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FEASIBILITY STUDY
for
OU-1

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

Northern Division
Naval Facilities Engineering Command
Contract No. N62472-90-D-1298
Contract Task Order 0279

October 1996

BROWN & ROOT ENVIRONMENTAL

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OCTOBER 1996

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FEASIBILITY STUDY
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OU-1

NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Northern Division
Environmental Branch, Code 14
Naval Facilities Engineering Command
10 Industrial Highway, Mall Stop #82
Lester, Pennsylvania 19113-2090

Prepared and Submitted by:
Brown & Root Environmental Corporation
993 Old Eagle School Road, Suite 415
Wayne, Pennsylvania 19087-1710

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PREPARED BY:

RUSSELL E. TURNER
PROJECT MANAGER
BROWN & ROOT ENVIRONMENTAL
WAYNE, PENNSYLVANIA

APPROVED BY:

JOHN J. TREPANOWSKI, P.E.
PROGRAM MANAGER
BROWN & ROOT ENVIRONMENTAL
WAYNE, PENNSYLVANIA

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EXECUTIVE SUMMARY

Under the Department of Defense's Installation Restoration Program, the Navy, in agreement with the United States Environmental Protection Agency (EPA), and in consultation with the State of New Jersey Department of Environmental Protection (NJDEP), is in the process of completing the Remedial Investigation and Feasibility Study (RI/FS) of 27 former known or suspected waste disposal sites at Naval Weapons Station Earle (NWS Earle), which is located in Colts Neck, New Jersey. The RI for the 27 NWS Earle Site was completed in July of 1996. Upon review of the data presented in the RI, the Navy and EPA agreed to group Sites 4, 5, 19, and 26 into Operable Unit-1 based on the volumes of waste materials present, the types of contaminants detected, and the potential for contaminant migration to human and environmental receptors.

This report presents the Feasibility Study (FS) performed for the Operable Unit-1 Sites. The FS report presents a range of remedial alternatives that address potential risks to human health and the environment posed by site-related contaminants identified previously under the Remedial Investigation. The current report only addresses remedial alternatives developed for Site 4, 5, and 19. Additional field investigations are being completed for Site 26 to refine the extent of trichloroethene contamination in groundwater. Once the new data have been evaluated and interpreted, remedial objectives and evaluation of alternatives will be completed for Site 26 and will be incorporated into the FS.

The remedial options developed in this document will be used by the Navy to select a preferred remedy. A Proposed Remedial Action Plan will then be prepared to present the preferred remedy for public comment. After the public comment period has concluded, all questions and concerns from the public would be addressed in a Responsiveness Summary and the selected remedy will be documented in a Record of Decision.

NWS Earle Site Summary

NWS Earle is located in Monmouth County, New Jersey, approximately 47 miles southeast of New York City. This facility was commissioned in 1943 with the primary responsibility of supplying ammunition to the Naval fleet. This station consists of an inland 10,248-acre Main Base and a 706-acre waterfront area connected by a right-of-way controlled by the Navy. NWS Earle was included on the National Priority List in October 1990.

Descriptions of the four Operable 1 Sites are summarized as follow:

Site 4 - Landfill West of "D" Group

Site 4 consists of a 5-acre landfill that received approximately 10,200 tons of mixed domestic and industrial wastes between 1943 and 1960. The bulk of materials disposed of at Site 4 included: metal scrap (steel banding, pipes, and empty trash barrels) and construction debris (lumber, concrete, brick, etc.); pesticide and herbicide containers, paint residues, and rinsewaters were also disposed in this landfill. Industrial wastes apparently only comprise a small portion of the materials disposed. Reports prepared by previous contractors indicated the potential presence other wastes that may have been disposed at the landfill including containers of paint, paint thinners, varnishes, shellacs, acids, alcohols, caustics, and asbestos. The landfill materials are currently covered by a thin layer of sandy soil. This landfill was never formally closed.

Sit 5 - Landfill West of Army Barricades

Site 5 consists of a landfill situated west of the Army Barricades that received approximately 6,600 tons of mixed domestic and industrial wastes between 1968 and 1978. The materials disposed of at Site 5 included: domestic wastes consisting of paper, glass, and plastics; construction debris (consisting of lumber, concrete, bricks, metal scrap, etc.); and industrial wastes consisting of wood, pesticide and herbicide containers, containers of paint, paint thinners, varnishes, shellacs, acids, alcohols, caustics, and small amounts of asbestos.

The landfill materials are currently covered by a layer of soil that appears to vary between 1 to 3 feet throughout most of Site 5, and are covered by vegetative growth. Approximately 1 acre of the landfill is currently occupied by the skeet and shooting range, which is used recreationally by the public. Apparently this landfill was never formally closed.

Site 19 - Paint Chip and Sludge Disposal Area

Site 19 consists of an ordnance maintenance area where paint chips and sludges were discharged into a topographic depression near Building S-34 from the early 1940s until the early 1960s. Paint slurries and solvent residues were discharged into a open drainage swale. The site occupies an approximate 300-foot circular area, half of which is paved with asphalt while the remainder has a gravel surface. The topographic depression measures approximately 50 feet in diameter and varies in depth between 5 to 10 feet. A small drainage ditch runs from the depression to a small stream in the wetlands adjacent to Site 19. The paved portion of this site is currently used for training Navy fork lift operators.

Sit 26 - Explosive "D" Washout Area

The explosive "D" washout area located behind Building BG-1 was used for a 1 year period during the 1960s to remove and recover ammonium picrate (explosive "D") from artillery shells. The shells were washed with hot water, and the ammonium picrate solution was discharged into a settling tank. The ammonium picrate was precipitated from the cooled solution, and was then recovered for reuse or disposal. Overflow from the settling tank was discharged into an unlined percolation pit. It is estimated that approximately 20,000 pounds of ammonium picrate may have been lost from the percolation pit as the result heavy rainfall and flooding. A tile-lined open pipe connects Building BG-1 and the percolation pit. A process leaching system, consisting of a grease pit and a cess-pool type leach tank, is also located adjacent to the building.

Regulatory History

An Initial Assessment Study conducted in 1982 identified 29 waste disposal areas at NWS Earlé, which led to the further investigation of 11 of those sites. Following the listing of NWS Earle on the NPL, Site Investigations were initiated at 16 sites. Two of the remaining sites were not included in these investigations because they were permitted to operate under the Resource Conservation and Recovery Act. In 1992, EPA requested Preliminary Assessments of 17 sites be performed. To date the following investigations have been completed and are documented:

- Installation Restoration Program (IRP) Phase II Confirmation Study (September 1986)
- Phase II Site Inspection Study (December 1993)
- IRP RI/FS for 11 sites (September 1993)
- IRP RI for 27 sites (July 1996)

Objective of the FS

The overall objective of this FS is to develop and evaluate alternatives that address source control and groundwater remediation actions for the OU-1 sites. The general FS process is described below:

- Develop Remedial Action Objectives that incorporate cleanup goals protective of human health and the environment. The Remedial Action Objectives specify the contaminants, media of interest, exposure pathways, and preliminary remediation goals. The preliminary remediation goals (numeric criteria) are developed based on chemical-specific

applicable or relevant and appropriate requirements (ARARs), when available, and site-specific risk-related factors.

- Develop general response actions to address each medium of interest. Each response action may be implemented singly or in combination with other actions to satisfy the Remedial Action Objectives.

- Identify and screen technologies applicable to each general response action. Technologies and process options that are not technically implementable are eliminated. Representative process options for the remaining technologies are then evaluated for their effectiveness, implementability, and cost.

- Assemble and screen remedial alternatives from the retained technologies. The alternatives consist of a range of remedial technologies for source control or groundwater remediation.

- Prepare a detailed analysis of individual alternatives following the criteria specified in the NCP and the RI/FS guidance document. Finally, compare and evaluate the alternatives.

Remedial Action Objectives (RAOs)

Based on the baseline human health risk assessment, the ecological risk assessment, and the RI results, RAOs were developed to address contaminated environmental media (soils, groundwater) present at the NWS Earle Operable Unit 1 Sites. These RAOs are presented below.

Site 4 RAOs

To address the potential threats posed by contaminated soil and landfilled materials at Site 4, the RAO to protect human health is to prevent human exposure to contaminated soils and landfilled materials.

