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Environmental Evaluation Report

Proposed Interim Remedial Action

Area A Landfill

at the

Naval Submarine Base

New London

Groton, Connecticut

Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0205

June 1995

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1.0 INTRODUCTION

1.1 General

This evaluation examines the environmental consequences of proposed interim remedial action at the Area A Landfill, one of several sites being considered for cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or "Superfund," at the Naval Submarine Base - New London (NSB-NLON) in Groton, CT. NSB-NLON, a major U.S. Navy support center for the U.S. Atlantic Fleet, occupies approximately 550 acres of land in the towns of Ledyard and Groton on the east bank of the Thames River approximately 6 miles north of Long Island Sound. Figure 1 shows the location of the NSB-NLON on a portion of the Uncasville, CT U.S. Geological Survey Topographic Quadrangle. NSB-NLON provides base command for naval submarine activities in the Atlantic, and includes housing for Navy personnel and their families, submarine training facilities, military offices, medical facilities, and facilities for maintenance, repair, and overhaul of submarines. The Area A Landfill, formerly used for disposal of incinerator ash, industrial and commercial/residential waste, and other wastes generated at NSB-NLON from about 1957 to 1973, occupies approximately 13 acres in the northeastern and north-central part of NSB-NLON (Atlantic, 1995; Halliburton NUS, 1995). The landfill has since been covered with soil and gravel and is presently dedicated to vehicle parking, material storage, and related uses. Figure 2 shows the Area A Landfill and its immediate surroundings on NSB-NLON.

Atlantic Environmental Services, Inc. has prepared a draft focused feasibility study (FFS) for the Navy to evaluate and select remedial actions to reduce risks to human health and the environment posed by contaminated soils of the Area A Landfill. A full range of remedial alternatives were screened in the FFS and four potential interim remediation options, including the alternative of no action, were identified. Therefore, only the proposed action (preferred alternative) and no action alternative are evaluated in this environmental evaluation report. The proposed action consists of installing an impermeable cap over the landfill with provisions for surface and subsurface drainage; access control; and continued use of the landfill area for parking, material storage, and related uses. The no action alternative essentially involves continuation of the status quo at the landfill, and would involve no remediation activities.

1.2 Relationship to NEPA

The National Environmental Policy Act of 1969 (NEPA) and its implementing regulations promulgated by the President's Council on Environmental Quality (CEQ) at 40 CFR 1500-1508 require federal agencies to consider environmental effects of proposed actions in the decision-making process and to make environmental information available to the public before decisions are made and actions are taken. For major federal actions having significant environmental impact, these regulations require preparation of an environmental impact statement (EIS) that considers the following:

(1) environmental impacts of the proposed action
(2) adverse impacts which cannot be avoided with the proposed implementation
(3) alternatives to the proposed action
(4) relationship between short term uses of the environment and the maintenance and enhancement of long term productivity
(5) irreversible and irretrievable commitments of resources which would be involved in the proposed action

CEQ regulations also provide for the preparation of environmental assessments (EAs) to ascertain whether a federal action may result in significant environmental impact and thus require preparation of an EIS, and for the establishment of categorical exclusions to identify actions that do not have significant impacts and thus do not require preparation of an EIS.

To a large extent, NEPA objectives can be met through the CERCLA remediation process which uses the remedial investigation/feasibility study (RI/FS) process to evaluate a range of reasonable alternatives and includes an evaluation of overall protection of human health and the environment, public acceptance, and compliance with environmental laws and regulations. Despite this functional similarity, federal agencies [other than the U.S. Environmental Protection Agency (EPA)] that undertake CERCLA remediation actions generally have been considered subject to NEPA's procedural requirements. As a result, federal agencies are attempting to integrate the CERCLA and NEPA procedural requirements for remediation projects.

This Environmental Evaluation Report does not itself constitute a formal EIS, EA, or categorical exclusion under NEPA. However, it is intended that this report provide concise

documentation of potential environmental effects of the Navy's proposed remediation of contaminated soils at the Area A Landfill consistent with NEPA requirements, particularly with respect to such environmental resources as air, water, wetlands, floodplains, endangered and threatened species and critical habitats, coastal zones and barriers, cultural resources, wild and scenic rivers, wilderness areas, and significant agricultural lands. This report draws on information from reports produced thus far in the RI/FS process for the landfill, as well as ongoing studies and information obtained from government resource agencies.

2.0 PURPOSE AND NEED FOR ACTION

Of necessity, NSB-NLON has used, handled, stored, and disposed of hazardous materials, some of which have contaminated soil and water. Some of the contamination is the result of accidental spills and leaks. The remainder is the result of disposal practices that were common in the past, but that are now known to be inadequate and have been discontinued (e.g., prior landfilling practices). Currently, there are 23 locations that are known or presumed to be contaminated as identified in the proposed Federal Facility Agreement (FFA), an interagency agreement that provides the framework for EPA, Connecticut Department of Environmental Protection (CTDEP), and the Navy to address environmental problems at NSB-NLON (Atlantic, 1995). Presently, the NSB-NLON follows environmentally safe guidelines for the management and disposal of all hazardous materials and waste.

As a result of evaluations conducted under CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986, NSB-NLON was placed on the National Priorities List of federal Superfund sites on August 30, 1990, by EPA. Remediation at NSB-NLON, including the Area-A Landfill remediation, is conducted under the Installation Restoration Program (IRP), a Department of Defense Program established in 1975 to investigate and clean up hazardous waste sites at its facilities. The IRP is conducted in accordance with CERCLA, which involves use of the RI/FS process to determine the nature and extent of contamination and to evaluate and select appropriate remediation measures.

A Phase I RI study was completed in 1992 for nine sites at NSB-NLON, including the Area A Landfill, to evaluate potential risks to human health and the environment (Atlantic, 1992). Several of the sites, including the Area A Landfill, were determined to pose potential risks as a result of soil and groundwater contamination. To address these risks, a feasibility study was initiated to address each of the sites. As work on the feasibility study progressed, EPA expressed concern about the data on which the FS was based. As a result, work on the FS was stopped and a Phase II RI investigation (Halliburton NUS, 1995) was initiated to fill data gaps and, with respect to the Area A Landfill, better characterize contaminated soils.

The time required for full evaluation and selection of final remedial actions through the RI/FS process to address all environmental media (soil and groundwater) at these contaminated sites could take many years. Therefore, the Navy has decided to accelerate remedial activities for soil at three of the sites for which risks had been positively identified, including the Area A Landfill, to minimize risks from these areas. As part of these accelerated efforts, a FFS

(Atlantic, 1994a) was undertaken to evaluate alternatives and select a proven, commercially available remedy that would effectively control the source of contamination at the Area A Landfill, i.e., the landfill contents and contaminated soils.

The FFS includes a comprehensive evaluation and screening process conducted in accordance with EPA guidance, engineering judgment, and requirements of the National Contingency Plan (i.e., the NCP, EPA's regulations at 40 CFR 300 for implementing remedial actions under CERCLA). A total of 8 alternatives were screened in the FFS with respect to effectiveness, implementability, and cost, narrowing the list to three potential remedial alternatives in addition to no action, as follows: (1) the proposed action, which would involve capping the landfill without prior selective removal of contaminated soils; (2) selective removal and treatment of contaminated soils exhibiting PCB concentrations above target remediation levels (i.e., PCB "hot spots") at an incinerator permitted under the Resource Conservation and Recovery Act (RCRA) followed by capping; and (3) selective removal and disposal of PCB hot spots at a RCRA permitted landfill, followed by capping.

These four alternatives were subjected to detailed evaluations with respect to nine criteria as specified in the NCP and EPA's RI/FS guidance (EPA, 1988). In addition to effectiveness, implementability, and cost, these criteria include consideration of public acceptance; reduction of toxicity, mobility or volume; overall protection of human health and the environment; and compliance with applicable or relevant and appropriate requirements (ARARs), a requirement of CERCLA and the NCP. ARARs addressed in the FFS include a broad spectrum of federal and state environmental laws, regulations, and standards that would be complied with to ensure appropriate protection of air, surface water, groundwater, soils, wetlands, plants and animals, cultural resources, land use values, and other elements of the environment in undertaking remediation of Area A Landfill soils.

Construction and maintenance of the landfill cap, the proposed action described below, is intended to provide an interim source control measure that should prevent contamination in the groundwater at the Area A Landfill from worsening. Groundwater contamination at the landfill will be addressed in the final remedy (Atlantic, 1995).

In addition to enabling the Navy to responsibly meet its commitment under CERCLA for remediation of the Area A Landfill, the proposed action would allow continued use of the Area A Landfill for long-term parking; storage of sand, sandbags, salt, and other materials; and related activities essential to the NSB-NLON mission.

3.0 PROPOSED ACTION AND ALTERNATIVES

The purpose of the FFS is to evaluate and select remedial actions to mitigate risks to human health and the environment posed by contaminated soil at the Area A Landfill and provide descriptions and evaluations of remedial alternatives for the prevention of human health risks posed by the contaminated soil. The FFS prepared for the Area A Landfill considered eight remediation options including a no action alternative. The screening process reduced the list of options to four (Atlantic, 1995). This environmental evaluation report addresses only the following two options:

3.1 Proposed Action

The proposed action, the Navy's preferred alternative (U. S. Navy, 1995), consists of installing an impervious cap approximately 13 acres in size over the areas of the landfill where wastes have been disposed. The landfill would be graded, and storm-water management features would be provided to promote runoff and prevent run-on. Access to the landfill would continue to be restricted via existing perimeter fencing and security procedures and Area A Landfill operations would continue. Groundwater in the vicinity of the landfill would be monitored during the post-closure period (Atlantic, 1995).

