the 100 year flood plain of Thames River)
- Coastal Zone Management Act (applicable because the site is present in a coastal zone)

This alternative would comply with chemical specific ARARs and TBCs, particularly the direct exposure criteria under the State of Connecticut's Remedial Standards for soils.

Estimated Time for Construction:	Minimal
Capital Cost:	$90,800
Operating and Maintenance Cost:	$618,000 (total for 30 years)
Total Cost (as present worth):	$708,000

8.3 ALTERNATIVE 3 - "HOT SPOTS" EXCAVATION, OFFSITE DISPOSAL, INSTITUTIONAL CONTROLS, AND MONITORING

Alternative 3 would consist of four major components in addition to the existing cap: (1) excavation of contaminated soil "hot spots" with dewatering of wet soil and repair and restoration of the existing cap, (2) offsite disposal of excavated soil, (3) institutional controls, and (4) monitoring.

Soil contaminated with Contaminants of Concern (COCs) at concentrations exceeding industrial land use remediation goals would be excavated, dewatered on site as required, and disposed of at an offsite RCRA hazardous waste Treatment/Storage/Disposal (TSD) facility. Clean soil from an offsite borrow source would be backfilled in the excavated areas. The excess water present in the soil excavated from the saturated zone would be drained and the wastewater treated onsite at a Dewatering/Wastewater Treatment (DW/WWT) plant that would be constructed on site, followed by discharge to Thames River.

Institutional controls and monitoring would be identical to those for Alternative 2.

This alternative would comply with location-specific ARARs, particularly:

- Federal Executive Order regarding Floodplain Management (applicable because the site is within the 100 year flood plain of Thames River)

- Federal and State of Connecticut Coastal Zone Management Act (applicable because the site is present in a coastal zone)

This alternative would comply with chemical specific ARARs and TBCs, particularly the direct exposure criteria under the State of Connecticut's Remediation Standards for soil.

This alternative would also comply with action-specific ARARS with regard to excavation, dewatering, and offsite disposal, particularly:

- Federal Clean Air Act: National Emission Standards for Hazardous Air Pollutants (NESHAPs) applicable to control of fugitive dust emissions during excavation, handling, and transportation)

- Federal Air Pollution Control: Stationary Sources, Control of Particulate Emissions and Control of Odors (applicable to control of fugitive dust emission, particulate emissions and odors during excavation, handling and transportation)

- State of Connecticut's Hazardous Waste Management: Generator and Handier Requirements-General Standards, Listing and Identification (applicable to determining hazardous characteristics of excavated waste)

- State of Connecticut's Hazardous Waste Management: Treatment/Storage/Disposal Facility (TSDF) Standards (applicable to temporary storage and dewatering of excavated soil that is determined to be hazardous by characteristic)

- State of Connecticut's Solid Waste Management Regulations (applicable to closure of site remaining after excavation of "hot spots")

- State of Connecticut's Disposition of PCBs (applicable to disposal of excavated soil containing PCBs at levels exceeding remedial goals)

- State of Connecticut's Water Pollution Control and Water Quality Standards (applicable to discharge of treated water from dewatering of excavated soil)

Estimated Time for Construction:	5 months
Capital Cost:	$4,363,000
Operating and Maintenance Cost:	$ 618, 000 (total for 30 years)
Total Cost (as present worth):	$4,981,000

8.4 ALTERNATIVE 4 - EXCAVATION, ONSITE TREATMENT (THERMAL DESORPTION & FIXATION-SOLIDIFICATION), AND OFFSITE DISPOSAL

Alternative 4 would consist of three major components: (1) excavation with dewatering of wet soil, (2) on site treatment of excavated soil, and (3) offsite disposal of treated soil.

Soil contaminated with COCs at concentrations exceeding residential land use, ecological, and surface water protection remediation goals would be excavated. Wet excavated soil would be dewatered on site if necessary. The excess water from the excavated saturated zone soil would be drained and the wastewater treated onsite at a DW/WWT plant and discharged to Thames River, as noted under Alternative 3.

Excavated soil would be treated on site using a combination of thermal desorption to remove and destroy organic COCs and chemical fixation-solidification to immobilize inorganic COCs. High-temperature thermal desorption would remove organic contaminants through volatilization and subsequent treatment and destruction of these volatilized contaminants. As required, the thermally treated soil would then undergo chemical fixation-solidification to bind inorganic contaminants with the soil in a leach-resistant matrix. Prior to thermal desorption, excavated soil would be pre-treated by size separation and/or crushing-grinding-shredding, if necessary.

Following on site treatment, the soil would be disposed of at an offsite solid waste disposal facility. Clean soil from an offsite borrow area would be backfilled into the excavated areas.

This alternative would comply with location- specific ARARs, particularly:

- Federal Executive Order regarding Floodplain Management (applicable because the site is within the 100 year flood plain of Thames River)

- Federal and State of Connecticut's Coastal Zone Management Act (applicable because the site is present in a coastal zone)

This alternative would comply with chemical specific ARARs and TBCs, particularly the direct exposure criteria under the State of Connecticut's Remediation Standards for soil.