Because the continued leaching of soil contaminants would degrade groundwater underlying Site 4, the RAO for protection of the environment is to minimize contaminant migration into groundwater. The groundwater RAO for protection of human health is to prevent human exposure to VOC and metal contaminants in groundwater.

Site 5 RAOs

To address the potential threats posed by contaminated soil and landfilled materials at Site 5, the RAO to protect human health is to prevent human exposure to contaminated soils and landfilled materials.

Because the continued leaching of soil contaminants would degrade groundwater underlying Site 5, the RAO for protection of the environment is to minimize contaminant migration into groundwater. The groundwater RAO for protection of human health is to prevent human exposure to VOC and metal contaminants in groundwater.

Site 19 RAOs

To address the potential threats posed by contaminated soils/sediments at Site 19, the RAO to protect human health is to prevent human exposure to contaminated soils/sediments.

The RAO for protection of the environment is to minimize contaminant migration into groundwater and adjacent wetlands.

The groundwater RAO for protection of human health is to prevent human exposure to contaminated groundwater.

Alternatives Development

Following the technology screening and detailed evaluation, remedial technologies were assembled into alternatives that address contaminated soils and groundwater and the RAOs. These alternatives provide variable levels of protection to human health and the environment, as well as compliance with ARARs. Remedial alternatives included source control actions such as: no action; consolidation and capping; excavation, on-site solidification, on-base disposal; and off-base disposal. The groundwater response actions for these remedial alternatives included institutional controls and natural attenuation. With the implementation of source control actions, reduced leaching of soil contaminants to groundwater would result and groundwater would not be degraded further.

Summaries of remedial alternatives that passed the screening step for each Operable Unit 1 site are presented in the following section.

Site 4 R m dial Alternatives

Site 4 - Alternative 1: No Action

The No-Action Alternative was developed as a baseline to which other alternatives may be compared, as required by the NCP. No remedial actions would be taken to protect human health or the environment. The purpose of the alternative is to evaluate the overall human health and environmental protection provided by the site in its present state. Periodic reviews of site conditions, typically every five years, and long-term monitoring of groundwater, surface water, and sediments would be the only activities conducted under this alternative.

Site 4 - Alternative 3: Capping, and Institutional Controls, Natural Attenuation, and Long-Term Monitoring

This alternative is a containment option that utilizes capping and institutional controls to prevent potential human exposure to contaminated soils and landfilled materials, and to minimize further contaminant leaching into groundwater. Over time, the contaminants in groundwater will likely attenuate naturally through chemical and biological degradation (VOCs only) and physical and chemical processes (metals and VOCs). Contaminant concentrations in groundwater will also decrease as a result of reduced infiltration of precipitation through contaminated landfill materials.

A low-permeability cover system that complies with federal and state regulatory requirements will be used to prevent potential human and animal contact with contaminants in landfill materials, limit contaminant leaching to groundwater, and minimize contaminant migration via surface runoff and erosion. Following capping, the cap would be maintained as needed. Institutional controls would be enacted to limit future uses of the site that may result in disturbance of the soil cover or direct contact with contaminated media and to prohibit use of untreated contaminated groundwater.

Long-term, annual monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years since wastes are left in place.

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C. 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Sit 5 R m dial Alternativ s

Site 5 - Alternative 1: No Action

The No-Action Alternative was developed as a baseline to which other alternatives may be compared, as required by the NCP. No remedial actions would be taken to protect human health or the environment. The purpose of the alternative is to evaluate the overall human health and environmental protection provided by the site in its present state. Periodic reviews of site conditions, typically every five years, and long-term monitoring of groundwater would be the only activities conducted under this alternative.

Site 5 - Alternative 3: Capping, and Institutional Controls, Natural Attenuation, and Long-Term Monitoring

This alternative is a containment option that utilizes capping and institutional controls to prevent potential human exposure to contaminated soils and landfilled materials, and to minimize further contaminant leaching into groundwater. One acre of the existing landfill will be further capped while the remaining three acres would be left in its current condition since there is adequate soil cover and erosion is not evident. Over time, the contaminants in groundwater will likely attenuate naturally through chemical and biological degradation (VOCs only) and physical and chemical processes (metals and VOCs). Contaminant concentrations in groundwater will also decrease as a result of reduced infiltration of precipitation landfilled materials.

For the new cap, a low-permeability cover system that complies with federal and state regulatory requirements will be used to prevent potential human and animal contact with contaminants in landfill materials, limit contaminant leaching to groundwater, and minimize contaminant migration via surface runoff and erosion. Both the new and existing cap would be periodically maintained. Institutional controls would be enacted to limit future uses of the site that may result in disturbance of the new and existing cap or direct contact with contaminated media and to prohibit use of untreated contaminated groundwater.

Long-term, annual monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years since wastes are left in place.

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Sit 19 Remedial Alternatives

Site 19 - Alternative 1: No Action

The No-Action-Alternative was developed as a baseline to which other alternatives may be compared, as required by the NCP. No remedial actions would be taken to protect human health or the environment. The purpose of the alternative is to evaluate the overall human health and environmental protection provided by the site in its present state. Periodic reviews of site conditions, typically every five years, and long-term monitoring of groundwater, surface water, and sediments would be the only activities conducted under this alternative.

Site 19 - Alternative 4: Excavation, On-Site Solidification, On-Site Disposal, Natural Attenuation, and Long-term Monitoring

Alternative 4 employs soil treatment to limit exposure to hazardous substances and minimize migration of contaminants to groundwater and the adjacent wetlands. Contaminants in site groundwater would naturally attenuate over time through precipitation, adsorption, dilution, and dispersion after leaching of contaminants from site soils and sediments is abated.

Under this alternative, the contaminated sediments and soils from the drainage ditch and the topographic depression would be excavated and treated by solidification to immobilize metals in a stable matrix. Treated soils would be placed in the topographic depression. The depression would be backfilled with clean fill; graded level with the surrounding paved surface; and closed with an asphalt cover to form a treated-soil containment cell. Access restrictions would be enacted to limit future uses of the site that may result in intrusion into the treated-soil cell. Access restrictions would also prohibit the use of untreated groundwater for drinking water.

Long-term, annual monitoring of groundwater, surface water, and sediments would be conducted to assess contaminant status and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years since wastes are left in place.

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Site 19 - Alternative 5: Excavation and Disposal

Under Alternative 5, all contaminated soils and sediments in excess of selected clean-up goals would be excavated and 1) sent off site for disposal or 2) consolidated into Site 4 prior to capping. Site 19 soils would no longer pose threats to groundwater or the adjacent wetlands. Once the source of contamination is removed, contaminants in site groundwater would naturally attenuate over time through precipitation, adsorption, dilution, and dispersion. Institutional controls would be enacted to prohibit the use of untreated contaminated groundwater for drinking water.

Long-term, annual monitoring of groundwater, surface water, and sediments would be conducted to assess contaminant status and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years as long as groundwater contamination remains.

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Individual and Comparative Analysis of Alternatives

Detailed evaluations of remedial alternatives were performed for this FS in accordance with the requirements of the NCP and the EPA RI/FS Guidance Document. As part of the detailed analysis, the remedial alternatives were compared to identify differences and compare how site contaminant threats are addressed. Summaries and comparative evaluation of alternatives for Sites 4, 5, and 19 are presented in Tables ES-1 through ES-3, respectively, of this FS.

The following seven criteria, as established by the NCP, were used for the detailed analysis of alternatives:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of mobility, toxicity, or volume through treatment
- Short-term effectiveness
- Implementability

- Cost

Two other evaluation criteria, state and community acceptance, will be addressed in the Record of Decision following the receipt of comments during public comment period, after the Proposed Remedial Action Plan has been presented to the public.