The cap would be designed and constructed to meet substantive Resource Conservation and Recovery Act (RCRA) requirements for final landfill covers as specified in 40 CFR 265.310. As such, the cap would be designed to (1) provide long term minimization of liquid migration through the landfill, (2) function with minimal maintenance, (3) promote drainage and minimize erosion or abrasion of the cover, (4) accommodate settling and subsidence, and (5) have a permeability less than or equal to the soils at the bottom of the landfill. Specific provisions for the cap design include an impervious barrier to minimize infiltration (i.e., provide source control for contamination); an operating surface to enable vehicle parking, materials storage, an access road, and related facilities; run-on and run-off controls; and features to facilitate venting of methane generated by decomposition of organic wastes in the landfill. The cap would essentially be two caps; one designed for the plateau area and the other for the sideslope area. As presently conceived, the plateau cap would consist of a 12-inch porous gas management/bedding layer topped by a polyethylene geomembrane/ geosynthetic clay liner. Above this would be a 12-inch lateral drainage layer (sub-base), a 6-inch base layer of coarse aggregate and geotextile, and 3-inches of asphalt. The current

sideslope cap design is similar to the plateau cap design, except that the course aggregate base layer and asphalt surface is replaced by a 12-inch layer of rip-rap (Atlantic, 1995; U.S. Navy, 1995).

Contaminated soils would remain on site untreated. Site grading and storm-water management provisions, along with the impervious cap layer, would be designed to minimize infiltration and subsequent leaching from unsaturated soils, and would minimize erosion. Surface water run-on control would be provided by removing existing storm drainage lines passing through the landfill and constructing an interceptor ditch and storm drain to route stormwater around the southern perimeter of the landfill. Subsurface drains would be constructed so that they would not act as a preferential flow path for leachate from the landfill. Concrete collars and/or impervious liners would be provided as necessary to the storm sewer system to prevent leachate migration. Sheet flow from the cap would be filtered by the riprap on the sideslope cap before it enters an adjacent wetland (the Area A Wetland; see Figure 2). A subsurface drain would also be provided upslope from the landfill to reroute non-contaminated groundwater in the shallow overburden around the landfill to prevent the water from contacting landfill contents/soils. Among the alternatives considered for this subsurface drain is a separate trench containing perforated plastic pipe and pervious backfill from the ground surface to the depth of bedrock along the slope south of the landfill upgradient of the surface water run-on control drain. Another option combines the surface water run-on and groundwater drainage systems into one channel along the south side of the cap (Atlantic, 1995).

As presently envisioned, methane emissions would be controlled by a horizontally-vented passive gas management system, which would be field tested after construction (Cervenak, 1995a). Standard construction measures would be taken to reduce fugitive dust exposure and erosion in accordance with all applicable laws and regulations.

Fencing and security procedures would prevent access and damage to the cap by unauthorized personnel. Future use of the Area A Landfill is expected to remain relatively unchanged except that crane testing activities at the landfill may be moved to another site and the landfill may serve as temporary access for construction vehicles to and from construction activities elsewhere on NSB-NLON. Operations procedures would be developed for persons working at the Area A Landfill to prevent any unauthorized digging or other activities that could jeopardize cap integrity, and to ensure adequate worker protection and continued effectiveness of environmental protection measures. The expected lifetime of this remedy is finite, since it

is contingent upon continued maintenance and monitoring of the integrity of the cap. However, this alternative would afford immediate protection, could be implemented in approximately 12 months, and is cost-effective. Institutional controls would be implemented as necessary to provide notice of hazardous materials remaining at the landfill and to ensure that the future land use is controlled in the long term (Atlantic, 1995).

The Area A Landfill remedial action would be implemented in accordance with all administrative procedures in the NCP for remedial actions. The proposed remedial action would be intended to be final remedial action in that the cap selected would be the final cap and no further excavation is expected to take place. However, the proposed remedial action would be an interim source control remedy for the operable unit addressed (i.e., soil and landfill contents) and an interim action for the site. The proposed remedial action would not be final for the Area A Landfill site as a whole in that all potential ecological concerns are not addressed, in particular those due to contaminated groundwater. Monitoring wells in the Area A Landfill would be sampled periodically to assess site groundwater quality and site hydrology, as specified in the Phase II Remediation Investigation (RI) Work Plan (Atlantic, 1993). Based on this assessment, a determination would be made whether on-site groundwater remediation or additional source control measures would be necessary to protect water quality.

3.2 No Action Alternative

The no action alternative is evaluated as a baseline to aid in the comparative analysis of alternatives and generally is required as an alternative for NEPA evaluations. This is the least effective alternative. All contaminated materials would be left on the Area A Landfill untreated. Nothing would be done to eliminate exposure pathways or contaminant migration. There would be no short-term or long-term minimization or elimination of hazards to human health or the environment. Since no action would be required, this alternative would be easy to implement; additionally, there would be no cost associated with this option.

4.0 AFFECTED ENVIRONMENT

4.1 Area A Landfill Site Description

The Area A Landfill is located in the northeastern and north central section of NSB-NLON. The landfill consists of a relatively flat terrace bordered by a steep ridge sloping up from the landfill on the south and a wetland (called the Area A Wetland) created from impounded dredge spoils from the Thames River on the north. There is a steep wooded ravine to the west. Aerial photos indicate that the landfill extends easterly along the southern edge of the Area A Wetland and that most filling occurred on the eastern and western limits of the landfill. The landfill is approximately 13 acres in size. Access is via a dirt road off Wahoo Avenue. Drainage from the landfill is from south to north through the Area A Wetland and ultimately into streams that discharge to the Thames River. The depth of landfill deposits is estimated to be between 10 and 20 feet. Gravel was used as cover material (Atlantic, 1995).

According to a report of an Initial Assessment Study (IAS) of the Area A Landfill conducted by Envirodyne Engineers, Inc. (Envirodyne, 1982), as described by Atlantic (1995), the landfill opened sometime before 1957. However, a 1957 aerial photograph shows no apparent landfilling, indicating a somewhat later startup date. All materials generated by base operations that were not salvageable were incinerated, and the residues were disposed in the Goss Cove and Area A Landfills. The base incinerator ceased operating in 1963, and from 1963 to 1973 all wastes were disposed in the landfill, unburned. During this time, all non-salvageable materials generated by the submarines and base operations were disposed in the Area A Landfill, including radioactive wastes and medical wastes from the hospital, industrial wastes from ship repair and maintenance facilities, commercial/residential wastes from housing and office facilities, and bulky wastes from construction activities. There are no records indicating the volume or type of wastes disposed of in the landfill (Atlantic, 1995).

Landfilling operations ceased in 1973. After closure, a bituminous concrete pad was constructed in the southwest portion of the landfill for the aboveground storage of industrial wastes. The pad is still in existence and is located adjacent to and northeast of Building 373, and south of the dirt road that bisects this area. At the time of the IAS survey, 42 steel drums, 87 transformers (mineral and PCB), and 60 to 80 electric switches were stored on the pad. Two transformers and several electrical switches were leaking. Past leakage of oil was also

evident. Most drums were stacked on wooden pallets and those having PCB labels were covered and bound with plastic sheeting. All of these materials have since been properly disposed of off-site (Atlantic, 1995).

According to Atlantic (1995), the IAS report also noted that refuse, including steel drums, oxygen candles, wood scrap, metal scrap, concrete, and tires, was exposed at the edge of the landfill adjacent to the Area A Wetland. The IAS reported that petroleum compounds had recently been poured from containers and had flowed into the wetland at two locations (northwestern portions of landfill). The IAS report also stated that when batteries were overhauled, spent sulfuric acid solution was transferred to barrels and transported to Area A for disposal. The acid was poured into trenches dug with a bulldozer and subsequently covered with soil (Atlantic, 1995).

As described in Section 4.2, present uses of the site include deployed parking and storage of salt, sand and other materials necessary to the NSB-NLON mission.

4.2 Land Use

Atlantic (1995) reports that land use adjacent to NSB-NLON generally consists of residential, undeveloped, and commercial lands. Residential development borders NSB-NLON to the north and extends north into Ledyard. Property east of NSB-NLON consists of widely spaced private homes and undeveloped wooded land. The nearest Groton/Ledyard resident is located along Route 12 approximately 1400 feet from the landfill. To the southeast along Route 12, development is mixed residential and commercial. Navy personnel housing is also located to the south approximately 1600 feet from the landfill (Atlantic, 1995).

Recreational facilities (including tennis courts and a racquetball building) are located along the eastern border of the Area A Landfill; the NSB-NLON Model Shop (Building 460) is located upslope near the southeastern border of the landfill (see Figure 2). Another formerly used disposal area called the Over Bank Disposal Area (OBDA), which has not been covered, is located immediately west of the Area A Landfill. The Area A Landfill itself is used for deployed personnel parking and storage of various materials used at NSB-NLON, including sand and sandbags, salt, transformers, removed underground storage tanks, crane weights, piping and other construction materials. Buried utilities (storm sewers) have been installed within the landfill, as well. With some exceptions, it is expected that these uses would continue after capping of the landfill. For example, it is expected that storm sewers would be

re-routed around the landfill, crane testing activities at the landfill may be moved to another site, and the landfill may serve as temporary access for construction vehicles to and from construction activities elsewhere on NSB-NLON (Atlantic, 1995; U. S. Navy, 1995).

4.2.1 Coastal Zones and Coastal Barriers

The Connecticut Coastal Management Act designates the town of Groton, Connecticut as being within the Connecticut Coastal Area. The Coastal Boundary is defined on maps provided by CTDEP and includes the northern half of the Area A Landfill. A Federal Consistency Determination under the Connecticut Coastal Management Act would be sought and obtained prior to implementing the proposed action.

4.2.2 Floodplains

Executive Order 11988 "Floodplain Management" directs federal agencies to ensure consideration of potential effects of flood hazards and floodplain management for any action taken in a floodplain and to avoid floodplain impacts to the extent practicable. A review of the floodplains maps provided by the Federal Emergency Management Agency (FEMA, 1995) indicates that the 100 year floodplain is downstream from the Area A Wetland adjacent to the Thames River and neither the Area A Landfill nor the Area A Wetland is in a floodplain. Since the Area A Landfill is not located in a floodplain, the requirements of Executive Order 11988 are not applicable. The Area A Wetland is discussed in detail in Section 4.7.1.

4.2.3 Wilderness Areas

The Wilderness Act contains provisions to assure that federal actions do not adversely impact designated wilderness areas. CTDEP indicated that there are no designated wilderness areas in the state (Winther, 1995).