This alternative would also comply with action-specific ARARS with regard to excavation, onsite treatment and offsite disposal, particularly:

- Federal Clean Air Act: National Emission Standards for Hazardous Air Pollutants (NESHAPs) applicable to control of fugitive dust emissions during excavation, handling, treatment, and transportation and applicable to control of emissions from thermal desorption)

- Federal Air Pollution Control: Stationary Sources, Control of Particulate Emissions, Control of Organic Compounds Emissions and Control of Odors (applicable to control of fugitive dust emission, particulate emissions and odors during excavation, handling, treatment, and transportation, and applicable to control of emissions from thermal desorption)

- State of Connecticut's Hazardous Waste Management: Generator and Hand'er Requirements-General Standards, Listing & Identification (applicable to determining hazardous characteristics of excavated waste)

- State of Connecticut's Hazardous Waste Management: Land Disposal Restrictions (applicable to deriving treatment standards for excavated soil that is determined to be hazardous by characteristic)

- State of Connecticut's Hazardous Waste Management: TSDF Standards (applicable to temporary storage and treatment of excavated soil that is determined to be hazardous by characteristic)

- Federal Resource Conservation and Recovery Act: Treatment Standards for Hazardous Debris-Thermal Desorption (applicable to treatment of excavated soil that is determined to be hazardous by characteristic)

- State of Connecticut's Solid Waste Management Regulations (applicable to closure of site after excavation of soil contaminated at levels exceeding remediation goals)

- State of Connecticut's Disposition of PCBs (applicable to treatment and disposal of excavated soil containing PCBs at levels exceeding remedial goals)

- State of Connecticut's Water Pollution Control and Water Quality Standards (applicable to discharge of treated water from dewatering of excavated soil)

Estimated Time for Construction:	7 months
Capital Cost:	$ 16,129,000
Operating and Maintenance Cost	$ 0
Total Cost (as present worth):	$ 16,129,000

9.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 121(b)(1) of CERCLA presents several factors that, at a minimum, the U.S. Navy is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives.

9.1 EVALUATION CRITERIA USED FOR DETAILED ANALYSIS

A detailed analysis was performed on the alternatives using the nine evaluation criteria in order to select an interim site remedy. Section 9.2 contains a summary of the comparison of each alternative's strengths and weaknesses with respect to the nine evaluation criteria. These criteria are summarized in Subsection 9.1.1 through 9.1.3.

9.1.1 Threshold Criteria

The two threshold criteria described below must be met in order for the alternatives to be eligible for selection in accordance with the NCP.

- Overall protection of human health and the environment addresses whether a remedy provides adequate protection to human health and the environment, in both short term and long term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposure.

- Compliance with ARARs addresses whether a remedy attains applicable or relevant and appropriate requirements under Federal environmental laws and state environmental and facility siting laws or provide grounds for involving a waiver.

9.1.2 Primary Balancing Criteria

The following five criteria are utilized to compare and evaluate the elements of one alternative to another that meet the threshold criteria.

Long-term effectiveness and permanence addresses the criteria that are utilized to assess alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

- Reduction of toxicity, mobility, or volume through treatment addresses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the site.

- Short-term effectiveness addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

- Implementability addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

- Cost includes estimated capital costs (indirect and direct) and annual operating & maintenance (O&M) costs, as well as present-worth costs.

9.1.3 Modifying Criteria

The modifying criteria are used on the final evaluation of remedial alternatives generally after the U.S. Navy has received public comment on the RI/FS and Proposed Plan.

- State acceptance addresses the state's position and key concerns related to the preferred alternative and other alternatives, and the state's comments on ARARs and to be considered (TBC) criteria or the proposed use of waivers.

- Community acceptance addresses the public's general response to the alternatives described in the Proposed Plan and RI/FS report.

9.2 COMPARATIVE ANALYSIS OF ALTERNATIVES BY CATEGORY

9.2.1 Overall Protection of Health and Environment

Alternative 1 would provide some protection of human health and the environment because of the existing cap. However, since the cap would not be maintained, this protection would be limited. Also, since no monitoring would be performed, potential contaminant migration to groundwater and to the Thames River would not be detected in time for appropriate action.

Alternative 2 would be protective of human health and the environment. Institutional controls would be protective because the existing cap would be maintained, site access would be restricted, and the DRMO would be kept in its current industrial function, all of which would minimize human health and ecological risks from direct exposure to contaminated soil under the current land use scenario. Maintenance of the cap would also minimize infiltration through the contaminated vadose zone soil and thereby, minimize potential contaminant migration. Monitoring would be protective as it would detect potential migration of soil contaminants to the Thames River which could adversely impact ecological receptors in that river or to groundwater.

Alternative 3 would be more protective than Alternative 2 since, in addition to institutional controls and monitoring, soil "hot spots" (i.e., soil contaminated above industrial land use remediation goals) would be removed from the site and disposed of at an offsite RCRA hazardous waste TSD facility. Although complete verification sampling would not be feasible because of the presence of sheet piling and water in most excavated areas, this removal and disposal would virtually eliminate unacceptable human health risk from direct exposure to contaminated soil under the current industrial land use scenario. Removal and disposal of soil "hot spots" would also be protective of ecological receptors in the Thames River by significantly reducing the possibility that contaminants would migrate from the DRMO soil to that river.

Alternative 4 would be the most protective of human health and the environment. All soil contaminated above residential land use, ecological, and surface water protection remediation goals would be excavated, treated on site to irreversibly remove and destroy organic COCs and immobilize inorganic COCs, and disposed of at an offsite solid waste disposal facility. Although the existing cap would be removed and not replaced and complete verification sampling would not be feasible because of the presence of sheet piling and water in most excavated areas, these actions would virtually eliminate unacceptable risks to human and ecological receptors from direct exposure to soil under all scenarios. These actions would also be protective of ecological receptors in the Thames River since the sources of potential contaminant migration to that river from the DRMO soil would no longer exist.

9.2.2 Compliance with ARARs and TBCs

Alternative 1 would not comply with chemical-specific and location-specific ARARs. No action-specific ARARs or TBCs apply to this alternative.

Alternatives 2 , 3, and 4 would comply with chemical-specific, location-specific, and action-specific ARARs and TBCs. These alternatives would comply with the CTDEP Remediation Standard Regulations by either minimizing exposure or removing the contaminants from the site. These alternatives would also comply with the Executive Order regarding Floodplain Management and the Coastal Zone Management Act.