TABLE ES-1
SITE 4 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 3: CAPPING, INSTITUTIONAL CONTROLS, NATURAL ATTENUATION, AND LONG-TERM MONITORING
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Prevent Human Exposure to Contaminated Soils and Landfilled Materials	No action taken to prevent human exposure to contaminated soils and landfilled materials. Existing risks would remain. Continued deterioration of the landfill surface would expose more contaminated soils and landfilled materials and result in increased direct exposure risks.	Enhanced cover system would prevent direct contact with contaminated soils and landfilled materials. Current direct contact risks were not quantified, but it is conservatively assumed that landfilled materials may pose excess health risks. Any excess risks would be reduced to acceptable levels by installing and maintaining the cap.
Prevent Human Exposure to VOC and Metal Contaminants in Groundwater	No action taken to prevent human exposure to contaminated groundwater. Carcinogenic and non-carcinogenic risks exceeding EPA's target risk range would remain. No actions taken to reduce contaminant leaching to groundwater. No institutional controls implemented to prohibit use of untreated groundwater for drinking water.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. The cover system would reduce leaching of contaminants to groundwater, facilitating natural attenuation of contaminants. In time, contaminant concentrations would reach levels that would not pose excess risk.
Minimize Contaminant Migration	No actions taken to reduce contaminant leaching to groundwater. Contaminants would continue to leach into groundwater and migrate downgradient, potentially affecting downgradient receptors.	The cover system would reduce leaching of contaminants to groundwater and would reduce migration of contaminants to the environment by surface water and wind erosion.
COMPLIANCE WITH ARARs		
Chemical-Specific ARARs	Would not comply with state groundwater quality standards.	Groundwater contaminant concentrations would initially exceed state GWQC; over time GWQC would be achieved by natural attenuation. A classification exception area (CEA) would be established to provide the state official notification that standards would not be met for a specified duration.

TABLE ES-1
SITE 4 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2

Location-Specific ARARs	Not Applicable.	Would comply with federal and state ARARs for wetlands, floodplains, and other sensitive receptors.
Action-Specific ARARs	Would not comply with federal or state ARARs for post-closure maintenance of municipal landfills.	Would comply with federal and state ARARs for closure and post-closure of municipal landfills.
LONG-TERM EFFECTIVENESS AND PERMANENCE		
Magnitude of Residual Risk	Existing risks would remain: approximately 1.4×10^{-4} excess cancer risk (ECR) and HI = 3.3 non-carcinogenic risks from exposure to site groundwater. Increased risk anticipated over time as landfill surface deteriorates.	Implementation and enforcement of institutional controls would reduce risks from exposure to site groundwater to less than 1×10^{-6} ECR and HI less than 1.0. Over time, natural attenuation would result in permanently reduced risks. Installation and maintenance of the cap would reduce direct exposure risks to less than 1×10^{-6} ECR and HI less than 1.0.
Adequacy and Reliability of Controls	No new controls implemented. Existing site features provide limited controls.	If properly maintained, the cap system would be reliable for preventing exposure and reducing contaminant migration to the environment. If implemented and enforced, institutional controls could prevent damage to the cap, intrusion into contaminated materials, and use of contaminated groundwater.
Need for 5-Year Review	Review would be required since soil and groundwater contaminants would be left in place.	Same as Alternative 1.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT		
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, since no treatment would be employed.	Groundwater contamination eventually eliminated by natural attenuation.
SHORT-TERM EFFECTIVENESS		
Community Protection	No risk to community anticipated.	No significant risk to community anticipated. Engineering controls would be used during implementation to mitigate risks.
Worker Protection	No risk to workers anticipated if proper PPE is used during long-term monitoring.	No significant risk to workers anticipated if proper PPE is used during remediation and long-term monitoring.

TABLE ES-1
SITE 4 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 3

Environmental Impacts	No adverse impacts to the environment anticipated.	No significant impacts to the environment anticipated. Engineering controls would be used during implementation to mitigate risks.
Time Until Action is Complete	Not applicable.	1.5 years enhanced cap is in place. Natural attenuation will likely take longer.
IMPLEMENTABILITY		
Ability to Construct and Operate	No construction or operation involved.	No difficulties anticipated. Capping is a readily implementable technology.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	If additional actions are warranted, the cover system may need to be opened to access contaminated materials within.
Ability to Monitor Effectiveness	Monitoring would provide assessment of potential exposures, contaminant presence, migration, or changes in site conditions.	Same as Alternative 1.
Ability to Obtain Approvals and Coordinate with Other Agencies	Coordination for 5-year reviews may be required and would be obtainable.	Coordination for 5-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	Same as Alternative 1.
Availability of Equipment, Specialists, and Materials	Personnel and equipment available for implementation of long-term monitoring and 5- year reviews.	Ample availability of equipment and personnel to construct cap and perform long-term maintenance, monitoring, and 5-year reviews.
Availability of Technology	Not required.	Common construction techniques and materials required for cap construction.
COST		
Capital Cost	$0	$1,983,000
First-Year Annual O&M Cost	$16,200	$29,600
Present Worth Cost	$234,000	$2,400,000

TABLE ES-2
SITE 5 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 3: CAPPING, INSTITUTIONAL CONTROLS, NATURAL ATTENUATION, AND LONG-TERM MONITORING
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Prevent Human Exposure to Contaminated Landfill Soils and Materials	No action taken to prevent human exposure to landfilled materials. Existing risks would remain. Continued deterioration of the landfill surface, particularly the eastern portion, would expose more landfilled materials and result in increased direct exposure risks.	New cover system over eastern 1 acre of landfill and would prevent direct contact with contaminated materials. Existing soil/vegetative cover over western portion of landfill would limit direct contact with contaminated materials. Current direct contact risks were not quantified, but it is conservatively assumed that landfilled materials may pose excess health risk. Excess risks would be reduced by installing the new cap and maintaining the new and existing caps.
Prevent Human Exposure to VOC and Metal Contaminants in Groundwater	No action taken to prevent human exposure to contaminated groundwater. Carcinogenic and non-carcinogenic risks exceeding EPA's target risk range would remain. No actions taken to reduce contaminant leaching to groundwater. No institutional controls implemented to prohibit use of untreated groundwater for drinking water.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. The enhanced cover system would reduce leaching of contaminants to groundwater, facilitating natural attenuation of contaminants. In time, contaminant concentrations would reach levels that would not pose excess risk.
Minimize Contaminant Migration to Groundwater	No actions taken to reduce contaminant leaching to groundwater. Contaminants would continue to leach into groundwater and migrate downgradient, potentially affecting downgradient receptors.	The enhanced cover system would reduce leaching of contaminants to groundwater and would reduce migration of contaminants to the environment by surface water and wind erosion.

TABLE ES-2
SITE 5 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2

COMPLIANCE WITH ARARs		
Chemical-Specific ARARs	Would not comply with state groundwater quality standards.	Groundwater contaminant concentrations would initially exceed state GWQC; over time GWQC would be achieved by natural attenuation. A classification exception area (CEA) would be established to provide the state official notification that standards would not be met for a specified duration.
Location-Specific ARARs	Not Applicable.	Would comply with federal and state ARARs for wetlands, floodplains, and other sensitive receptors.
Action-Specific ARARs	Would not comply with federal or state ARARs for post-closure maintenance of municipal landfills.	Would comply with federal and state ARARs for closure and post-closure of municipal landfills.
LONG-TERM EFFECTIVENESS AND PERMANENCE		
Magnitude of Residual Risk	Existing risks would remain: approximately 1.3×10^{-4} ECR and HI = 5.2 non-carcinogenic risks from exposure to site groundwater. Increased risk anticipated over time as landfill surface deteriorates, especially on eastern portion of landfill.	Implementation and enforcement of institutional controls would reduce risks from exposure to site groundwater to less than 1×10^{-6} and HI less than 1.0. Over time, natural attenuation would result in permanently reduced risks. Installation of the new cap, maintenance of the new and existing caps, and implementation of access restrictions to prevent intrusion into contaminated materials would reduce direct exposure risks.
Adequacy and Reliability of Controls	No new controls implemented. Existing site features provide limited controls.	If properly maintained, the cap system would be reliable for preventing exposure and reducing contaminant migration to the environment. If implemented and enforced, institutional controls could prevent damage to the cap, intrusion into contaminated materials, and use of contaminated groundwater.