4.2.4 Wild and Scenic Rivers

As with the Wilderness Act, the Wild and Scenic Rivers Act contains provisions to assure that federal actions do not adversely affect designated wild and scenic rivers. CTDEP indicated that only one wild and scenic river, the Farmington River, has been so designated in the state of Connecticut (Winther, 1995). It is located in the northern portion of the state.

4.2.5 Significant Agricultural Lands

Prime farmland, as defined by the U. S. Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops (SCS, 1983). Designated prime farmland may not be urban land, built-up land, or water areas. It must either be used for producing food or fiber or be available for these uses (SCS, 1983). The Area A Landfill and the adjacent land is a developed area built upon fill deposited over the last thirty years and does not meet the definition of prime farmland.

4.3 Geology and Soils

Previous reports on the Area A Landfill (e.g., Atlantic, 1992, 1995) indicate that NSB-NLON is situated in the Eastern Uplands region of Connecticut, an area that is characterized by irregular hilly areas with many swamps, exposed bedrock, and poorly drained, uneven valleys. A major east-west trending fault, the Honey Hill Fault, is present approximately six miles north of NSB-NLON. The ground surface slopes gently from the Area A Landfill toward the Area A Wetland. The southern edge of the landfill is bordered by a hillside. The ground surface drops along a steep ravine to the OBDA northwest of the landfill. The ground surface increases in elevation to the northeast from the tennis courts to Route 12 (Atlantic, 1995).

Most of the surficial deposits on NSB-NLON are unconsolidated glacial materials deposited during the Pleistocene Age. The remainder of the surficial deposits are the products of post-glacial geologic processes and man-made modifications. The glacial deposits are divided into two types: nonstratified drift (i.e., till or ground moraine) and stratified drift (i.e., outwash). Most of the bedrock at NSB-NLON is mantled by a thin layer of till which consists of a dense, heterogeneous mixture of clay, silt, sand and rock fragments ranging in size from cobbles to boulders. Till is exposed on most of the upland surface and underlies outwash materials in the valleys. It varies considerably in thickness and in some places is absent, but averages less than ten feet thick. Till mapped on NSB-NLON consists of either locally fissile, bouldery sand and gravel or a fissile, bouldery, silt and clay (Atlantic, 1995).

The bedrock at NSB-NLON can be divided into three age groups, Pre-Silurian, Pre-Pennsylvanian, and Pennsylvanian or younger. The local bedrock contains a complex series of folds, faults, anticlines and synclines. Pre-Silurian rocks at the site consist primarily of members of the Mamacoke Formation (gneiss) and, to a lesser extent, the Plainfield Formation (also gneiss). Pre-Pennsylvanian rocks occurring at NSB-NLON are members of the Sterling

Plutonic Group and consist of igneous intrusives that have been metamorphosed to granitic gneisses. The Sterling Plutonic Group is further divided into the Alaskite Gneiss and the Granite Gneiss (Atlantic, 1995).

In general, soils at NSB-NLON have moderate to moderately rapid permeability (SCS, 1983). Available water capacity is moderate to low, and runoff is rapid or very rapid. The pH is strongly to moderately acidic. Erosion hazard is severe. The soil in the Area A Landfill is mapped as primarily Udorthents-Urban Land, defined as excessively drained to moderately drained soils disturbed by cutting and filling. Along the southwestern slope of the landfill and in upgradient areas, the soil is classified as Hollis-Charlton-Rock Complex, defined as stones and boulders intermingled with a dark, fine, sandy loam. Bedrock outcrops and boulders are observable on this slope. Hydric soils present in the adjacent Area A Wetland consist of poorly and very poorly drained fine textured marine sediments (dredge spoils from the Thames River) and native, moderately textured, poorly drained glacial till soils (Atlantic, 1995).

Based on studies summarized in the FFS, soils at the Area A Landfill have been contaminated. Documented soil contaminants detected in the landfill include the following (Atlantic, 1995):

Surface Soils (Samples collected from depths of 0 - 6 inches and 0 - 2 feet):

- Volatile organic compounds (VOCs), predominantly xylene, toluene, chlorobenzene, and ethylbenzene, ranging in concentration from not detected to 75 ppm for individual constituents and from not detected to 93.5 ppm for total VOCs. Benzene was not detected in any surficial soil samples.

- Semivolatile organic compounds (SVOCs), predominantly polycyclic aromatic hydrocarbons (PAHs), ranging in concentration from not detected to 0.39 ppm for individual constituents, and from not detected to 1.58 ppm for total SVOCs.

- Pesticides, predominantly DDT, DDD, and DDE, ranging in concentration from non- detected to 2.3 ppm for individual constituents and from not detected to 2.87 ppm for total constituents. The criterion to be considered, or "TBC" value, for DDT is 0.50 ppm.

- Polychlorinated biphenyls (PCBs), ranging in concentration from not detected to 12.0 ppm for total PCBs. The TBC values for PCB are 10 ppm (EPA) and 2 ppm (CTDEP).

- Inorganic constituents of concern (heavy metals) on a mass basis were detected consistently and significantly above background levels, including beryllium, cadmium, barium, copper, lead, nickel, and zinc.

- Several inorganic constituents were detected above TBC values in a TCLP extract including: barium, cadmium, arsenic, and lead.

Subsurface Soils (Samples collected from depths greater than 2 feet):

- VOCs, predominantly toluene, ethylbenzene, and xylene, ranging in concentration from not detected to 75 ppm for individual constituents and 90.8 ppm for total VOCs. Benzene was not detected.

- SVOCs, predominantly PAHs, ranging in concentration from not detected to 61 ppm for individual constituents, and 321.2 ppm for total PAHs.

- Pesticides, predominantly DDT, DDD, and DDE, ranging in concentration from not detected to 1.7 ppm for individual constituents and 2.89 ppm for total constituents. The TBC value for DDT is 0.50 ppm.

- PCBs ranging in concentration from not detected to 51 ppm for total PCBs (concentrations ranged from not detected to 130 ppm using field screening techniques). The highest PCB concentrations were observed as "hot spots" near the bituminous concrete pad. The TBC values for PCB are 10 ppm (EPA) and 2 ppm (CTDEP).

- Inorganic constituents of concern (heavy metals) on a mass basis were detected consistently and significantly above background levels, including arsenic, barium, cadmium, copper, chromium, lead, nickel, and zinc.

- Several inorganic constituents were detected above TBC values in a TCLP extract including: arsenic, cadmium, lead, selenium, and silver; with the exception of selenium, all were detected in soils above background.

Two remedial action objectives were developed as a result of these data. One is to reduce the exposure of workers to PCBs located near the bituminous concrete pad. The other objective is to control, minimize, or eliminate, to the extent necessary to protect human health and the environment, post-closure escapes of hazardous substances to the environment.

4.4 Groundwater Resources

According to the FFS (Atlantic, 1995), groundwater in the vicinity of the NSB-NLON is present in stratified drift, bedrock and, to a lesser extent, till. A fine-grained stratified drift aquifer is mapped on the western and southwestern portions NSB-NLON. Mapped thickness of stratified drift ranges from ten feet along the banks of the Thames River to a maximum depth of 80 feet at the former location of Crystal Lake in the southwestern portion of the NSB-NLON. Average estimated permeabilities of wells in stratified drift in the area range from 250 to 1,400 gallons per day per square foot (gpd/ft^2). Well yields in the area range from 40 to 200 gallons per minute (gpm) (Atlantic, 1995).

In bedrock aquifers, groundwater movement is along joint planes rather than through intergranular openings. Well records indicate that bedrock wells in the vicinity of NSB-NLON yield from between one and 65 gpm. Potential well yields in bedrock wells are dependent on degree of fracturing, topography, and type and thickness of overburden (Atlantic, 1995).

Wetlands and watercourses downstream from Area A (i.e., the Area A Downstream) and the OBDA are physically separated from the Area A Wetland by an earthen dike and from the Area A Landfill by a steep slope (see Figure 2). It appears that groundwater in the central/eastern portion of Area A flows north toward the Area A Wetland and groundwater in the northwestern portion of the Area A Landfill flows northwest toward the Area A Downstream and eventually to the Thames River. The velocity of groundwater flow through sediments in the landfill and wetland portions of Area A was estimated to be 0.04 feet/day, using a hydraulic conductivity of 3.2 feet/day, a porosity of 0.30 and a hydraulic gradient of approximately 0.004. The groundwater flow velocity through the soils in the Area A downstream, using a hydraulic conductivity of 6.8 feet/day, 0.30 for the porosity, and 0.01 for the hydraulic gradient, was calculated to be 0.02 feet/day. Groundwater flows northeast across most of the landfill, from the bedrock high to the

Area A Wetland. Upward groundwater gradients from the bedrock to the overburden/fill are predominant. East of the landfill, groundwater flow is to the north and west. In the western portion of the landfill near the dike, groundwater flows to the northwest toward small streams downstream from Area A (Atlantic, 1995).

The CTDEP has classified the groundwaters beneath the central and southern portions of NSB-NLON as GB/GA. A classification of GB/GA indicates that the groundwater may not be suitable for direct human consumption without treatment due to waste discharges, spills, chemical leaks, or land use impacts. GB/GA waters may be useful for industrial process waters or cooling waters. The State's goal is to restore the water to drinking water quality (Halliburton NUS, 1995).

The groundwater beneath the north portion of NSB-NLON is classified by CTDEP as GA. This includes the area containing the Area A Landfill. The GA classification signifies groundwaters presumed suitable for direct human consumption without the need for treatment. The CTDEP's goal is to maintain drinking water quality (Halliburton NUS, 1995).

VOCs, SVOCs, and inorganic contaminants were found in groundwater at the Area A Landfill as a result of sampling and analysis efforts summarized in the FFS (Atlantic, 1995). VOCs were detected in groundwater at four (of twelve) monitoring well locations in Area A Landfill, as follows:

- benzene, 0.010 ppm (well 2LMW18S in a central location east of Deployed Parking; see Figure 2 for approximate location)
- chlorobenzene, 0.220 ppm (well 2LMW18S)
- ethylbenzene, 0.002 and 0.120 ppm (well 2LMW8S in a central location south of Deployed Parking, and well 2LMW18S)
- xylene, 0.002 and 0.840 ppm (wells 2LMW8S and 2LMW18S)
- dichloroethene, 0.001 ppm (well 2LMW13D at the northwestern border of landfill)
- tetrachloroethane at 0.140 ppm and 0.001 ppm (well 2LMW13D, and well 2LMW17D in the Deployed Parking Area)
- trichloroethene at 0.010 ppm (well 2LMW13D).