In addition to these location-specific ARARs, Alternative 2 would also comply with action-specific ARARs corresponding to monitoring well placement, and handling/storage/disposal of any hazardous waste or PCB-contaminated waste that may be generated during well placement, Alternatives 3 and 4 would also comply with action-specific ARARs corresponding to fugitive dust emissions controls, water pollution control and water quality standards, hazardous waste management, TSDF standards, and PCBs disposition for excavation/dewatering and storage/disposal of wastes. Alternative 4 would also comply with RCRA standards for thermal desorption treatment.

9.2.3 Long-term Effectiveness and Permanence

Alternative 1 would have very limited long-term effectiveness and permanence because all contaminated soil would remain on site, and the existing cap would not be maintained. Therefore, as the existing cap deteriorates over time, an unacceptable risk (HI > 1.0) could develop for site workers from direct exposure to contaminated soil. As there would be no institutional controls to limit site access or prevent residential development, the potential would also exist for unacceptable risk to develop for trespassers (HI > 1.0) and possible future resident (HI > 1.0 and ICR > 1E-4). Residential development of the DRMO could also result in unacceptable risk to a correspondingly increased population of ecological receptors from exposure to contaminated surface soil. Since there would be no monitoring, potential impact to the groundwater and to the Thames River from possible migration of contaminants from soil would not be detected in time for appropriate remedial action,

Alternative 2 would be long-term effective, Institutional controls, including maintenance of the existing cap, limits to site access, and land use restrictions, would effectively minimize risks from direct exposure of human and ecological receptors to contaminated soil. Long-term monitoring would be effective for the detection of potential migration of soil contaminants to the Thames River which could adversely impact ecological receptors in that river.

Alternative 3 would provide better long-term effectiveness than Alternative 2 since, in addition to institutional controls and monitoring, it would include removal and offsite disposal of soil "hot spots". Although complete verification sampling would not be feasible because of the presence of sheet piling and water in most excavated areas, these remedial actions would effectively eliminate unacceptable human health risk from direct exposure to soil contaminated above industrial land use remediation goals. These remedial actions would also effectively reduce the potential for soil contaminants to migrate to the Thames River, which could adversely impact ecological receptors in that river.

Alternative 4 would offer the best long-term effectiveness. All soil contaminated above residential land use, ecological, and surface water protection remediation goals would be excavated, treated on site to irreversibly remove and destroy organic COCs and immobilize inorganic COCs, and disposed of at an offsite solid waste disposal facility. Although complete verification sampling would not be feasible because of the presence of sheet piling and water in most excavated areas, these remedial actions would effectively eliminate unacceptable risks to human and ecological receptors from direct exposure to soil under all land use scenarios. These remedial actions would also effectively eliminate the potential for soil contaminants to migrate to the Thames River, which could adversely impact ecological receptors in that river.

9.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 1 and 2 would not achieve any reduction of toxicity, mobility, or volume of contaminants through treatment.

Alternative 3 would achieve a slight reduction in contaminant toxicity and volume through the on site treatment of the drainage water from the wet excavated soil by the granular activated carbon (GAC) adsorption unit of the DW/WWT facility. Because the GAC would ultimately be either thermally regenerated or destroyed by incineration, the achieved reduction in contaminant toxicity and volume would be 100-percent irreversible.

Alternative 4 would significantly reduce contaminant toxicity, mobility, and volume through treatment. On site thermal desorption would remove 90 percent or more of organic COCs in a 100 percent irreversible way. On site chemical fixation-solidification would immobilize inorganic COCs in an almost completely irreversible way. However, chemical fixation-stabilization may also increase volume of treated soil by 10 to 15 percent. As Alternative 3, Alternative 4 would also achieve a slight, 100-percent irreversible, reduction in contaminant toxicity and volume through the on site treatment of the drainage water from the wet excavated soli by the GAC adsorption unit of the DW/WWT facility.

9.2.5 Short-term Effectiveness

Implementation of Alternative 1 would not result in risks to site workers or adversely impact the surrounding community or environment since no remedial activities would be performed. Alternative 1 would never achieve the remedial action objectives (RAOs).

Implementation of Alternative 2 would result in a slight possibility of exposing site workers to contaminated soil during the maintenance of the existing cap and fence and to contaminated soil and groundwater during the construction of new groundwater monitoring wells and the maintenance and sampling of the new and existing wells. However, these risks of exposure would be effectively controlled by wearing of appropriate PPE and compliance with proper site-specific health and safety procedures. Implementation of Alternative 2 would not adversely impact the surrounding community and environment. Alternative 2 would immediately achieve the RAOs. However, continued achievement of the RAO for protection of ecological receptors in the Thames River would have to be regularly verified through monitoring.

Implementation of Alternatives 3 and 4 would result in a significant possibility of exposing construction workers to contaminated soil and groundwater during the excavation, dewatering, and offsite transportation activities. Implementation of Alternative 4 would also result in an added possibility of exposing construction workers to contaminated soil and offgas emissions during the thermal desorption and chemical fixation-solidification activities. However, all these risks of exposure would be effectively controlled by the implementation of engineering controls (e.g., dust suppression, offgas treatment), by the wearing of appropriate PPE, and by compliance with applicable OSHA regulations and proper site-specific health and safety procedures. Implementation of Alternative 3 could have some impact on the surrounding community and environment because of the potential for release of fugitive dust and spillage of contaminated soil during excavation and offsite transportation. However, this impact would be adequately controlled through the implementation of appropriate procedures, such as perimeter air monitoring, spill prevention, and erosion and sedimentation controls. Implementation of Alternative 4 could have a slightly greater impact than Alternative 3 on the surrounding community and environment because of the added risk of exposure to offgas from the thermal desorption unit. However, this possible incremental impact would also be adequately controlled through offgas treatment. Alternative 3 would achieve the RAOs in 5 months but continued achievement of the RAO for protection of ecological receptors in the Thames River would have to be regularly verified through monitoring: Alternative 4 would achieve the RAOs in 7 months.