TABLE ES-2
SITE 5 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 3

Need for 5-Year Review	Review would be required since soil and groundwater contaminants would be left in place.	Same as Alternative 1.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT		
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, since no treatment would be employed.	Groundwater contamination eventually eliminated by natural attenuation.
SHORT-TERM EFFECTIVENESS		
Community Protection	No risk to community anticipated.	No significant risk to community anticipated. Engineering controls would be used during implementation to mitigate risks.
Worker Protection	No risk to workers anticipated if proper PPE is used during long-term monitoring.	No significant risk to workers anticipated if proper PPE is used during cap construction and long-term monitoring.
Environmental Impacts	No adverse impacts to the environment anticipated.	No significant impacts to the environment anticipated. Engineering controls would be used during implementation to mitigate risks.
Time Until Action is Complete	Not applicable.	14 months until enhanced cap is in place. Natural attenuation will likely take longer.
IMPLEMENTABILITY		
Ability to Construct and Operate	No construction or operation involved.	No difficulties anticipated. Capping is a readily implementable technology.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	If additional actions are warranted in the eastern portion of the landfill, the single barrier cover system may need to be opened to access contaminated materials within. Additional actions would be easily implemented in the western portion of the landfill.
Ability to Monitor Effectiveness	Monitoring would provide assessment of potential exposures, contaminant presence, migration, or changes in site conditions.	Same as Alternative 1.

TABLE ES-2
SITE 5 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 4

Ability to Obtain Approvals and Coordinate with Other Agencies	Coordination for 5-year reviews may be required and would be obtainable.	Coordination for 5-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	Same as Alternative 1.
Availability of Equipment, Specialists, and Materials	Personnel and equipment available for implementation of long-term monitoring and 5- year reviews.	Ample availability of equipment and personnel to construct cap and perform long-term maintenance, monitoring, and 5-year reviews.
Availability of Technology	Not required.	Common construction techniques and materials required for cap construction.
COST		
Capital Cost	$0	$588,000
First-Year Annual O&M Cost	$10,400	$18,600
Present Worth Cost	$163,000	$852,000

TABLE ES-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 4: EXCAVATION, ON-SITE SOLIDIFICATION, ON-SITE DISPOSAL, NATURAL ATTENUATION, AND LONG-TERM MONITORING	ALTERNATIVE 5*: EXCAVATION, OFF-SITE DISPOSAL, NATURAL ATTENUATION, AND LONG-TERM MONITORING
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT			
Prevent Human Exposure to Contaminated Soils.	No action taken to prevent human exposure to contaminated soils and sediments.	Excavation, treatment, and on-site disposal would prevent direct contact with contaminated materials.	Excavation and off-site disposal would prevent direct contact with contaminated materials.
Prevent Human Exposure to Contaminated Groundwater	No action taken to prevent human exposure to contaminated groundwater. Carcinogenic and non-carcinogenic risks exceeding EPA's target risk range would remain. No actions taken to reduce contaminant leaching to groundwater. No institutional controls implemented to prohibit use of untreated groundwater for drinking water.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. Excavation and solidification of soils would reduce leaching of contaminants to groundwater, facilitating natural attenuation of contaminants. In time, contaminant concentrations would reach levels that would not pose excess risk.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. Excavation and off-site disposal of soils would reduce leaching of contaminants to groundwater, facilitating natural attenuation of contaminants. In time, contaminant concentrations would reach levels that would not pose excess risk.
Minimize Contaminant Migration to Groundwater and Adjacent Wetlands	No actions taken to reduce contaminant migration to groundwater or wetlands. Contaminants would continue to leach into groundwater and migrate into wetlands via surface runoff.	Excavation and solidification of contaminated soils would reduce leaching of contaminants to groundwater and would reduce migration of contaminants to the environment by surface water and wind erosion.	Excavation and removal of contaminated soils would reduce leaching of contaminants to groundwater and would reduce migration of contaminants to the environment by surface water and wind erosion.

TABLE ES-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2

COMPLIANCE WITH ARARs			
Chemical-Specific ARARs	Would not comply with state groundwater quality standards.	Groundwater contaminant concentrations would initially exceed state GWQC; over time GWQC would be achieved by natural attenuation. A classification exception area (CEA) would be established to provide the state official notification that standards would not be met for a specified duration. Alternative 4 would be implemented in compliance with RCRA Land Disposal Restrictions.	Same as Alternative 4.
Location-Specific ARARs	Not Applicable.	Would comply with federal and state ARARs for wetlands, floodplains, and other sensitive receptors.	Same as Alternative 4.
Action-Specific ARARs	Not Applicable.	If soils and sediments are determined to be hazardous, Alternative 4 would comply with federal and state ARARs for siting and operation of hazardous waste treatment facilities.	If soils and sediments are determined to be hazardous, Alternative 5 would comply with federal and state ARARs for transport/disposal of hazardous waste.

TABLE ES-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 3

LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk	Existing risks would remain: Approximately 3.3 x 10^{-4} ECR and HI = 3.0 non-carcinogenic risks from exposure to site groundwater; Risks exceeding EPA's protective guideline for exposure to lead in soil, dust, and groundwater (estimated 15.5 percent children exposed may have blood lead levels >10μg/l vs guideline of maximum 5 percent).	Implementation and enforcement of institutional controls would reduce risks from exposure to site groundwater to less than 1 x 10^{-6} and HI less than 1.0. Over time, natural attenuation would result in permanently reduced risks. Excavation, treatment, and on-site containment of contaminated soils and sediments would reduce direct exposure risks to acceptable levels for lead exposure.	Implementation and enforcement of institutional controls would reduce risks from exposure to site groundwater to less than 1 x 10^{-6} and HI less than 1.0. Over time, natural attenuation would result in permanently reduced risks. Excavation and off-site disposal of contaminated soils and sediments would reduce direct exposure risks to acceptable levels for lead exposure.
Adequacy and Reliability of Controls	No new controls implemented.	Solidification is a widely demonstrated, reliable technology for immobilization of metals in soils and sediments. Combined with on-site containment, solidification is expected to provide permanent protection from direct contact exposures and long-term reduction in contaminant leaching to groundwater.	Because contaminated soils and sediments would be removed, no controls would be necessary for preventing exposure and reducing contaminant migration to the environment. If implemented and enforced, institutional controls could prevent use of contaminated groundwater.
Need for 5-Year Review	Review would be required since soil and groundwater contaminants would be left in place.	Same as Alternative 1.	Review would be required since groundwater contaminants would remain, in excess of GWQC.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT			
Treatment Process Used	None.	Solidification/Natural Attenuation	Natural Attenuation
Amount Treated or Destroyed	None.	260 cubic yards of soil/sediment. All of contaminated groundwater.	All of contaminated groundwater.

TABLE ES-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 4

Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, since no treatment would be employed.	Mobility of metals in soils and sediments reduced through treatment by solidification. Contaminated groundwater treated through natural attenuation.	Contaminated groundwater treated through natural attenuation.
Irreversible Treatment	Not Applicable	Solidification treatment is expected to provide effective long-term immobilization of contaminants. Since contaminants are immobilized, rather than destroyed, treatment may not be irreversible. Contaminatd groundwater irreversibly addressed by natural attenuation.	Contaminatd groundwater irreversibly addressed by natural attenuation.
Statutory Preference for Treatment	No	Yes	Yes
SHORT-TERM EFFECTIVENESS			
Community Protection	No risk to community anticipated.	No significant risk to community anticipated. Engineering controls would be used during implementation to mitigate risks.	Same as Alternative 4.
Worker Protection	No risk to workers anticipated if proper PPE is used during long-term monitoring.	No significant risk to workers anticipated if proper PPE is used during remediation and long-term monitoring.	Same as Alternative 4.
Environmental Impacts	No adverse impacts to the environment anticipated.	No significant impacts to the environment anticipated. Engineering controls would be used during implementation to mitigate risks.	Same as Alternative 4.

TABLE ES-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 5

Time Until Action is Complete	Not applicable.	8 months until RAOs for exposure to contaminated soils and sediments achieved. 1 year until RAOs for exposure to site groundwater are achieved.	Alternative 5A: 2.5 months until RAOs for exposure to contaminated soils and sediments achieved. Alternative 5A: 11months until RAOs for exposure to contaminated soils and sediments achieved (including time to prepare Site 4 landfill for acceptance of excavated soils). Both 5A and 5B: 1 year until RAOs for exposure to site groundwater are achieved.
IMPLEMENTABILITY			
Ability to Construct and Operate	No construction or operation involved.	No construction or operational difficulties anticipated. Common construction techniques used for excavation and on-site disposal. Precautions would be taken to minimize damage to wetlands during excavation. Solidification is a well demonstrated technology employing common equipment and materials.	No construction or operational difficulties anticipated. Common construction techniques and equipment used for excavation and off-site disposal. Precautions would be taken to minimize damage to wetlands during excavation.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	If additional actions are warranted, the solidified materials could be excavated and removed.	Same as Alternative 1.
Ability to Monitor Effectiveness	Monitoring would provide assessment of potential exposures, contaminant presence, migration, or changes in site conditions.	Same as Alternative 1.	Same as Alternative 1.