Several of these results indicate exceedances of groundwater standards or criteria. Drinking water standards for trichloroethene and benzene, both 0.005 ppm, were exceeded at wells 2LMW13D and 2LMW18S, respectively. The CTDEP proposed groundwater protection criteria

(GWPC) of 100 ppb for chlorobenzene was exceeded at one location (220 ppb at 2LMW18S) and the GWPC for 1,1,2,2 tetrachloroethane was exceeded at two locations in the Area A Landfill and in the area downstream from the landfill (Atlantic, 1995)

SVOCs were detected in four of the twelve monitoring wells sampled in the Area A Landfill at relatively low concentrations; total SVOC concentrations ranged from not detected to 279 ppb. The only SVOC that exceeded an associated regulatory level was 1,4 dichlorobenzene, found at 99 ppb at well 2LMW18S. The maximum contaminant level (MCL) for this constituent is 75 ppb (Atlantic, 1995).

The only inorganic constituent found in Area A Landfill monitoring wells in excess of a primary drinking water standard was cadmium. The standard for this constituent is 0.005 ppm and concentrations exceeding this concentration (up to 0.016 ppm) were found in five out of twelve wells monitored. Lead was detected in one well (2WMW2D) at 22.4 ppb, slightly above the EPA action level of 15 ppb. Secondary MCLs were exceeded at one or more well at or near the landfill for aluminum (MCL = 200 ppb), iron (MCL = 300 ppb), and manganese (MCL = 50 ppb), and sodium was detected at several locations at concentrations above the State of Connecticut's notification level of 28,000 ppb (Atlantic, 1995).

The monitoring well sample analytical results included in the FFS do not indicate any significant ongoing release of contaminants to the groundwater (Atlantic, 1995). Concentrations of most metals were generally lower in deeper wells than in the corresponding shallow wells in both Phase I and Phase II RI sampling events, and contamination appears to center around two wells, 2LMW18S and 2LMW8S, located in different areas of the landfill (Halliburton NUS, 1995).

4.5 Surface Water Resources

NSB-NLON is located on the east bank of the Thames River within the Thames River Watershed. The Thames River and its tributaries drain approximately 1,400 square miles of eastern Connecticut, western Rhode Island, and south central Massachusetts. The Thames River originates at the City of Norwich Harbor, at the confluence of the Shetucket and Yantic Rivers, and discharges into Long Island Sound approximately six miles south of NSB-NLON. The Thames River estuary extends from Long Island Sound north 16 miles to Norwich. Widths of the river vary from 1.5 miles at New London Harbor to approximately 500 feet at Norwich Harbor (Atlantic, 1995). Connecticut water quality standards [Connecticut General Statutes (CGS), Title 22a, Chapter 426] classification for the Thames River is SC/SB. This classification designates the

water for marine fish, shellfish, and wildlife habitat, certain aquaculture operations, recreational uses, industrial and other legitimate use, and indicates the waters presently are not meeting water quality criteria or not supporting one or more designated uses due to pollution (Atlantic, 1992).

Surface water from NSB-NLON drains west toward the Thames River via streams and storm sewers. The off site portion of these watersheds includes a sparsely developed residential area located to the east along Route 12 and an area with limited commercial development located north of the intersection of Crystal Lake Road and Route 12. On-site drainage includes several streams and ponds located in the north central section of NSB-NLON. These water courses discharge to the Thames River through various discharge points (Atlantic, 1995).

Runoff from the Area A Landfill drains as overland flow north into the Area A Wetland, which subsequently flows downstream to the Thames River (Atlantic, 1995). Surface water from the Area A Landfill originates from runoff within the northern NSB-NLON watershed area, and eventually discharge to the Area A Wetland and downstream surface waters. The primary discharge point from the Area A Wetland is through four 24-inch metal culverts through the dike. This discharge forms a small stream which flows west for approximately 200 feet and into a small pond. Wetland sediments accumulate upstream of the dike. Under normal flow conditions, this pond discharges to a small stream which flows north and then west toward Triton Avenue. The stream continues flowing west under Triton Avenue and Shark Boulevard and eventually discharges to the Thames River. This pond also has a discharge structure on the south side. During periods of high flow and high water at the pond, water also flows out through this structure to a stream which flows south from the OBDA. A second pond to the west of the pond referenced above is formed by groundwater inflow, and flows to the west around North Lake (Atlantic, 1995).

Groundwater also discharges from the Area A Landfill to a small wetland at the base of the dike and the OBDA. A stream flows from this wetland west toward North Lake, a recreational swimming area for Navy personnel. Under normal flow conditions the stream enters a culvert that bypasses North Lake and discharges to a stream below its outfall. This stream flows west under Shark Boulevard and through the golf course to the Thames River. There is a manhole adjacent to North Lake that connects to another pipe which was designed to discharge overflow water from North Lake; however, this pipe has been plugged. The invert elevation of this pipe is several inches higher than the main culvert, so that under normal flow conditions no water would have flowed to North Lake. However, under substantial runoff conditions it is possible that some water may have discharged to North Lake from this stream. At the time of Atlantic's site

inspection, North Lake had been drained, yet some water remained, indicating that it receives groundwater recharge (Atlantic, 1995).

4.6 Climatology, Meteorology, and Air Quality

Southeastern Connecticut has a variable climate that is defined by both continental and maritime air masses. The most pronounced topographical effect is the land-sea breeze, an occurrence generally associated with the spring through early autumn months (NOAA, 1994). According to data from Westbrook, Connecticut, the average annual temperature is 49°F. Average daily temperatures vary from 70°F in July to 28°F in January (NOAA, 1982).

The prevailing wind directions are from the northwest for the months of November through March and from the southwest for the months of June through August. Wind speeds are fairly constant throughout the year with an annual average velocity of 12 miles per hour (NOAA, 1982).

Precipitation is fairly evenly distributed throughout the year with an average rate of approximately 4 inches per month. The mean annual precipitation rate is approximately 47 inches per year (NOAA, 1982).

The State of Connecticut has established primary and secondary standards for the following criteria pollutants [Regulations of Connecticut State Agencies (RCSA), Title 22a-174]:

- sulfur dioxide
- particulate matter
- carbon monoxide
- ozone
- volatile organic hydrocarbons
- lead
- dioxin

NSB-NLON is in the Eastern Connecticut Intrastate Air Quality Control Region (AQCR) which is in attainment or is unclassified for carbon monoxide, nitrogen dioxide, and particulate matter less than 10 microns in diameter. This AQCR does not meet ambient standards (i.e., is a nonattainment area) for ozone (40 CFR 81.307).

Air pollutant emitting sources such as NSB-NLON must comply with the Connecticut State Agency Regulation Title 22a-174 "Abatement of Air Pollution." This regulation permits facilities that emit criteria or hazardous air pollutants.

4.7 Biological Resources

The New London/Groton area lies in the Central Hardwoods zone that covers a great portion of the northeastern United States. Due to settlement, agriculture, lumbering, and coal production, the virgin forests have been replaced by second or third growth stands. Many of the wetlands have been filled and are presently in commercial and residential use (NEESA, 1983).

Oak/beech/red maple forests dominate the upland forests on NSB-NLON while the common reed, *Phragmites australis*, dominates the wetlands.

The Area A Landfill is characterized by a flat graveled terrace with scattered patches of low growing grasses and forbs. A fenced vehicle parking area, a concrete storage pad, a salt storage shed, several large sand piles, and temporary storage facilities for building materials and sand bags are located on the terrace. A tennis court and racquetball court are constructed on the eastern end. Adjacent to and south of the landfill, the land rises sharply through a second growth hardwood forest dominated by American beech and various species of oak with an understory of mountain laurel (Giroux, 1995). Adjacent to the landfill and to the north is the Area A Wetland dominated by *Phragmites australis*.

Animal species common to the region would be expected to be found on NSB-NLON (NEESA, 1983). The following species have been recorded on the Area A Landfill, the adjacent upland woods, or the adjacent wetland area: mallard, house sparrow, swamp sparrow, northern mockingbird, common crow, red-tailed hawk, gray catbird, eastern gray squirrel, eastern cottontail, woodchuck, muskrat, eastern chipmunk, white-footed mouse, star-nosed mole, short-tailed shrew, raccoon, and otter (Atlantic, 1992).

4.7.1 Wetlands

The historical land use of the Area A Landfill and the Area A Wetland provides significant insight into wetland conditions that currently exist on site (Atlantic, 1995). Based on historic aerial photographic interpretation (discussed in the EPA Site Analysis, New London Submarine Base, Groton, Connecticut, dated March 1992), Area A was significantly altered by the pumping of

dredge spoils from the Thames River about 1960. An earthen dike was constructed across a relatively narrow valley at the western end of the area to contain the dredged spoils forming what is now referred to as the Area A Wetland. Dredge spoils were dewatered by pumping them behind the dike and allowing the water to drain through a culverted drop structure. Downstream from the dike, an existing small watercourse was dredged to allow flow from the drop structure into a man-made secondary sediment containment pond (Upper Pond), allowing further dewatering of the dredge spoils. An overflow structure and culvert were installed on the southern bank of the Upper Pond to allow overflows to enter the adjoining wetland (OBDA Pond). This dewatering system and disposal of dredge spoils eventually created 24 acres of man-made wetlands, the Area A Wetland, behind (east of) the earthen dam, and the Upper Pond. Earlier aerial photographs (1943, 1952, and 1957) reveal generally undisturbed conditions; wetland systems located within Area A appear during those dates to be isolated to relatively narrow wetland corridors generally associated with a watercourse. It is likely that only a fraction of the current 24 acres of wetlands existed prior to placement of the dredge spoils and associated structures (Atlantic, 1994).