9.2.6 Implementabillity

There would be no remedial action to implement under Alternative 1.

Alternative 2 would be simple to implement. Maintenance of the existing cap and fence, posting of notices, and institution of land use restrictions as part of the institutional controls component are all relatively simple tasks which could be readily accomplished. Installation of new wells, maintenance and sampling of new and existing wells, and performance of 5-year reviews as part of the monitoring component could also be readily accomplished. Resources, equipment, and materials are available for all of these tasks. The administrative implementability of institutional controls and monitoring would also be simple as long as the DRMO stays under the Navy control but, even in the unlikely event that this would change, adequate provisions could be relatively easily incorporated in any property transfer documents to insure continuation of these controls and monitoring under civilian ownership.

Alternative 3 would be significantly more difficult to implement than Alternative 2. This alternative would require excavation of non-cohesive soil (i.e., sand and gravel) to a depth of up to 10 feet bgs, which is well below the groundwater table. This would raise two significant implementability concerns. First, the excavated areas would have to be extensively shored with sheet piling and, second, water would have to be allowed to accumulate within the excavated areas, which would significantly hinder excavation efficiency. These concerns aside, excavation could be performed with normal construction equipment which is readily available. Installation and operation of a DW/WWT facility for the onsite dewatering of wet soil and treatment of drainage water could be implemented with readily available resources, equipment, and material. Offsite disposal of excavated soil would be readily implementable since permitted RCRA hazardous waste TSD facilities with adequate capacity are available to receive this kind of waste material. The institutional controls and monitoring components of Alternative 3 would be identical to and as readily implementable as those of Alternative 2. The administrative implementability of Alternative 3 would be very similar to that of Alternative 2 with the difference that the proper State agencies would have to be consulted to determine treatment criteria for discharge of the drainage water to the Thames River and that offsite disposal of excavated soil would have to meet all applicable RCRA regulations, including manifesting of the shipments of excavated soil. Both of these additional administrative requirements could readily be accomplished.

Alternative 4 would be the most difficult to implement. The significant concerns about implementability of the excavation component of this alternative would be identical to those of the same component for Alternative 3. As with Alternative 3, onsite dewatering of wet soil and treatment of the drainage water would be readily implementable. For the onsite treatment component, although thermal desorption services are readily available, the number of contractors with experience for treatment of PCB contaminated waste may be relatively limited. The balance of the on site treatment component would be easily implementable since experienced chemical fixation-solidification contractors are readily available, There would be no institutional controls and monitoring to implement. The administrative implementability of Alternative 4 would be comparable to that of Alternative 3 with the additional requirement that the appropriate State agencies would have to be contacted to determine acceptable air emissions for the thermal desorption unit, which could be accomplished relatively easily.

9.2.7 Cost

The capital, total O&M cost over 30 years, and 30-year net present-worth (NPW) costs of the alternatives are presented in the following table and ranked according to the 30-year NPW cost.

Alternative	Capital(&)	30-year O&M ($)	30-year NPW(&)
1	0	0	0
2	90,800	618,000	708,000
3	4,363,000	618,000	4,981,000
4	16,129,000	0	16,129,000

The total operating costs shown for Alternatives 2 and 3 are for groundwater monitoring only and include a $20,000 lump sum amount at the end of the third year of monitoring for final site reviews and report preparation. The 30-year NPW costs for Alternatives 2 and 3 include the performance of 5-year reviews for 30 years.

9.2.8 State Acceptance

The CTDEP, as a party of the Federal Facility Agreement (FFA), has provided comments on the FS (B&R Environmental, September 1997) and PRAP (U.S. Navy and B&R Environmental, September 1997), and has documented its concurrence with the remedial action, as stated in Section 13 of this Interim ROD. A copy of the CTDEP's letter of concurrence is presented in Appendix D of this Interim ROD.

9.2.9 Community Acceptance

The PRAP presents the preferred alternative for the DRMO. From September 18, 1997 through October 18, 1997, the U.S. Navy held a public comment period to accept public input. A public meeting was held in Groton, Connecticut on September 25, 1997 to discuss the PRAP and to accept any oral comments.

Community acceptance of the PRAP was evaluated based on comments received at the public meeting and during the public comment period. This is documented in the transcript of the Public Meeting in Appendix A, and in the Responsiveness Summary in Appendix C of this Interim ROD.

10.0 SELECTED REMEDY

Based upon the requirements of CERCLA, the NCP, the detailed analysis of alternatives, and comments received from the U.S. EPA, the CTDEP, and the public, the U.S. Navy has selected Alternative 2 (Institutional Controls and Monitoring) as the most appropriate remedy for the DRMO site. Upon implementation of this remedy, the human health risks resulting from exposure to the soil and groundwater at the DRMO will be minimized and potential risks to ecological receptors in the adjacent Thames River will be monitored.

Alternative 2 consists of two components in addition to the existing asphalt and GCL cap: 1) institutional controls and 2) groundwater monitoring. This alternative will rely upon maintenance of the existing cap, limitation of site access, restrictions of land use, and groundwater monitoring to evaluate whether contaminants present at the DRMO are migrating to the Thames River and causing adverse ecological effects. Although this alternative is based on the assumption that the DRMO will continue to be owned and operated by the Navy, provisions are included in this IROD for the continuation of these institutional controls in the event of a different ownership. The estimated net present worth of Alternative 2 is $708,000, with a capital cost of $90,800 and an annual operation and maintenance cost of $21,000.

10.1 COMPONENT 1: INSTITUTIONAL CONTROLS

Institutional controls will include maintenance of the existing cap, limitations on site access, and restrictions on land use.