TABLE ES-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
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Ability to Obtain Approvals and Coordinate with Other Agencies	Coordination for 5-year reviews may be required and would be obtainable.	Coordination for 5-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable.	Coordination for 5-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable. Alt. 5A: manifests would be required for off-site transportation and disposal of contaminated materials.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	No off-site TSD capacity or services required. Ample availability of companies to provide equipment and services for solidification treatment.	Alt. 5A: Sufficient commercial landfill capacity available for materials requiring disposal. Alt. 5B: Sufficient area available for disposal of materials at the Site 4 landfill.
Availability of Equipment, Specialists, and Materials	Personnel and equipment available for implementation of long-term monitoring and 5- year reviews.	Ample availability of companies with trained personnel, equipment, and materials to perform excavation, treatment, disposal, long-term monitoring, and 5-year reviews.	Ample availability of companies with trained personnel, equipment, and materials to perform excavation, off-site disposal, long-term monitoring, and 5-year reviews.
Availability of Technology	Not required.	Solidification is a well demonstraded technology employing relative common and available equipment and materials. Several vendors are available that could provide the necessary equipment and materials.	Common construction techniques and materials required for excavation and off-site disposal

TABLE ES-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 7

COST			
Capital Cost	$0	$491,000	Alt. 5A: $375,000 Alt. 5B: $153,000
First-Year Annual O&M Cost	$16,200	$21,600	Alt. 5A: $21,600 Alt. 5B: $21,600
Present Worth Cost	$234,000	$793,000	Alt. 5A: $677,000 Alt. 5B: $455,000

Notes:
* Evaluation presented pertains to Alternative 5A (off-base disposal) and Alternative 5B (on-base disposal) unless otherwise noted.

1.0 INTRODUCTION AND BACKGROUND INFORMATION

This FS report presents an executive summary (preceding this section), a summary of previous investigations for the four sites addressed in this FS (Section 1.0), identification and screening of remedial technologies for the four sites (Section 2.0), development and screening of remedial action alternatives (Section 3.0), and a detailed analysis of the alternatives, including a no-action alternative (Section 4.0).

Section 1.0 consists of an overview of NWS Earle operations and regional environmental settings. A summary of previous investigative activities and results and a discussion of human health and ecological risks for the four sites have also been presented. For a full understanding of site conditions, the Final Remedial Investigation (RI) Report, July 1996, must be reviewed. The RI report is the essential companion document to this FS, both having been prepared as part of the prescribed CERCLA RI/FS development procedure.

Section 2.0 provides a discussion on potential chemical-specific, location-specific, and action-specific ARARs and TBCs. This section also addresses remedial action objectives (RAOs), preliminary remedial goals (PRGs), and general response actions. RAOs and PRGs are addressed on a site-specific basis for the identification, screening, and evaluation of remedial technologies and process options. Selected site-specific remedial options are also presented.

Selected remedial alternatives for the individual sites are addressed in Section 3.0. The rationale for selection of the alternatives and a description of each alternative, including a no-action alternative, are presented.

Section 4.0 provides a detailed analysis and comparison of the alternatives discussed in Section 3.0.

1.1 SITE DESCRIPTION AND SETTING

This feasibility study (FS) report includes a discussion of remedial alternatives for the Operable Unit 1 (OU-1) sites, which include Sites 4 (Landfill West of "D" Group), 5 (Landfill West of Army Barricades), 19 (Paint Chip and Sludge Disposal Area), and 26 (Explosive "D" Washout Area). The OU-1 sites are all located within the Mainside area of Naval Weapons Station (NWS) Earle.

NWS Earle is located in Monmouth County in east-central New Jersey. It is situated on approximately 11,134 acres, and includes a Mainside area, which is approximately 10 miles inland from the Atlantic Ocean at Sandy Hook Bay, and a Waterfront area, which includes an ammunition depot and associated piers. The

Mainside and Waterfront areas are linked by a narrow tract of land that serves as a right-of-way for a government road and railroad. Figure 1-1 shows the Mainside area and OU-1 sites.

The main entrance to NWS Earle is located off State Route 34, and the entrance to the Waterfront area is located adjacent to State Route 36.

An estimated 2,500 people reside and/or work at NWS Earle. The total population of Monmouth County is approximately 550,000. Colts Neck Township, which is the location of the Mainside facility, has a total population of approximately 8,560 people. Middletown Township, which is the location of the Waterfront area, has a total population of approximately 68,200 people (United States Department of Commerce, 1990).

The majority of the land at the Mainside area is undeveloped land associated with ordnance operations, production, and storage facilities; the undeveloped land is encumbered by explosive safety quantity distance (ESQD) arcs. Land use at the Mainside facility includes residences, office buildings, workshops and warehouses, recreational areas, open space, and undeveloped land. The area around the Mainside facility includes agricultural areas, vacant land, and low-density residential land.

NWS Earle is located in the coastal lowlands of Monmouth County, New Jersey, within the Atlantic Coastal Plain Physiographic Province. The Mainside area, which includes all the sites included in OU-1, lies in the outer Coastal Plain, approximately 10 miles inland from the Atlantic Ocean. The Mainside area is relatively flat, with elevations ranging from approximately 100 to 300 feet above mean sea level (MSL). The most significant topographic relief within the Mainside area is Hominy Hills, a northeast-southwest-trending group of low hills located near the center of the station.

The rivers and streams draining NWS Earle ultimately discharge to the Atlantic Ocean, which is approximately 9 or 10 miles east of the Mainside area. The headwaters and drainage basins of three major Coastal Plain rivers (Swimming, Manasquan, and Shark) originate on the Mainside area. The northern half of Mainside is in the drainage basin of the Swimming River, and tributaries include Mine Brook, Hockhockson Brook, and Pine Brook. The southwestern portion of the Mainside drains to the Manasquan River via either Marsh Bog Brook or Mingamahone Brook. The southeastern corner of the Mainside drains to the Shark River. Both the Swimming River and the Shark River supply water to reservoirs used for public water supplies. Site-specific hydrology for each site is discussed in Section 1.3.

NWS Earle is situated in the Coastal Plain Physiographic Province of New Jersey. The New Jersey Coastal Plain is a seaward-dipping wedge of unconsolidated Cretaceous to Quaternary sediments that were deposited on a pre-Cretaceous basement-bedrock complex. The Coastal Plain sediments are primarily composed of clay, silt, sand, and gravel and were deposited in continental, coastal, and marine environments. The sediments generally strike northeast-southwest and dip to the southeast at a rate of 10 to