The subject wetlands are comprised of both a broad, shallow marsh and several narrow corridors associated with intermittent watercourses and ephemeral hydrologic conditions. The majority of wetlands and adjoining upland areas have been subject to some form of disturbance (e.g., filling, sediment deposition, etc.). The plant communities dominating the landscape consist of disturbed fill areas, mowed lawns, shrub/sapling hedge row areas, scrub/shrub, shallow marsh, and wooded areas. The wetland boundaries generally occur along sharp slope breaks between both the disturbed, filled, and native bedrock-controlled topography uplands and the wetland areas (Atlantic, 1994).

Boundaries of the Area A Wetland were formally delineated in 1994 (Atlantic, 1994). The wetland encompasses 24 acres and is classified as predominantly a palustrine emergent, nonpersistent, narrow-leaved and broad-leaved deciduous scrub/shrub wetland with a nontidal artificial water regime. Isolated, scattered areas of open water (generally shallow) wetland areas are also contained within this wetland unit. Emergent, nonpersistent, narrow-leaved wetland vegetation is dominated by dense stands of common reed (*Phragmites australis*). The nontidal regime is classified as artificially flooded due to the earthen dike positioned at the western end of the wetland. The open water areas appear to be semipermanently flooded, with the majority of the wetland either seasonally flooded or saturated. Wetland soils are dominated by poorly to very poorly drained, fine-textured, marine sediments that originated from the Thames River. Wetland soils are classified as Aquents (Aq), defined as poorly to very poorly drained disturbed soil where

two or more feet of the original soil surface has been filled over or excavated. Aquents are characterized by a seasonal-to-prolonged high groundwater table and either support, or are capable of supporting, wetland vegetation. In addition, two upland islands were identified within this wetland: one near the northern end of the wetland adjacent to the NSB-NLON Weapons Center, and the other along the southern wetland boundary near the deployed parking area (Atlantic, 1994).

Surrounding upland soils consist of disturbed Udorthents-Urban land complex and undisturbed native glacial till soils. Udorthents-Urban land complex (Ud) is defined as excessively drained to moderately well-drained soils that have been disturbed by cutting or filling, and areas that are covered by buildings or pavement such as occurs in the vicinity of the tennis courts at the east end of the landfill. Native glacial till soils are classified as Charlton-Hollis fine sandy loams (Cr), which are deep, moderately deep and shallow to bedrock, well-drained, moderately coarse texture, friable glacial till soils, and Hollis-Charlton-Rock outcrop complex (Hr), which are mostly shallow to bedrock, somewhat excessively drained, moderately coarse textured, friable glacial till soils. Between 10 to 50 percent of the Hr map unit consists of rock outcrop (Atlantic, 1994).

4.7.2 Threatened and Endangered Species

No federal threatened or endangered species have been reported to occur on NSB-NLON (Metzler, 1994; Amaral, 1995). A review of the Natural Diversity Data Base maps and files revealed that six species of state-listed threatened, endangered, or special concern species have been recorded from NSB-NLON (Metzler, 1994), as follows:

Species	Status	Last Date of Observation
Acipenser oxyrhynchus (Atlantic sturgeon)	State Threatened	1968
Zizia aptera (Golden alexanders)	State Endangered	1993
Ranunculus cymbalacia (Seaside crowfoot)	State Endangered	1902
Lespedeza repens	State Special Concern	1932

(Creeping bush-clover)		
Aster prenanthoides (Crooked-stem aster)	State Special Concern	1937
Carex crawfordii (No common name)	State Special Concern	1933

The Area A Landfill is an extremely impacted area with a history of intense use for over 30 years. The remediation activities would take place largely on the graveled terrace and the slope adjacent to the Area A Wetland. This area contains no habitat suitable for the listed species and it is unlikely that they occur there. The second growth hardwood forest adjacent to and upslope from the landfill is the only area that supports relatively unimpacted vegetation as indicated by the large American beech (*Fagus grandifolia*) and mountain laurel (*Kalmia* sp.).

4.7.3 Ecological Risk Assessment

An assessment of current risks to terrestrial and aquatic biota in the Area A Landfill and adjacent wetland has been conducted; results are presented in the Phase I RI report (Atlantic, 1992) and summarized in the FFS (Atlantic, 1995). In general, estimated risks to biota from the Area A landfill are low. However, erosion of contaminated surface soils from the Area A Landfill to the adjacent wetlands present a continuing source of contamination which could increase risk to plants and animals in the wetland. As noted in the Phase I RI report, considerable uncertainty exists in both exposure and toxicity information available for use in the assessment. Therefore, assessment results are considered a qualitative estimate only.

4.8 Occupational and Public Health

The Phase I RI report (Atlantic, 1992) as summarized in the FFS (Atlantic, 1995), also provides an assessment of risks to human health that considers current and future land use, current site conditions and contaminants present, receptors and exposure pathways, and quantification of exposure. Following is a summary of the human health risk assessment as described in the FFS.

4.8.1 Current and Future Land Use

The Area A Landfill is used primarily for storage of various materials, including transformers, removed underground storage tanks, and crane weights. Military servicemen use a section of the landfill area for parking their vehicles while on sea duty. Current on-site activities include daily movement of stored items on wooden palettes, preparation of sandbags during summer months, and occasional storm sewer repair. The site is also periodically visited by the public during auctions of abandoned cars in the parking area. Because of existing uncovered dirt piles and current on-site activities, fugitive dust generation is likely.

The nearest Groton/Ledyard residence along Route 12 is 1400 feet from the site. Residential housing for junior officers and their families is approximately 1600 feet from the landfill. Recreational activities in close proximity to the Area A Landfill include military servicemen jogging along Wahoo Avenue and playing tennis at nearby tennis courts. A standing watch exists when Alpha Area storage is closed, but access is possible from the road and a wooded hillside to the west.

Based on discussions with Navy personnel, future uses of these areas are expected to remain the same as current use.

4.8.2 Chemicals of Concern

Inorganic and organic compounds were detected at elevated levels (i.e., above background) in the surface soils, subsurface soils, and groundwater at the Area A Landfill during the Phase I investigation. During selection of the Chemicals of Concern for evaluation, the following chemicals were evaluated for this area:

Non-carcinogenic PAHs (All HSL Compounds Included)[a]	**Carcinogenic PAHs** (All HSL Compounds Included)[a]	**PCBs** (Aroclors 1260 & 1254)
Other Semi-Volatiles (12 compounds: primarily phthalates and phenols)	**Pesticides** (7 compounds: DDT residues, endrin, methoxychlor)	**Metals** (14 metals: Al, Sb, As, Be, B, Cd, Cu, Fe, Pb, Mn, Hg, Ni, Se, Zn)
BTEX Compounds (All BTEX compounds)[b]	**Chlorinated Volatiles** (13 compounds)	**Other Volatiles** (4 compounds)

[a] HSL = Hazardous substance list.
[b] BTEX = benzene, toluene, ethyl benzene, and xylene, common contaminants from petroleum.

4.8.3 Receptors and Exposure Pathways

Based on information obtained during the FFS, the following potential receptors were identified:

- Utility workers repairing storm sewers in landfill;
- Weapons center personnel exposed to fugitive dust from landfill;
- Military servicemen moving pallets in Alpha A Storage;
- Military servicemen exposed to fugitive dust while engaging in nearby recreational activities;
- Groton/Ledyard residents exposed to fugitive dust;
- Citizens attending car auctions in Deployed Parking Area.
- NSB-NLON children playing in adjacent areas and exposed to fugitive dusts from the Area A Landfill and a similar NSB-NLON landfill located near the Thames River (the Defense Reauthorization Marketing Office, or DRMO, site).

4.8.4 Risk Assessment Methods

Risk calculations were made for chemicals with regard to their potential carcinogenic health risks and other (non-carcinogenic) health risks. These calculations were carried out in accordance with standard U.S. EPA guidance and also reflect specific guidance provided by U.S. EPA Region I in their guidance documents and discussions.

In estimating the risk, the maximum values reported for each chemical detected in subsurface soils were used in each scenario. In addition, the most recent U.S. EPA guidance concerning exposure factors and toxicity values was used in making the risk estimates.

Non-carcinogenic health risks were evaluated using the Hazard Index. Risks are presumed to exist for a particular receptor when the Hazard Index exceeds "1" for all the compounds and pathways combined. When the Hazard Index is less than "1" , non-carcinogenic health risks are considered to be negligible. If the Hazard Index exceeds "1", the compounds contributing to the risk and target organs are reviewed to evaluate whether different non-carcinogenic effects are being assessed.

Carcinogenic health risks were evaluated with respect to incremental lifetime risk of cancer for an exposed individual. These risk estimates were compared to one in one million (10^{-6}) to one in ten thousand (10^{-4}) range identified by the U.S. EPA. Risks less than 10^{-6} are generally considered negligible, while risks greater than 10^{-4} are generally considered indicative of requirements for remedial action. Within these two ranges requires risk management decisions that involve a variety of factors.

Lead exposure for workers was evaluated by comparison to the 500 to 1,000 mg/kg range used by EPA in the past for assessing adult exposure to lead at commercial/industrial sites. EPA established a screening level of 400 ppm lead in soils for protection of children in a residential setting using the Integrated Exposure Uptake Biokinetic (IUBK) model.

Groundwater within Area A contains VOCs and cadmium at levels above drinking water standards/guidance values, indicating a potential health risk if the water were to be consumed.

Dust concentrations for the fugitive dust scenarios were either modeled or an ambient particulate concentration was selected. In the storm sewer scenario, the soil samples collected to a depth of eight feet were used to calculate exposure point concentrations based on the depth to sewers in this area. Depth to groundwater in the Area A Landfill ranges from approximately 6 to 16 feet below the surface. Therefore, exposure to groundwater in this area is considered unlikely, but possible if storm sewers are located where the water table is less than eight feet beneath ground surface (Atlantic, 1995).