10.1.1 Cap Maintenance

Maintenance of the existing asphalt and GCL cap will consist of regular inspections to assess the integrity of the asphalt and GCL cap. Periodic repair and replacement of the asphalt layer will be performed as needed.

10.1.2 Limitations on Site Access

Limitations on Site Access will consist of maintaining the existing chain link fence that surrounds the DRMO and posting of signs to warn potential trespassers that a health hazard is present. Signs will be posted along the perimeter and at the front entrance to the site. In addition, during operation of the site for its current military purpose, gates will be locked, and a security desk will be maintained at the entrance to the site.

10.1.3 Land Use Restrictions

This IROD specifies the use of land use restrictions (LURs) for that portion of the Naval Submarine Base New London (the Installation) in the area of the DRMO (the Subject Area) to limit activities (including, but not limited to, excavation or drilling), to prohibit residential use of property, and restrict excessive vehicular use or any other activity that could compromise the integrity of the existing cover system. The restrictions are intended to protect human health and the environment from exposure to landfilled waste and contaminated soil and to restrict activities that could compromise the integrity of the cover system or interfere with monitoring of the site. If these institutional controls are complied with and they fail to protect human health and the environment, this IROD shall be reopened.

10.1.3.1 Land Use Restrictions

No restricted activities or uses shall occur without prior approval from EPA and the CTDEP. In furtherance of these purposes, the Navy shall require that use, occupancy, and activity of and at the Subject Area be restricted as follows:

1. No residential use (as defined under CT Remediation Standard Regulations, RSCA 22a-133k-1(a)(53)) of the Subject Area will be permitted;
2. No building, structure or improvement of existing structures shall be allowed on the Subject Area;
3. No activity that could breach or damage the existing cover system shall occur; and
4. No entry upon the Subject Area by any motor vehicle weighing in excess of the structural load limit of the existing cover system shag occur.

The Navy shall ensure that notice of the existence of the cover system and the LURs at the DRMO are conspicuously posted. A copy of the LURs shall be maintained and available at the Subject Area. The LURs shall be recorded in the base master plan and any other Installation vehicles which will ensure proper notification of the LURs to Installation personnel.

Any proposed changes to or temporary release of any previously identified LURs for the site must be approved by the agencies in writing prior to implementation. Requests for review of any LURs change proposal will consider the degree of change proposed, the effectiveness of the remediation effort to date, any natural remediation that may have occurred since the original remedial actions, etc.

10.1.3.2 Monitoring to assure compliance with the Land Use Restrictions

Compliance with the LURs at DRMO shall be accomplished through strict adherence to such vehicles as the base master plan. The Navy shall notify the agencies if, despite proper precautions, an unauthorized land use or activity is discovered by the installation. The unauthorized land use or activity will be reported immediately to the agencies for determination of an appropriate corrective action.

The Navy shall review on a quarterly basis the status of adherence to the LURs. The Navy shall forward an annual report describing the present and anticipated land use and LURs at DRMO to EPA and the CTDEP certifying retention of the specified LURs for the DRMO site.

10.1.3.3 Transfer of Title

If the Navy seeks to transfer title to any property within the Subject Area, the LURs shall be contained in the instrument of conveyance and such instrument shall be filed and recorded in the land Records of the Town of Ledyard, State of Connecticut.

The filing and recording of LURs by the Navy or disposal agency shall be in accordance with state and local law and include, without limitation, declaration(s) of covenants, conditions, and restrictions that run with the land setting forth the LURs and compliance therewith. The form and substance of the Declaration and any future declarations(s) shall be those determined in the sole and absolute discretion of EPA, in consultation with CTDEP, and shall be subject to review and approval by EPA, in consultation with CTDEP, prior to filing. All such declaration(s) shall be enforceable by the United States and the State of Connecticut and shall provide that these persons have the right to inspect the Subject Area at reasonable times and with prior notice, unless an emergency situation exists, to assess compliance with the declaration.

The LURs and obligations set forth in this IROD shall be binding upon any Successors in Interest and Assigns. In the event the Subject Area is to be transferred by deed, the Navy shall request the disposal agency to ensure that any deed, lease, or other instrument of conveyance for the Subject Area shall: (a) contain a notice that the Subject Area and any interest in the Subject Area is subject to the restrictions and obligations of this IROD: (b) contain such restrictions and obligations, and, (c) include agreement by the transferee of the interest in the Subject Area to comply with such restrictions and obligations. Prior to any transfer of any interest in the Subject Area the prospective Successor in Interest shall be provided with a copy of this IROD.

10.2 COMPONENT 2: GROUNDWATER MONITORING

Groundwater monitoring shall be performed in accordance with the Groundwater Monitoring Plan for the DRMO site (Brown & Root Environmental, October 1997). Groundwater samples will be analyzed to evaluate whether contamination from the DRMO is migrating to the Thames River and causing an adverse ecological effect. After baseline conditions have been established as described in the Groundwater Monitoring Plan, the monitoring program may be revised based on the analytical data collected from the previous sampling events. If groundwater COCs are detected at concentrations above SWPCs or Volatilization Criteria, additional evaluations will occur as described in the Groundwater Monitoring Plan, including but not limited to surface water and sediment samples shall be collected and analyzed to determine if these COCs are migrating from the DRMO to the Thames River. After sufficient monitoring data have been collected, such data will be evaluated to determine the need for additional remedial action at the site. If data show that the site has not adversely impacted the environment, the need for additional monitoring will be evaluated and modified, as appropriate. Figure 10-1 depicts the decision-making framework for the groundwater data collection.

Every 5 years for 30 years, a site review will be conducted to evaluate the site status and determine whether further action is necessary. Such site reviews are required when contaminants remain at the site (see CERCLA º121(c)).

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11.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, the U.S. Navy must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections the discuss how the selected remedy for the DRMO meets the statutory requirements.