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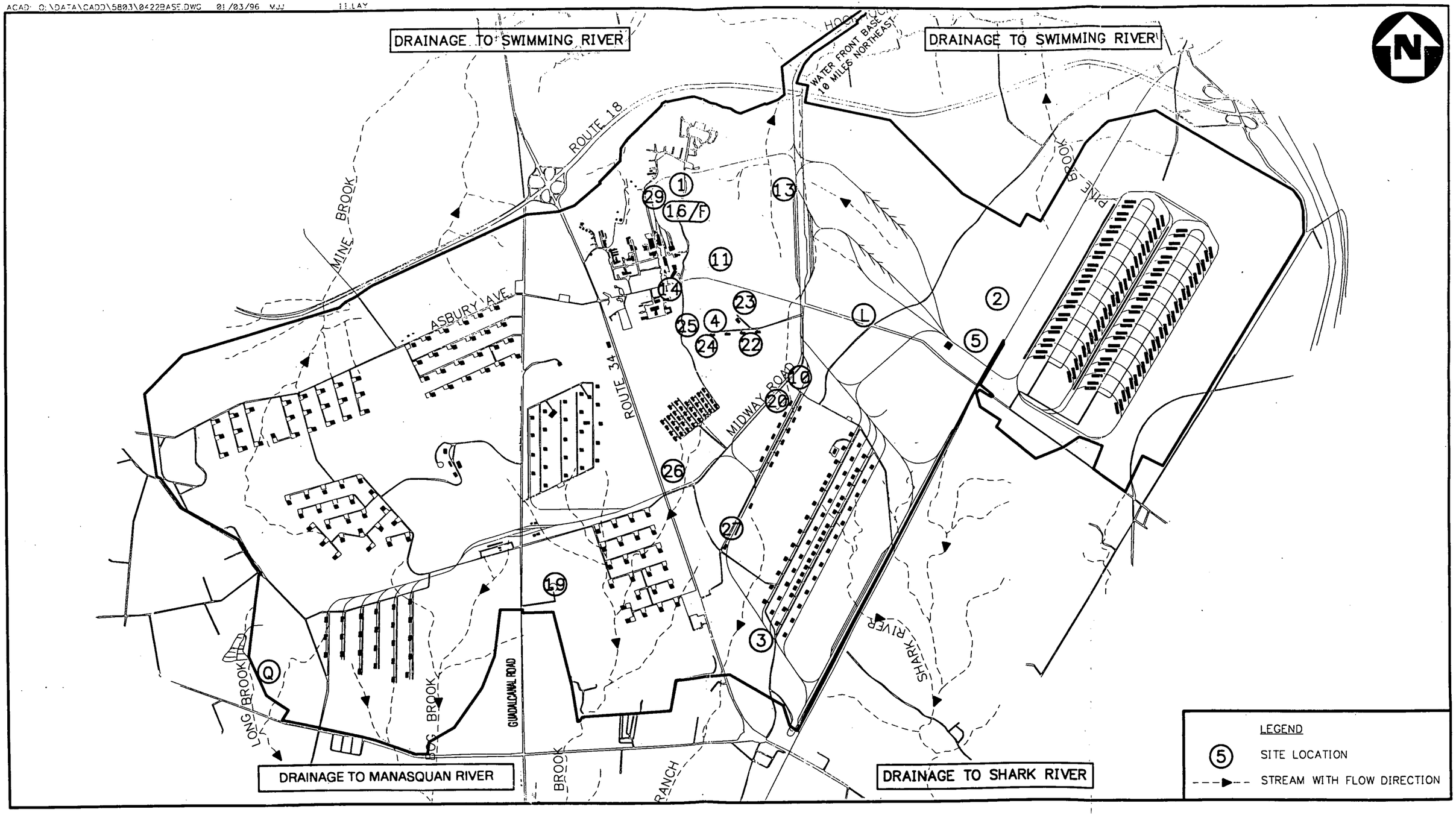

FIGURE 1-1

SITE LOCATIONS AND SURFACE DRAINAGE MAP
NWS EARLE, COLTS NECK, NEW JERSEY

Brown & Root Environmental

60 feet per mile. The approximate thickness of these sediments beneath NWS Earle is 900 feet. The pre-Cretaceous complex consists mainly of PreCambrian and lower Paleozoic crystalline rocks and metamorphic schists and gneisses. The Cretaceous to Miocene Coastal Plain Formations are either exposed at the surface or subcrop in a banded pattern that roughly parallels the shoreline. The outcrop pattern is caused by the erosional truncation of the dipping sedimentary wedge. Where these formations are not exposed, they are covered by essentially flat-lying post-Miocene surficial deposits. Site-specific geology and soils for each site are discussed in the site summary sections (Section 1.3).

Groundwater classification areas were established in New Jersey under New Jersey Department of Environmental Projection (NJDEP) Water Technical Programs Groundwater Quality Standards in New Jersey Administrative Code (N.J.A.C.) 7:9-6. The Mainside area is located in the Class II-A: Groundwater Supporting Potable Water Supply area. Class II-A includes those areas where groundwater is an existing source of potable water with conventional water supply treatment or is a potential source of potable water. In the Mainside area, in general, the deeper aquifers are used for public water supplies and the shallower aquifers are used for domestic supplies.

The Coastal Plain sediments are the most important source of potable water in the Coastal Plain of New Jersey, with wells supplying greater than 75 percent of the potable water supply. Water-supply problems associated with the increased demand for groundwater in the Coastal Plain include decreased groundwater levels and the induced recharge of fresh, brackish, or saline water from surface water or adjacent aquifers. The five principal Coastal Plain aquifers are the

- Kirkwood-Cohansey aquifer system
- Atlantic City 800-foot sand
- Wenonah-Mount Laurel aquifer system
- Englishtown aquifer
- Potomac-Raritan-Magothy aquifer system

Minor Coastal Plain aquifers include the

- Piney Point aquifer
- Vincentown aquifer
- Red Bank Sand aquifer

The five principal aquifers are capable of yielding large quantities of water for public supply use. The minor aquifers generally yield small to moderate quantities of water in or near their outcrop areas. All the Coastal Plain aquifers except the Kirkwood-Cohansey aquifer system are confined to semi-confined, except where

they crop out or are overlain by permeable surficial deposits. Increased groundwater withdrawals have produced large regional cones of depression in the major artesian aquifers.

The OU-1 sites are situated in the recharge area of the Kirkwood-Cohansey aquifer system. The Kirkwood-Cohansey aquifer system is a source of water in Monmouth County and is composed of the generally unconfined sediments of the Cohansey Sand and Kirkwood Formation. The Kirkwood-Cohansey aquifer system has been reported in previous investigations as being used for residential wells in the Mainside area. Along the coast, this aquifer system is underlain by thick diatomaceous clay beds of the Kirkwood Formation.

All facilities located in the Mainside Administration area are connected to a public water supply (New Jersey American Water Company). Water for the public supply network comes from surface water intakes, reservoirs, and deep wells. No public water supply wells or surface water intakes are located on the NWS Earle facility. A combination of private wells and public water supply from the New Jersey American Water Company serves businesses and residences in areas surrounding the Mainside facilities. There are a number of private wells located within a 1-mile radius of NWS Earle and several within the NWS Earle boundaries. The majority of these wells are used for potable supplies; previous testing for drinking water parameters indicates these wells have not been adversely impacted.

There is a rich diversity of ecological systems and habitats at NWS Earle. Knieskern's beaked-rush (Rynchospora knieskernii), a sedge species on the federal endangered list, has been seen on the station, and some species on the New Jersey endangered list, such as the swamp pink (Helonias bullata), may be present. An osprey has visited Mainside and may nest in another area at NWS Earle. The Mingamahone Brook supports bog turtles downstream of the Mainside area and provides an appropriate habitat for them at the Mainside area.

Resources and habitats of the drainage potentially impacted by sites investigated in the RI were summarized as follows (Source: NOAA in a letter from EPA Region II dated August 19, 1992, signed by Paul G. Ingrisano, project manager):

- Manasquan River - Mingamahone Brook and East Branch of Mingamahone Brook
  - American eel, alewife, white perch, and blueback herring are likely present in the upper reaches of the Manasquan River and may migrate to Mingamahone Brook.
- Swimming River - Pine Brook and Hockhockson Brook
  - Hockhockson and Pine Brooks originate within NWS Earle. Hockhockson Brook joins Pine Brook north of the facility. Pine Brook discharges to the Swimming River

about 2 kilometers below the Swimming River Reservoir. Swimming River is tidally influenced below its confluence with Pine Brook and flows from there about 4 kilometers to the Navesink River.

- Alewife and blueback herring are known to migrate in the Swimming River and have been sampled in Pine Brook. Their presence in Hockhockson Brook is expected.

- Navesink River

  - The Navesink River is a tidal embayment. NOAA trust species present in the Navesink River include striped bass, alewife, blueback herring, menhaden, bluefish, American eel, blue crab, and sea lamprey. Resource utilization is believed to be limited to foraging activity, with the exception of winter flounder and blue crab spawning.

- McClees Creek

  - McClees Creek flows about 5 kilometers to the Navesink River. The creek has not been studied but is free-flowing and could provide habitat for blueback herring, alewife, American eel, white perch, and blue crab.

Significant agricultural lands under consideration include cranberry bogs located at the headwaters of Yellow Brook and Marsh Bog Brook, potentially affected by Site 19.

Ecological risk assessments were performed for the OU-1 sites; results are discussed in Section 1.3.