4.8.5 Results

The results of the Risk Assessment presented in the FFS (Atlantic, 1995) for each scenario are as follows:

Utility Worker Repairing Storm Sewers in Area A Landfill

The Hazard Indices do not exceed "1" for this scenario, and the carcinogenic incremental lifetime risk associated with soil contaminant exposure fell between 10^{-6} and 10^{-5}. The risks were primarily due to the presence of PCBs in the subsurface soils, and to a lesser extent, the presence of carcinogenic PAHs. Combined, the carcinogenic PAHs contributed a maximum of approximately 10^{-6} risk. The distribution of the PCB and PAH contamination in the soil was patchy; therefore, the average risk is expected to be lower than that estimated using the maximum values. Based on the results of the analysis, the risks to the workers in this scenario are judged to be low.

Weapons Center Personnel Exposed to Fugitive Dust from Area A Landfill

The non-carcinogenic health risks and the incremental carcinogenic risks are within levels considered to be acceptable.

Military Servicemen moving Pallets within Area A Landfill

Non-carcinogenic health risks were negligible for these workers. Incremental lifetime cancer risks of 8.5×10^{-6} are within the U.S. EPA acceptable range. The risk is primarily due to the presence of PCBs in the landfill surface soils.

Military Servicemen Exposed to Fugitive Dust While Engaged in Recreational Activities Near Area A Landfill

The non-carcinogenic health risks and the incremental carcinogenic risks are negligible for potential receptors in this scenario.

Groton/Ledyard Residents Exposed to Fugitive Dust from Area A Landfill

The non-carcinogenic health risks and the incremental carcinogenic risks are negligible for potential off-site receptors in this scenario.

Citizens Attending Car Auctions in Deployed Parking Area

The non-carcinogenic health risks and the incremental carcinogenic risks are negligible for auction participants in this scenario.

Subase Children Exposed to Fugitive Dust from DRMO and Area A Landfill

Systemic (noncarcinogenic) and cancer risks are estimated to be negligible via exposure to fugitive dusts.

The human health risk assessment for the Area A Landfill as summarized in the FFS indicates that for the scenarios considered, the risks to human health from the landfill are present but minimal. These minimal risks are due primarily to the presence of PCBs in the landfill soils.

An updated baseline risk assessment is being prepared as part of the Phase II RI Report, presently in draft (Halliburton NUS, 1995). As was done for the completed risk assessment in the Phase I RI summarized above, the revised assessment considers potential exposure of multiple receptor groups, including utility workers, visitors, residents, and military personnel. This revised baseline risk assessment suggests higher risk that is indicated by the Phase I RI assessment. Based on these results, a number of these receptor groups may incur incremental lifetime cancer risk approaching the upper bound of the EPA's target risk range (1×10^{-4}), and utility workers could incur risks in excess of the upper bound. In general, the risk assessment results reported in the draft Phase II Report indicates that the landfill may pose a threat to the public health and to the groundwater at the facility. The proposed action would effectively address these concerns.

As noted in the Phase I RI report (Atlantic, 1992), there are numerous uncertainties associated with risk estimates for both carcinogens and non-carcinogens. These uncertainties are associated with both exposure to contaminants as well as toxicity estimates. The fact that uncertainties exist in estimating potential effects of low doses on humans using data on high

doses to animals broadly recognized. As a result of these uncertainties, assumptions were incorporated into the risk analysis which tend to overestimate resulting risk estimates.

4.9 Cultural Resources

The American Religious Freedom Act, Archaeological Resources Protection Act, National Historic Preservation Act, and the Native American Graves Protection and Repatriation Act require federal agencies to consider the potential impact of their actions on archaeological, cultural, and historic resources. A Step 1 Cultural Resources Survey has been completed for NSB-NLON and revealed no historic or prehistoric resources in or adjacent to the Area A Landfill (Giroux, 1995).

4.10 Socioeconomic Resources

The economy of the region is heavily dependent upon industry and government employment. Approximately 15,000 military personnel are assigned to facilities in the region, including the Navy Submarine Base, the Coast Guard, and the Naval Underwater Systems Center. Industries allied closely with national defense once employed approximately 20,000 civilians at its facility; that number is steadily decreasing because of Department of Defense cutbacks. Tourism is becoming economically important to the region. Fishing and agriculture play a smaller role. Dairy and poultry farming are the major agricultural activities. Except for some commercial lobstering and other shellfish harvesting, fishing in the area is primarily recreational. A major new economic force in the region is the Foxwoods Casino Complex, which opened in February 1992 in the town of Ledyard. Owned by the Mashantucket Pequot Indians, Foxwoods employed over 3,800 people; the complex has since proposed plans for expansion into surrounding communities (Atlantic, 1995).

The towns of Ledyard and Groton typify the differences in the region's local communities. Ledyard is primarily a residential community of approximately 15,000 people. The town of Groton is a much more commercial and industrial community than Ledyard. The town of Groton has approximately 45,000 residents. Industry makes up more than 32% of the tax base for the town of Groton.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 Land Use

5.1.1 Proposed Action

The proposed action would preserve and enhance existing land uses at the Area A Landfill by reducing potential health risks to persons involved in landfill activities (e.g., vehicle parking, material storage, and related activities) and by providing improved drainage and working surfaces (e.g., gravel, pavement) for these activities. Similarly, the proposed action offers potential to preserve and enhance land use downstream from the landfill through reduced risk to persons who may be exposed to contaminants in surface waters.

Temporary disruption of adjacent recreational uses (e.g., tennis) and annoyance to nearby residents may be experienced during the remediation phase. For example, construction activities associated with implementation of the proposed action would involve movement and operation of vehicles, earth-moving equipment, drilling rigs, and workers, and would be associated with occasional high noise levels (e.g., drilling rigs, air compressors and portable generators) as well as high intensity lighting if work is done at night. The increase in local noise levels associated with the operation of heavy equipment would be temporary in nature and would be minimized by ensuring that equipment is properly equipped with functional noise abatement systems where required, and by confining such activities to daylight hours to the extent practicable.

No impacts on other land uses would result from the proposed action. Such uses include floodplains, prime farmland, coastal zones, wild and scenic rivers, and wilderness areas. The landfill lies within the coastal boundary established under the Connecticut Coastal Management Act. However, a federal consistency determination under this statute would be sought and obtained prior to initiating the proposed action.

5.1.2 No Action

The no action alternative would have essentially no immediate effect on existing land uses. However, efforts to stabilize and remediate the landfill could result in decreased potential for existing uses of this area in the future.

5.2 Geology and Soils

5.2.1 Proposed Action

Effects on the geology would primarily involve the removal of some bedrock outcrops during the grading process. These outcrops would be removed, crushed, and used as clean fill in other areas of NSB-NLON where practicable. The proposed action would have no effect on minerals, petroleum resources, or other geologic or soil resources of any particular economic value.

The proposed action would involve a number of activities with the potential for disturbing soils. Removal of vegetation on the landfill surface and exposure of soils (Cervenak, 1995) would contribute to increased erosion temporarily during the capping process. However, erosion and potential sedimentation would be controlled by implementing an effective erosion and sedimentation control plan in accordance with CTDEP regulations (see Section 5.4.1).

5.2.2 No Action

The no action alternative would leave contaminated soils in their present condition. No cap or other source control measures would be installed or implemented, allowing potential for continued erosion and movement of contaminants through soils. Erosion of the contaminated soils could result in siltation and sedimentation within the Area A Wetland, discussed below. The no action alternative would allow the continued movement of contaminants through the vadose soils into the shallow groundwater in the Area A Landfill. However, it is expected that there would be some attenuation of volatile organic constituents in upper soil horizons.

5.3 Groundwater Resources

5.3.1 Proposed Action

The proposed action is expected to have a positive effect on the groundwater of the landfill, in that by capping the landfill, infiltration through the contaminated soils and potential transportation of the contaminants into groundwater would be reduced. Therefore, some improvements to groundwater are predicted. However, due to remaining contamination in the saturated zone, these improvements may be limited.

5.3.2 No Action

The no action alternative would allow continued movement of contaminants through the vadose soils into the shallow groundwater in the Area A Landfill. Some attenuation of volatile organic constituents in upper soil horizons would be expected, but existing potential for movement of non-volatile or "semi-volatile" organics (e.g., lubricants) into groundwater would continue.

5.4 Surface Water Resources

5.4.1 Proposed Action

A small amount of erosion is possible from installation of the cap and construction of the diversion ditch. A proportionately small amount of sediment could enter the Area A Wetland and be transported downstream as a result of these earth-moving activities. Although siltation and sedimentation could occur, it would have no lasting effect on water quality and would cease to be a concern once areas adjacent to the wetland are stabilized. Construction activities would be conducted in accordance with Clean Water Act requirements under the National Pollutant Discharge Elimination System (NPDES) stormwater regulations as administered by CTDEP. Measures to control erosion and sedimentation would be implemented in accordance with the required erosion and sedimentation control plan, which would include such standard construction techniques as sediment barriers and construction sequencing to minimize soil exposure.

Once implemented, the proposed action is expected to have a net positive impact on surface waters due to the elimination of a potential pollution source (i.e., contaminated soils and landfill contents) to the Area A Wetland and downstream areas. Any adverse effects on surface water during the operational phase of the action are expected to be minor at worst. The potential for such effects include erosion or scouring of Area A wetland sediments, introduction of contaminants to the wetland from material storage or spills, and changes in drainage influent rates to the wetland. However, drainage diversion facilities around the landfill would be designed to minimize potential scouring of wetland sediments at influent points (i. e., through the use of broad trapezoidal channels, etc.) and the cap would be designed to control runoff as sheet flow to the rip-rap covered slopes to eliminate potential

erosion and scouring. Potential for spills resulting from future activities on the landfill (e.g., vehicle parking, material storage) would be minimized by compliance with best management practices, stormwater pollution prevention plan requirements, and other ARARs.