11.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy protects human health by minimizing direct contact with the contaminants using institutional controls and maintenance of the existing asphalt and GCL cap. The reduced exposure to potential receptors will ensure that the risks are within the acceptable limits corresponding to a maximum cumulative ICR of 1E-04 and a maximum cumulative HI of 1.0. The selected remedy will be protective of the environment of concern, namely the Thames River, that runs adjacent to the site by monitoring for contaminant migration from the soil into the groundwater. The monitoring will be conducted according to the Groundwater Monitoring Plan described in Section 10 of this Interim ROD. If the groundwater COCs are shown to exceed site-specific Surface Water Protection Criteria, then additional action would be taken, including expansion of the scope of monitoring to include surface water and sediment sampling. If exceedances of Volatilization Criteria are detected, then additional action would be taken including determining the need for additional remedial action.

11.2 COMPLIANCE WITH ARARS

The selected remedy will comply with all Federal and State of Connecticut ARARs. The chemical-specific, location-specific, and action-specific ARARs and TBCs that have been analyzed for this remedial action and the methods by which compliance will be attained are summarized in Tables 11-1, 11-2, and 11-3, respectively.

TABLE 11-1

ASSESSMENT OF CHEMICAL-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 2 - INSTITUTIONAL CONTROLS AND MONITORING
DEFENSE REUTILIZATION AND MARKETING OFFICE
NSB-NLON, GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirements	Action to be Taken to Attain ARAR
FEDERAL				
		There are no federal chemical-specific- ARARs		
STATE OF CONNECTICUT				
		There are no state chemical-specific ARARS		

TABLE 11-2

ASSESSMENT OF LOCATION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 2 - INSTITUTIONAL CONTROLS AND MONITORING
DEFENSE REUTILIZATION AND MARKETING OFFICE
NSB-NLON, GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Action to be Taken to Attain ARAR
FEDERAL				
Executive Order 11988 RE: Floodplain Management	Executive Order 11988	Applicable	This order required Federal agencies, wherever possible, to avoid or minimize adverse impacts upon floodplains. Requires reduction of risk of flood loss, minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values of the floodplains.	Monitoring well installation and groundwater monitoring activities within the 100-year floodplain will be carried out to minimize impacts to floodplain resources.
Coastal Zone Management Act	16 USC Parts 1451 et seq.	Applicable	Requires that any actions must be conducted in a manner consistent with state approved management programs.	This site is located in a state coastal flood zone (within the 100 year floodplain). Therefore, applicable state coastal zone management requirements will be addressed.
Fish and Wildlife Coordination Act	16 USC 661 et seq: 40 CFR º 6 302	Applicable	Requires action to be taken to protect fish and wildlife from projects affecting streams or rivers, Consultation with U.S. Fish & Wildlife Service to develop measures to prevent and mitigate loss.	If monitoring wells are required to be installed in the river or its tidal zone, the U.S. Fish & Wildlife Service will be consulted as to measures required to protect fish and wildlife resources.
STATE OF CONNECTICUT				
Coastal Management Act	CGS ºº 22a-92 and 94	Applicable	Requires projects within a state designated coastal zone to minimize adverse impacts on natural coastal resources.	Monitoring well installation and groundwater monitoring activities within the 100-year coastal floodplain will be carried out to minimize impacts to coastal resources.
Tidal Wetlands	RCSA ºº 22a-30-1 thru 17	Applicable	Activities within or affecting tidal wetlands are regulated.	If monitoring wells are required to be installed in the river or its tidal zone monitoring and maintenance activities will be implemented so as to not negatively impact tidal resources.
CT Endangered Species Act	CGS ºº 26-303 thru 314	Applicable	Regulates activities affecting state-listed endangered or threatened species or their critical habitat.	The state-threatened Atlantic sturgeon inhabits the Thames River. If monitoring wells are required to be installed in the river or its tidal zone monitoring and maintenance activities will be implemented so as to not negatively impact the sturgeon or any of its critical habitat which may occur within the River.

TABLE 11-3
ASSESSMENT OF ACTION-SPECIFIC ARARs AND TBCs
FOR ALTERNATIVE 2 - INSTITUTIONAL CONTROLS AND MONITORING
DEFENSE REUTILIZATION AND MARKETING OFFICE
NSB-NLON, GROTON, CONNECTICUT

Requirement	Citation	Status	Synopsis of Requirement	Action to be Taken to Attain ARAR
FEDERAL				
Guidance on Remedial Actions for Superfund Sites with PCB Contamination	OSWER Directive 9355.4-01	To be considered	This guidance describes how to address PCB contamination issues as part of remedial actions	This guidance will be considered in evaluating PCB issues as part of the remedial action Low levels of PCBs (47.2 ppm or less) are present within soils at the site.
STATE OF CONNECTICUT				
Hazardous Waste Management: Generator and Handler Requirements	RCSA º 22a-449(c)100-101	Applicable	These sections establish standards for listing and identification of hazardous waste, The standards of 40 CFR 260-261 are incorporated by reference.	For any materials generated during monitoring well installation, hazardous waste determinations will be performed, and the wastes would be managed in accordance with requirements of these regulations, if necessary.
Hazardous Waste Management: TSDF Standards	RCSA º 22a-449(c)104	Applicable	This section establishes standards for groundwater monitoring and post-closure. The standards of 40 CFR 264 are incorporated by reference.	The remedy would comply with the post-closure requirements of this section through groundwater monitoring and institutional controls at the Site.
Control of Noise Regulations	RCSA º 22a-69-1 through 7.4	Applicable	These regulations establish allowable noise levels. Noise levels from construction activities are exempt from these requirements.	Noise generated by installation of monitoring wells will meet these regulations. This alternative involves drilling and monitoring activities which are not anticipated to generate excessive noise.
Guidelines for Soil Erosion and Sediment Control	The Connecticut Council on Soil and Water Conservation	To be considered	The guidelines provide technical and administrative guidance for the development, adoption, and implementation of erosion and sediment control program.	Erosion and sediment control measures would be implemented during well installation.
Water Quality Standards	CBS 22a-426	Relevant and appropriate	Connecticut's Water Quality Standards establish specific numeric criteria, designated uses, and anti-degradation policies for groundwater and surface water.	Standards will be used to evaluate monitoring results to determine if further remedial action is required to protect resources.
Remediation Standards Regulations	RCSA º 22a-133k-3	Relevant and appropriate	These regulations provide specific numeric cleanup criteria for a wide variety of contaminants in soil, groundwater and soil vapor. These criteria include volatilization criteria, pollutant mobility criteria, direct exposure criteria and surface water protection criteria.	Although no groundwater plume has been identified at this site, the proposed groundwater monitoring will be conducted to determine if any contaminants of concern are migrating offsite at levels above CTDEP surface water protection or volatilization standards for GB groundwater. Maintenance of the cap and institutional controls will satisfy the Remediation Standards Regulations for soil.