1.2 SITE OPERATING HISTORY

NWS Earle was commissioned as a Naval Ammunition Depot on December 13, 1943, with the primary responsibility of furnishing ammunition to the Naval fleet. The station's Ordnance Department coordinates all port services and logistic support for home-ported and visiting ships, conducts safety inspections, supervises ammunition loading for the United States Coast Guard, and provides afloat firefighting capability and standby tug services. Other major active divisions include the Ammunition Distribution and Control Division, responsible for ensuring that a balanced, purified stock of ammunition is maintained in support of Navy, Coast Guard, and Marine Corps programs; the Operations Division, which performs ammunition movement, ship loading, demilitarization of obsolete ammunition, and reclaiming/renovation of various munitions; the Anti-Submarine Warfare (ASW) and Special Weapons Division, which plans and carries out station-level

maintenance of air and antisubmarine weapons and provides shore-based support to various commands, and the Port Services Division, responsible for operating the station fireboat, service craft, and oil pollution containment equipment.

Over 90 percent of the acreage at NWS Earle is dedicated to its primary mission of storage and delivery of ordnance. The actual amount of land used for storage and distribution facilities is much less than this, but Explosive Safety Quantity Distance (ESQD) arcs are established around each facility. Any development within these arcs is extremely restricted by safety requirements. The formal disestablishment or reclassification of a facility is required before any development can occur within an ESQD arc.

Two areas of NWS Earle, the Mainside Administration and Housing area and the Waterfront Administrative area, are not encumbered by ESQD arcs. These areas are used for offices, base support, housing, and recreational facilities. Any future development would be expected to occur in one of these areas unless the development had an ordnance-specific use. Sites 1, 14, 16, and 29 are within the Mainside Administration and Housing area. Sites 6, 12, 15, and 17 are within the Waterfront Administration area. None of these sites are included in OU-1. Future land use is not expected to vary significantly from current land use unless a major base realignment were to occur. If this were to happen, an Environmental Baseline Survey would be conducted to evaluate the impact of any proposed land-use change.

The sites in OU-1 were utilized for various purposes. The landfill west of "D" group (Site 4) is a 5-acre site that was used from 1943 to 1960 for the disposal of domestic and industrial wastes (Figure 1-2). At this site, wastes were burned in trenches and then buried. Industrial wastes disposed at Site 4 consist of demolition wastes, pesticide and herbicide containers, paint residues, and rinsewaters. Industrial wastes apparently comprise only a small portion of the approximately 10,200 tons of waste estimated to have been disposed at the site. Other wastes that may have been disposed in the landfill were discarded containers of paint, paint thinners, varnishes, shellacs, acids, alcohols, caustics, and asbestos.

The landfill west of the Army Barricades (Site 5) is a 5-acre site that was used from 1968 to 1978 for the disposal of domestic and industrial wastes (Figure 1-3). The majority of the waste was domestic waste, consisting of paper, glass, and plastics. Industrial wastes consisted of wood, pesticide containers, pesticide, rinsewaters, and discarded containers of paint, paint thinner, solvents, varnishes, shellacs, acids, alcohol's, caustics, and small amounts of asbestos.

Site 19 is an ordnance maintenance area where paint chips and paint sludge were discharged to a topographic depression near Building S-34 (Figure 1-4). The site was in operation from the early 1940s until the early 1960s. Paint slurries and solvent residues were discharged into the open drainage swale. During construction at the site, a significant portion of the contaminated material may have been removed. The site

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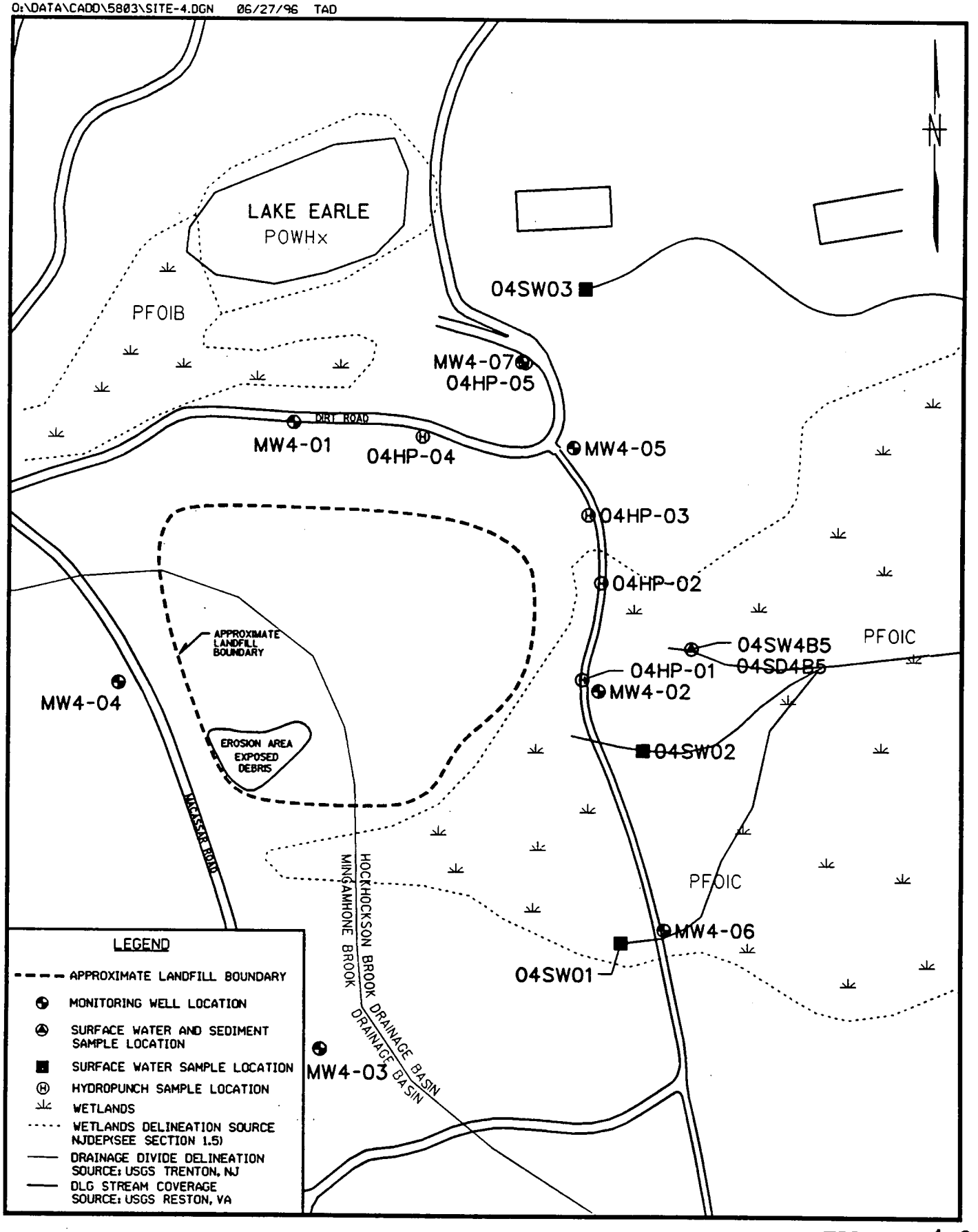