The cap and diversion facilities for stormwater and shallow groundwater are likely to result in minor changes in the rates and amounts of surface water and groundwater inflow to the Area A Wetland. The impervious cap would reduce infiltration of stormwater and thus decrease groundwater influent to the wetland while increasing both the rate and quantity of surface water influent. The diversion facilities would intercept stormwater and shallow surface water upgradient from the landfill cap and route it around the landfill. Nearly all of this intercepted water would be routed as surface water influent to the Area A Wetland; water intercepted from a small area at the northwest end of the landfill may be drained to an existing watercourse beyond the dike. A net gain in the long term average amount of water entering the wetland may occur since groundwater presently lost due to evapotranspiration from the landfill surface would be essentially eliminated by the cap. However, the proposed drainage provisions would result in little, if any, change in drainage area to the wetland, so any change in the total amount of water entering the Area A Wetland would be minor. Rates of flow to the Area A Wetland (and induced water level fluctuations) are likely to be increased somewhat, particularly during storm events, since these influents would be more directly routed to the wetland and would be less subject to the attenuation, or leveling effect, normally associated with groundwater influents. However, such effects would be minor at worst since the 13-acre cap (which would be expected to have the greatest influence on influent rates) represents only 10 percent of the Area A Landfill drainage area (Cervenak, 1995b) and some stormwater enters the wetland as overland flow at present. Any resultant effects on surface water elevations in the wetland would be limited by the drop structure culvert which discharges through the dike to downstream watercourses and wetlands.

5.4.2 No Action

The no action alternative could result in the continued movement of contaminants through the soils into the groundwater and eventually into the wetlands adjacent to the landfill, and continued potential for erosion and direct introduction of contaminated sediments to the wetland. These sources of contamination could ultimately result in some degradation of downstream water quality. Existing surface and groundwater flow regimes would remain unchanged.

5.5 Air Quality

5.5.1 Proposed Action

Operations involved in the capping of the Area A Landfill such as grading and the moving of soil would create fugitive particulate emissions. The guidance listed in CTDEP Regulation 22a-174-18 (b) regarding fugitive dust control would be followed. The capping and remediation of the Area A Landfill would take the following reasonable precautions to prevent particulate matter from becoming airborne, such as the following: the use of water for the control of dust during the grading and/or clearing of the landfill; covering, at all times when in motion, open-bodied trucks transporting soil likely to give rise to airborne dusts; and prompt removal of any soil from paved streets deposited by trucking or earth-moving equipment, erosion by water, or other means.

According to the FFS (Atlantic, 1995) the types of materials discarded into the landfill included steel drums, wood and metal scrap, concrete, tires, transformers (mineral and PCB) and electric switches, and some petroleum compounds. Additionally, Section 1.6.2 of the above document states that soil contaminants detected include volatile organic compounds and semivolatile organic compounds with concentrations ranging from a few parts per million to 300 parts per million. The temporary grading and moving of these soils would not release quantities of volatile organics high enough to have a measurable effect on air quality.

A methane gas survey of thirty-seven sampling locations in the Area A Landfill showed 29 locations with nondetected levels and 4 locations with methane levels greater than 25% of its lower explosive limit (LEL) (Atlantic, 1995). Venting of the methane gas from under the cap is not viewed as a major air pollution concern since the proposed action would merely serve to facilitate landfill venting (an ongoing process), vented methane would be maintained well below its LEL, and the fact that methane is not classified as a volatile organic compound. However, Connecticut's Air Pollution Control Regulations indicate that permitting and emission controls may be required if emissions exceed 5 tons per year. Necessary studies and coordination with CTDEP would be effected to ensure all applicable requirements are met.

5.5.2 No Action

The no action alternative would result in continued emissions of contaminated fugitive dust, emissions of VOCs due to volatilization of organic constituents in the soil, and methane from decomposition of organics in the landfill. There would be some reduction in concentrations of both organic and inorganic contaminants in upper-profile soils over time as a result of the processes described earlier in Section 3.0. This would in turn reduce airborne concentrations of both organic and inorganic contaminants.

5.6 Biological Resources

5.6.1 Proposed Action

Although the adjacent wetlands and upland hardwood forest do provide some wildlife habitat, the landfill where the remediation would take place consists predominantly of a graveled terrace used for vehicle parking and material storage which provides little if any wildlife habitat. Consequently, no measurable impacts to small mammal, reptile, and bird populations or their habitat are expected to result from implementation of the proposed action. The only notable area of wildlife habitat is the second growth hardwoods located upslope from the Area A Landfill. The diversion ditch has the potential to encroach on this area but any resultant impact is expected to be minor.

Construction activities associated with implementation of the proposed action would involve movement and operation of vehicles, earth-moving equipment, drilling rigs, and workers and would be associated with occasional high noise levels (e.g., drilling rigs, air compressors and portable generators) as well as high intensity lighting if work is done at night. Any resulting disturbance to wildlife in the vicinity would be temporary in nature.

Based on a review of habitat requirements (Metzler, 1995), the five special status plant species listed by the State of Connecticut and reported to have been observed on NSB-NLON (Section 4.7.2) are not expected to occur on the highly disturbed landfill site. The Atlantic Sturgeon would be confined to the estuarine waters of the Thames River. Therefore, the proposed action would not affect these species. Initial discussions with the U.S. Fish and Wildlife Service (Amaral, 1995) indicate concurrence with the position that no federally listed threatened or endangered species occupy potentially affected areas. A determination of no

impact on federally listed species would be sought and obtained from the U.S. Fish and Wildlife Service in accordance with Section 7 of the Endangered Species Act prior to implementing the proposed action.

No wetlands would be directly impacted by the proposed action. All construction would take place on the upland side of the delineated wetland line (Atlantic, 1995). A small amount of siltation could occur in the Area A Wetland adjacent to the landfill during remediation activities, but no measurable impacts to wetland values (e.g., fish and wildlife habitat) and functions (e.g., flood control) would be expected. As noted in Section 5.4.1, potential impacts from surface water runoff and siltation of the wetland would be reduced to acceptable levels using appropriate design provisions, implementation of an effective erosion and sedimentation control plan, and compliance with other relevant ARARs. No appreciable effects on the wetland biotic community are expected from changes in hydrologic regime and induced water level fluctuations (Section 5.4.1); such changes would be within the range of normal variations experienced at present, to which the existing wetland community is well adapted.

5.6.2 No Action

The no action alternative would have no impact on biological resources other than continued effect of possible seepage of contaminated groundwater and transport of contaminated sediments into the adjacent wetland, discussed earlier in Section 5.4. These contaminants could, depending on ambient concentrations, result in reduced abundance and diversity of aquatic life, such as benthic macroinvertebrates and small fish, in the wetland and further downstream. The no action alternative would have no effect on threatened or endangered species. In general, the estimated ecological risks to wildlife and plants of the Area A Landfill are considered to be low (Atlantic, 1995).

The no action alternative would have no discernible effect on wetlands, other than the possible movement of contaminants into the Area A Wetland as discussed in Section 5.4.

5.7 Occupational and Public Health

5.7.1 Proposed Action

Short-term exposure of construction workers to contaminated soil under this alternative from removal, grading, and transport resulting in dermal contact and incidental ingestion, as well as exposure to fugitive dust particles and volatiles, would be of potential concern. However, risks to on-site workers would be maintained at acceptable levels by air monitoring, by using appropriate engineering and construction management controls when required, and by using the proper personal protective equipment (to protect against dermal contact and inhalation of contaminants) in accordance with an approved site-specific health and safety plan as required for remediation conducted in accordance with the NCP.

There would be some short-term risk due to spills during contaminated soils transport. However, these risks are considered low because the chance of a spill is unlikely and, if a spill does occur, the soils could be readily contained, since they are solid.

In the long term, exposure of persons engaged in activities on or near the Area A Landfill to landfill contaminants from dermal contact, incidental ingestion, and inhalation of particulates (of soil contaminants present at the ground surface or at depth) would be essentially eliminated by capping. The planned monitoring of the integrity of the cap would ensure that these exposure routes would not be present in the future.

There are no construction projects proposed for the Area A Landfill site that would require exposure of underlying soils after installation of the cap. Institutional controls and operations and maintenance procedures to be followed by persons working at the Area A Landfill would prevent unauthorized construction activities. These controls and procedures would also ensure appropriate measures would be taken (e.g., use of personal protective equipment) to adequately ensure worker health and safety in the event future construction offers potential for exposure to contaminated soils or groundwater. Installation of a cap does not eliminate the possibility that contaminants in the saturated zone may leach to groundwater, or that organic compounds may migrate both laterally as well as vertically.

5.7.2 No Action

The no action alternative assumes that no remedial action would occur. The no action alternative would allow a small but unacceptable risk to on-site workers (from dermal contact, incidental ingestion, and inhalation of volatiles and particulates from the contaminated soils) and to a lesser degree, the public. Under the no action alternative, contaminated soil in the Area A Landfill would not be contained or isolated. Contaminants would eventually come into contact with percolating rainwater and produce leachate that could further contaminate groundwater and could migrate off-site, potentially into the Thames River. The no action alternative offers only a minimal reduction in risk over time as a result of the natural attenuation of organic contaminants in the soil. In addition, the progress of attenuation would not be monitored. Since the no action alternative does not involve construction activities and disturbance of contaminated soils, the potential short-term risks to on-site workers and the public during the construction period as described for the proposed action would be avoided.

5.8 Socioeconomic Resources

5.8.1 Proposed Action

The proposed action would involve small crews operating construction and earth-moving equipment and supporting utilities. Any change in employment would be very small relative to the NSB-NLON work force and the regional work force. Most of the workers (such as equipment operators, electricians, and well drillers) most likely would be from the Groton area; a few others may temporarily relocate from outside the region. The socioeconomic effects of the proposed action could be viewed as a minor, but positive, impact.

5.8.2 No Action

The no action alternative would not alter existing employment levels and would not result in socioeconomic impacts.

6.0 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS AND CONSIDERATIONS THAT OFFSET ADVERSE IMPACTS

Implementation of the proposed action would unavoidably result in some adverse impacts. However, these impacts would be minor; most would be restricted to the construction phase of the project. Depending on the final location and design of the diversion drain and southern boundary of the cap, a small amount of second growth slope forest could be lost, and materials (e.g., aggregate, fuel) would be consumed in the construction process. However, the potentially affected woodlands are not unique, nor are they known to harbor species deserving of special protection measures. Materials that would be consumed consist of common fuels and construction materials that are readily obtainable.