11.3 COST EFFECTIVENESS

In the U.S. Navy's judgement, the selected remedy is cost effective, (i.e., its overall protectiveness justifies the cost). In selecting this remedy, the U.S. Navy analyzed the overall effectiveness of all alternatives that were protective and complied with ARARs. The No Action alternative is the least expensive (zero cost) alternative, but it would not be protective of human health, and there would be no mechanism to monitor any impacts on the environment. Alternative 2 would be the least expensive of the alternatives that address the exposure to contaminants and the potential for their migration in the environment. Given the potential land use at the DRMO in the foreseeable future, the current industrial land use is likely to continue and residential land use is very unlikely. As long as the base maintains records of the contamination in the Master Plan and through any other applicable means, residential land use would be prohibited and any transfer of property would be accompanied with deed restrictions. Also, records of the contamination in the Master Plan at the site or through any other applicable means would warn workers to take adequate protective measures during intrusive activities. Under these circumstances, the costs associated with excavation and offsite disposal of contaminated soil (Alternative 3) or excavation of contaminated soil with onsite treatment followed by offsite disposal (Alternative 4) would not be justifiable.

Estimated total cost (30-year present worth) of the selected remedy: $ 708,000

11.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedy proposes maintenance of the existing asphalt and GCL cap to minimize exposure to potential receptors within the foreseeable future at the DRMO under the management of the U.S. Navy. The nature of the contaminants and potential risks at the DRMO do not warrant the need for an alternative treatment or resource recovery technology. Among those alternatives that are protective of human health and the environment and comply with ARARs, the U.S. Navy, with the U.S. EPA and CTDEP concurrence, has determined that this selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility or volume through treatment; short-term effectiveness; implementabillity; and cost while also considering the statutory preference for treatment as a principal element and considering state and community acceptance.

11.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy does not treat the soil for reduction of toxicity, mobility or volume through treatment as the principal element. The risks posed by the contaminants can be adequately reduced by minimizing exposure to potential receptors.

12.0 DOCUMENTATION OF NO SIGNIFICANT CHANGES

The U.S. Navy (September 1997) released the PRAP for public comment on September 18, 1997. The PRAP identified institutional Controls and Monitoring (Alternative 2) as the preferred alternative for soil and groundwater remediation for the DRMO. Public comments have been considered by the U.S. Navy prior to the selection of the preferred alternative. Upon review of these comments, it was determined that no significant changes to the remedy, as originally identified in the Proposed Plan were necessary.

13.0 STATE ROLE

The CTDEP, as part of the Federal Facilities Agreement (FFA), has reviewed the various alternatives. The CTDEP has also reviewed the Phase II RI (B&R Environmental, March 1997), FS (B&R Environmental, September 1997), and PRAP (U.S. Navy and B&R Environmental, September 1997) to determine if the selected remedy is in compliance with applicable or relevant and appropriate state environmental laws and regulations.

The CTDEP concurs with the selected remedy for the DRMO. A copy of the letter of concurrence is presented in Appendix D of this Interim ROD.

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APPENDIX A

PUBLIC MEETING TRANSCRIPT

<IMG SRC 98002J>

DEPARTMENT OF THE NAVY
NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
10 INDUSTRIAL HIGHWAY
MAIL STOP, #82
LESTER, PA 19113-2090

IN REPLY REFER TO

MINUTES OF PUBLIC MEETING

SITE 6 - DEFENSE REUTILIZATION AND MARKETING OFFICE

To: NSB-NLON Public Meeting Attendees

From: Mark Evans, Remedial Project Manager, Northern Division, Naval Facilities Engineering Command

Date: 7 November 1997

Subject: Public Meeting Minutes - September 25, 1997
Installation Restoration Program
Naval Submarine Base - New London (NSB-NLON)
Groton, Connecticut

Attendees of the meeting

Andy Stackpole	NSB-NLON
Mark Evans	Navy
Greta Deirocini	Navy
Kymberlee Keckler	USEPA Boston
Mark Lewis	CTDEP
Corey Rich	Brown & Root
Kelly Smay	Brown & Root
Bart Pearson	Community
Noah Levine	Community
Gabe Stern	Community

Welcome and Introduction

Andy Stackpole opened the meeting at 6:30 p.m..

Mr. Stackpole introduced Kelly Smay from Brown & Root Environmental. Ms. Smay gave a presentation on the DRMO Proposed Remedial Action Plan.

APPENDIX B
CTDEP COMMENTS ON PROPOSED PLAN

<IMG SRC 98002K>

October 17,1997

Mr. Mark Evans
U.S. Department of the Navy
Northern Division, Naval Facilities Engineering Command, Code 1823
10 Industrial Way, Mail Stop 82
Lester, PA 19113-2090

Re: State Comments Regarding Proposed Plan for Site 6- Defense Reutilization and Marketing Office, Naval Submarine Base New London, Groton, Connecticut.