Notable temporary adverse effects during construction consist of potential for reduced availability of the landfill for existing uses (vehicle parking, material storage, etc.), localized fugitive dust and noise from heavy equipment, introduction of sediments to the Area A Wetland, and exposure of construction workers to contaminated soils. Potential for disturbance to residents would be reduced to the extent practicable by ensuring that appropriate noise abatement systems are installed and maintained on construction equipment. Potential for fugitive dust generation during construction would be abated by such standard construction methods as wetting exposed soils when necessary. Exposure of construction workers to contaminated soils would also be maintained at safe levels through the use of appropriate personal protective equipment and other measures as dictated by an approved site-specific health and safety plan. Potential for siltation of the adjacent Area A Wetland waters would be controlled through the use of an approved erosion and sedimentation control plan.

7.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Implementation of the proposed action would unavoidably result in some minor adverse impacts as described in Sections 5.0 and 6.0 of this report. However, this action would be fully compatible with land use plans and policies of the Navy and other government agencies, including land use controls established for coastal zones, floodplains, and wetlands. Installation of the cap and associated features would preserve and enhance existing land uses in the longer term by reducing potential health risk to personnel on and near the Area A Landfill and by providing enhanced parking and storage facilities on the landfill proper as needed to support the Navy's continued mission at NSB-NLON.

As discussed in Section 2.0, ARARs were carefully considered in the evaluation of remedial alternatives in the FFS. ARARs pertinent to the proposed action include a broad range of requirements, including federal and state laws and regulations related to air and water pollution; waste management and waste site remediation; protection of wetlands, biota, cultural resources, and land use values; and related environmental values (Atlantic, 1995). Compliance with these requirements in the planning, construction and operation phases of the proposed action provides substantial assurance that any impacts to human health and the environment would be maintained at acceptable levels.

8.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible and irretrievable commitment of resources associated with the proposed action would be of a minor nature. Some minor loss of second growth slope forest, common in the region, could occur to accommodate the cap and diversion drainage system. All materials to be used in the proposed action are readily available, common construction materials (i.e., gravel, geotextiles, asphalt, fuel, etc.).

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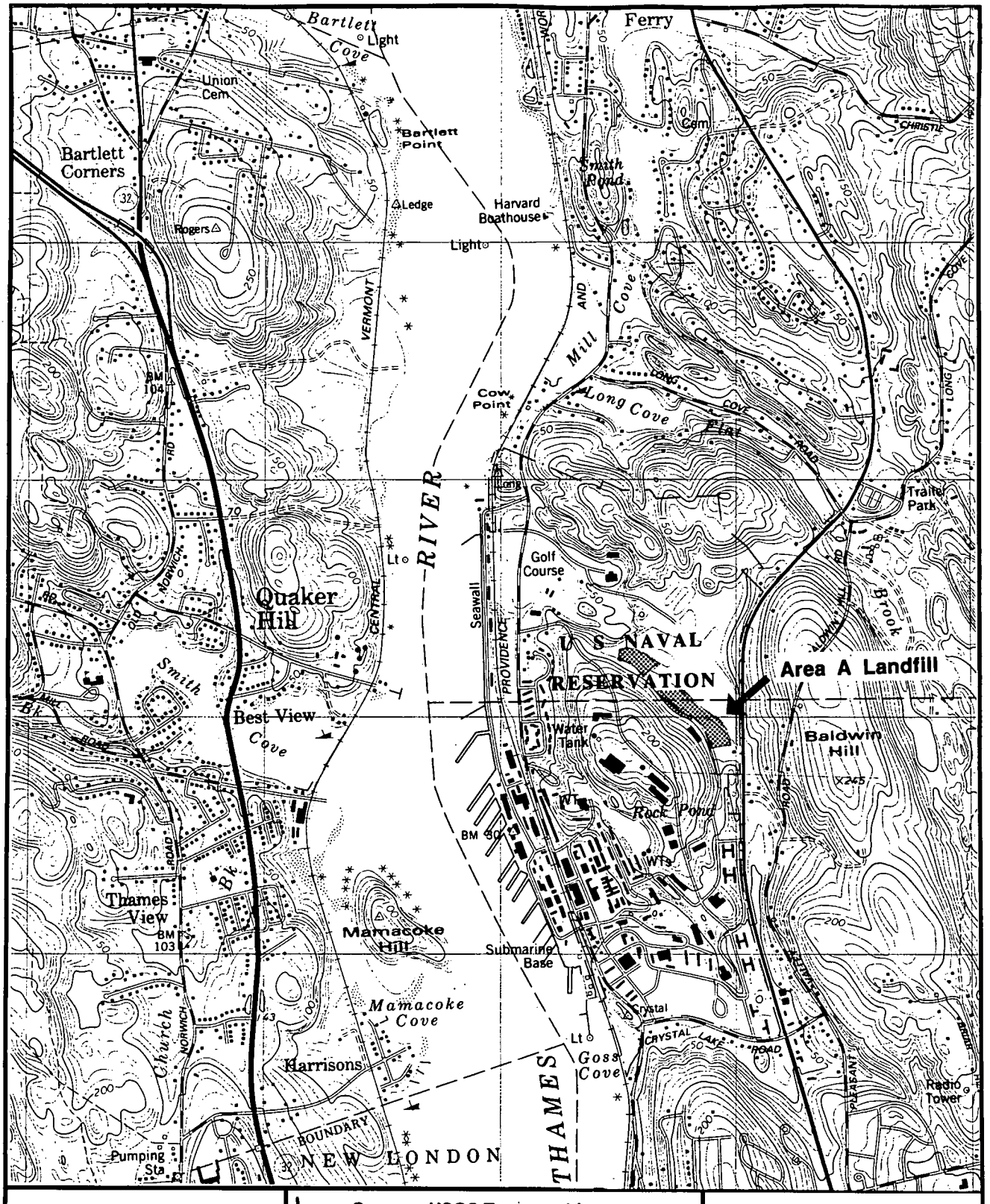

Naval Submarine Base - New London

Gr ton, CT

Source: USGS Topographic Quadrangle, Uncasville, CT

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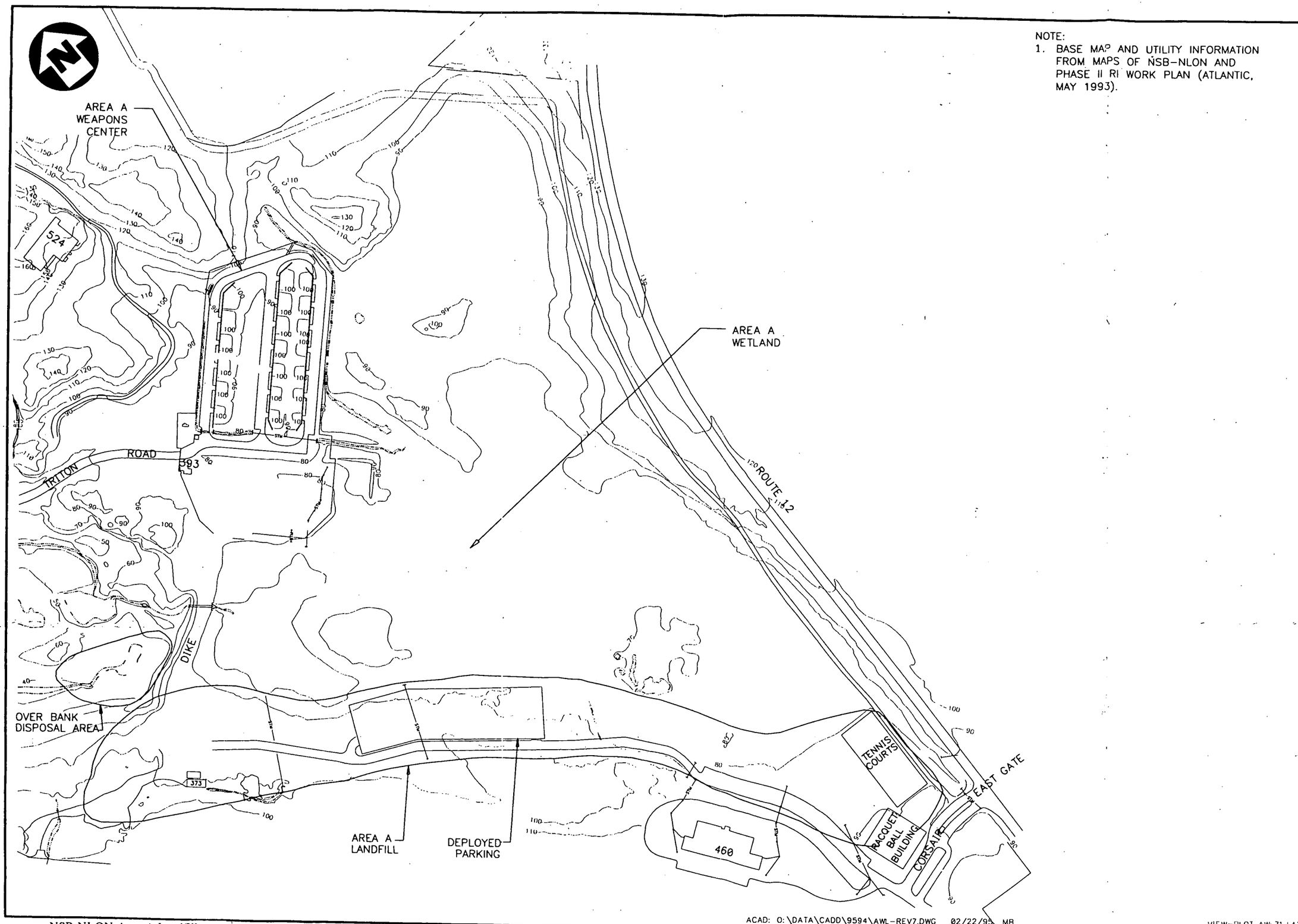
Figure 1

Site Location

Halliburton NUS CORPORATION



NOTE:
1. BASE MAP AND UTILITY INFORMATION FROM MAPS OF NSB-NLON AND PHASE II RI WORK PLAN (ATLANTIC, MAY 1993).

FIGURE 2

GENERAL SITE ARRANGEMENT
AREA A LANDFILL AND WETLAND

Halliburton NUS CORPORATION