Dear Mr. Evans:

The Department has received and reviewed the Proposed Plan for the Defense Reutilization and Marketing Office at the Naval Submarine Base New London in Groton. Proposed Plan was dated September 1997.

The preferred alternative being presented by the Navy in the Proposed Plan for the Defense Reutilization and Marketing Office consists of five elements: 1) Continued maintenance of the existing cap 2) Land use restrictions that would limit future development 3) Fencing and notices posted on the site perimeter, 4) Long- term monitoring of contaminants in groundwater, and if required, in surface water and sediment, and 5) Five-year reviews. The State supports the Proposed Plan as presented.

The State offers the following comments.

While the State believes the proposed remedy will satisfy the requirements of the Remediation Standard Regulations, we would prefer a more permanent remedy involving excavation of contaminated materials. Polluted soil with substances exceeding the pollutant mobility and direct exposure criteria remains on the site. The numeric direct exposure and pollutant mobility criteria, which are contained in Appendices A and B, respectively, of the Regulations, do not apply to these soils, by virtue of the location of the soils with respect to permanent structures, pavement, and the water table at the site, as described below.

Direct Exposure Criteria

The numeric direct exposure criteria (Appendix A to the Regulations) do not apply to soils that are inaccessible, as defined in the Regulations. Inaccessible soil is defined in the Regulations as "polluted soil which is (A) more than four feet below the ground surface; (B) more than two feet below a paved surface comprised of a minimum of three inches of hiniminous concrete or concrete, which two feet may include the depth of any material used as sub-base for the pavement; or (C)(i) beneath an existing building or (ii) beneath another existing permanent structure provided written notice that such structure will be used to prevent human contact with such soil has been provided to the Commissioner." Section 22a-133k-2(b)(3) of the Regulations states in part that the direct exposure criteria do not apply to "inaccessible soil at a release area provided that if such inaccessible soil is less than 15 feet below the ground surface an environmental land use restriction is in effect with respect to the subject parcel or to the portion of such parcel containing such release area, which environmental land use restriction ensures that such soils will not be exposed as a result of excavation, demolition or other activities and that any pavement which is necessary to render such soil inaccessible is maintained in good condition unless and until such restriction is released in accordance with said section 22a-133q-1" (emphasis added).

To fully comply with the intent of the Regulations, the remedy must include institutional controls, and an inspection and maintenance program to ensure the continued integrity of the pavement that renders the soil inaccessible.

Since all of the remaining contaminated soil is either beneath the cap (a permanent structure designed to prevent human contact) or beneath pavement, this exemption is applicable, provided a regular inspection and maintenance program is put in place to ensure that the pavement and cap remain in good condition and institutional controls prevent damage to the cap which will prevent human contact with soil contaminated at levels exceeding the direct exposure criteria.

Pollutant Mobility Criteria

Section 22a-133k-2(c)(1) and (2) of the Regulations specifies that in an area with a ground water classification of GB, the pollutant mobility criteria apply to "soil above the seasonal high water table". Because the soil with contaminants at levels exceeding the pollutant mobility criteria found in located below the seasonal high water table, the numeric pollutant mobility criteria found in Appendix B to the Regulations do not apply.

Interim Remedy

The Navy, EPA, and the State previously agreed that this will be considered an interim status remedy since compliance with all ARARs has not yet been demonstrated. Further action may be required depending on the results of ground water monitoring. The Proposed Plan does not clearly identify the fact that this is an interim remedy. This fact should be clearly spelled out in the Record of Decision.

It should also be stated clearly that the purpose of the ground water monitoring program is to evaluate the effectiveness of the interim remedy (cap) being selected and to provide data to determine whether contaminants migrating from the site pose an unacceptable threats to human health and the environment. If the monitoring program identifies such unacceptable threats, future actions to address those threats should not be limited only to the additional monitoring described in the proposed plan. We anticipate that the final Record of Decision for the DRMO will depend heavily on the results of ground monitoring performed under the interim Record of Decision, and upon ground water investigations performed under the base wide ground water Operable Unit.

If you have any questions regarding this letter, please contract me at (860)424-3768.

Sincerely,
<IMG SRC 98002L>
Mark R. Lewis
Senior Environmental Analyst
Federal Remediation Program
Permitting, Enforcement & Remediation Division
Bureau of Water Management

cc: Kymberlee Keckler, US EPA New England, Federal Facilities Section
Andy Stackpole, NSBNL Environmental Department
Jack Looney, CT Attorney General's Office

APPENDIX C

RESPONSIVENESS SUMMARY

The Navy published a notice and brief analysis of the Proposed Plan in the New London Day on September 18, 1997 and made the plan and the administrative record available to the public at the Groton Public Library, the Bill Library and the Naval Submarine Base Library.

On September 25, 1997, the Navy held an informational meeting to discuss and present the Proposed Plan. Also, on September 25, 1997 the Navy held a public hearing to discuss the Proposed Plan and to accept any oral comments. A transcript of this meeting is included in Appendix A. From September 18, 1997 to October 18, 1997 the Navy held a 30-day public comment period to accept public comment on the Proposed Plan.

SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD

Oral comments received during the public hearing held on September 25, 1997 are provided in Appendix A. No written comments were received during the public comment period other than a letter dated October 17, 1997 from the Connecticut Department of Environmental Protection (CTDEP) expressing their support of the Proposed Plan as presented.

APPENDIX D

DECLARATION OF CONCURRENCE

The State of Connecticut has concurred with the Proposed Remedial Action Plan as shown in Appendix B. The changes to this ROD as requested by the State have been incorporated in this ROD. The U.S. EPA has concurred with the selected remedial action as described in the Declaration of this ROD.

<IMG SRC 98002M>