FIGURE 1-2

SITE 4 - LANDFILL WEST OF "D" GROUP

0 200 400
SCALE IN FEET

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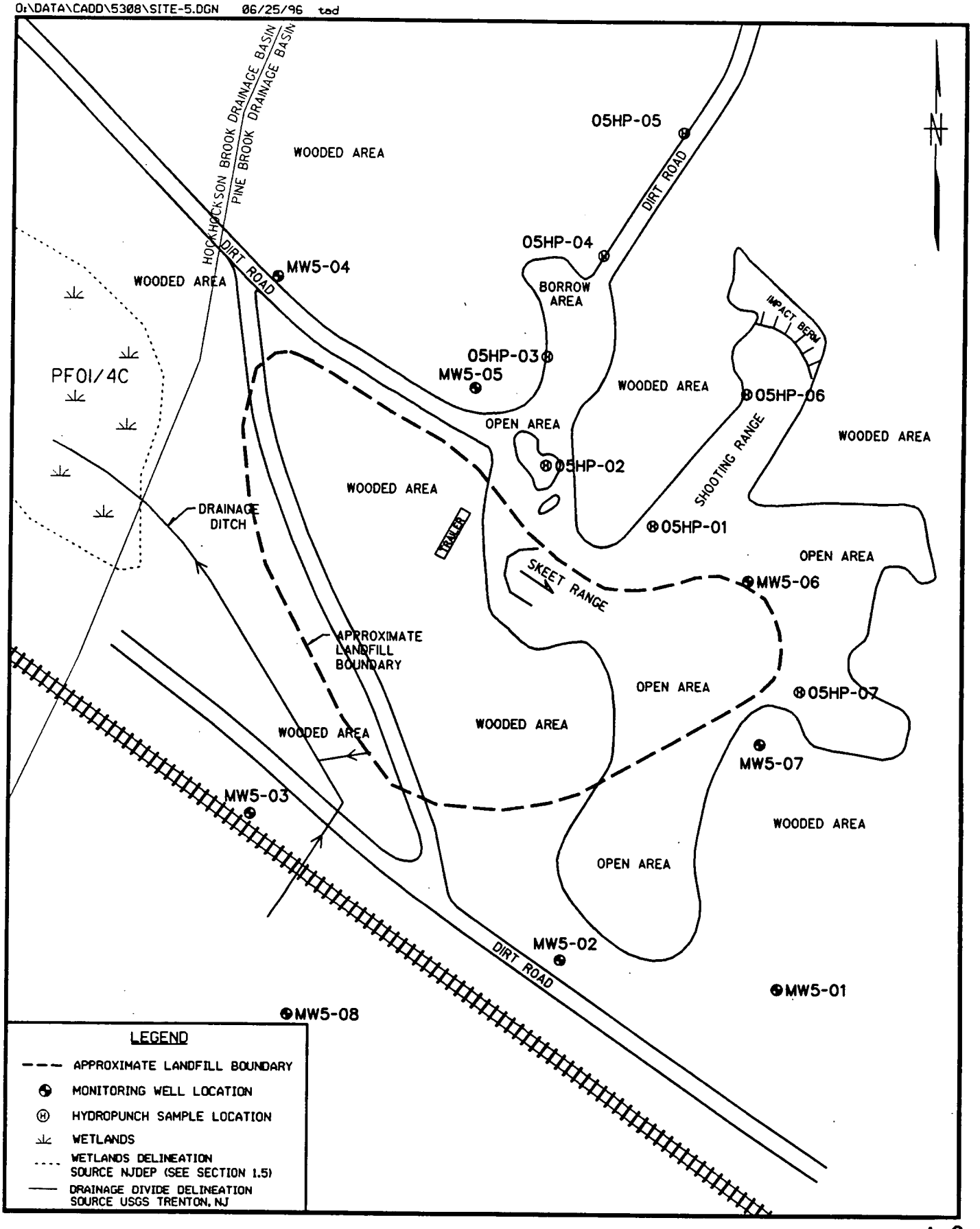

FIGURE 1-3

SITE 5 - LANDFILL WEST OF ARMY BARRICADES

0 150 300
SCALE IN FEET

Brown & Root Environmental

is a 300-foot circular area that is surrounded by woodlands. Half the site, from Building S-34 south to the site perimeter, is paved. The remainder has a gravel surface. The depression that received the sludge discharge is approximately 50 feet in diameter and 5 to 10 feet deep and is located in the center of the site south of a barricade. A small drainage ditch runs from the depression to the west, toward a wetlands area. General groundwater flow direction is toward the northwest.

The explosive "D" washout area (Site 26) is located behind Building GB-1 (Figure 1-5). For one year in the late 1960s, the site was used for the removal and recovery of ammonium picrate (known as explosive D) from artillery shells. The ammonium picrate was removed from the shells by washing with hot water. The explosive was water soluble, and the resulting solution flowed into a settling tank. Overflow from this settling tank flowed into an unlined percolation pit. Upon cooling, the explosive precipitated, and the precipitate was collected for reuse or disposal. According to a previous investigation (Hart, 1983), as much as 20,000 pounds of ammonium picrate could have been lost to surface water due to heavy rainfall before the percolation pit was cleaned. Investigation has shown that the main issue of concern at Site 26 is not the explosive D operation but is related to a former process leach tank, where solvent compounds have been found in soil and groundwater.

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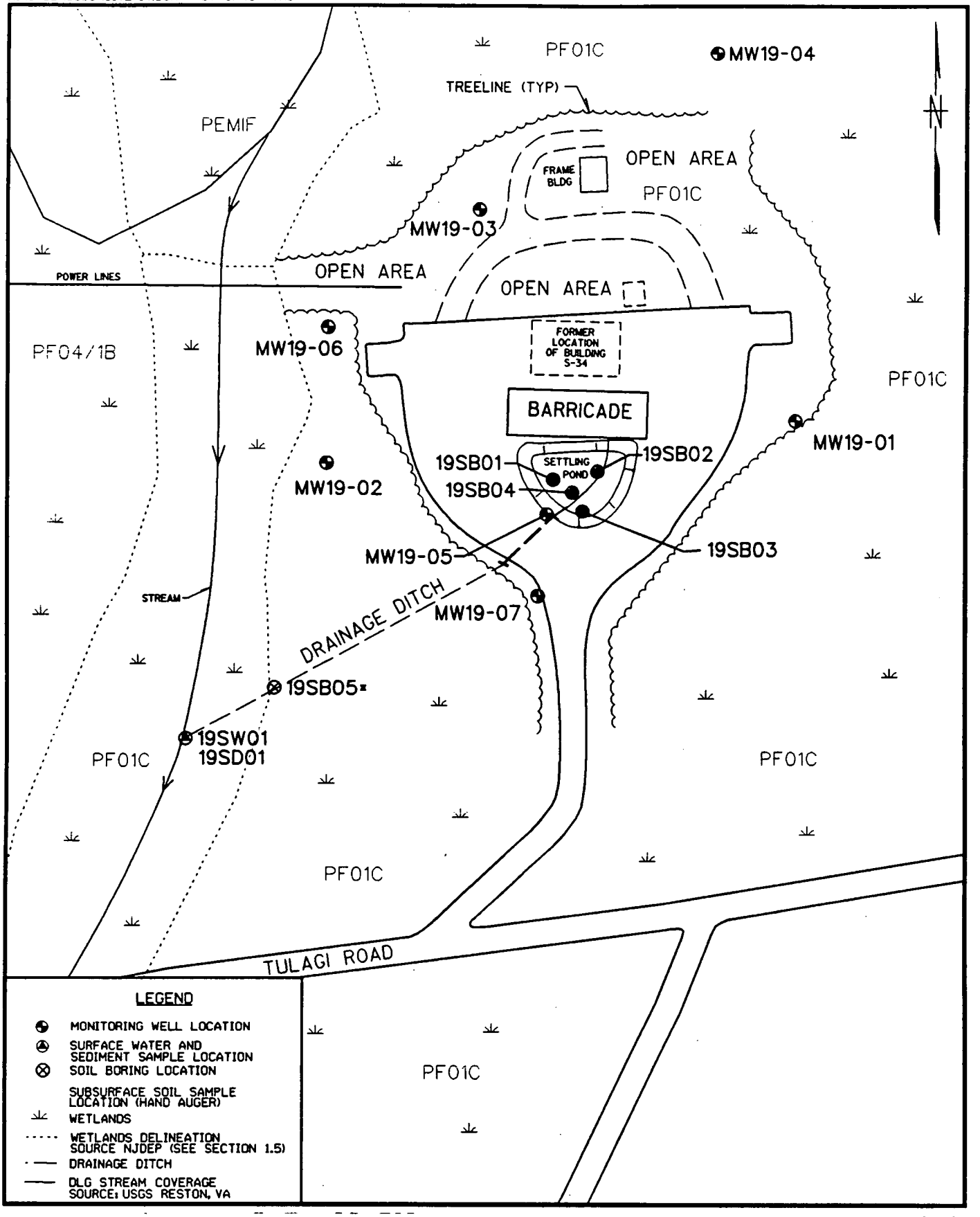

FIGURE 1-4

SITE 19 - PAINT CHIP AND SLUDGE DISPOSAL AREA

0 100 200

SCALE IN FEET

Brown & Root Environmental

K:\CADD\5803\SITE-26.DGN 07/2/96 TAD

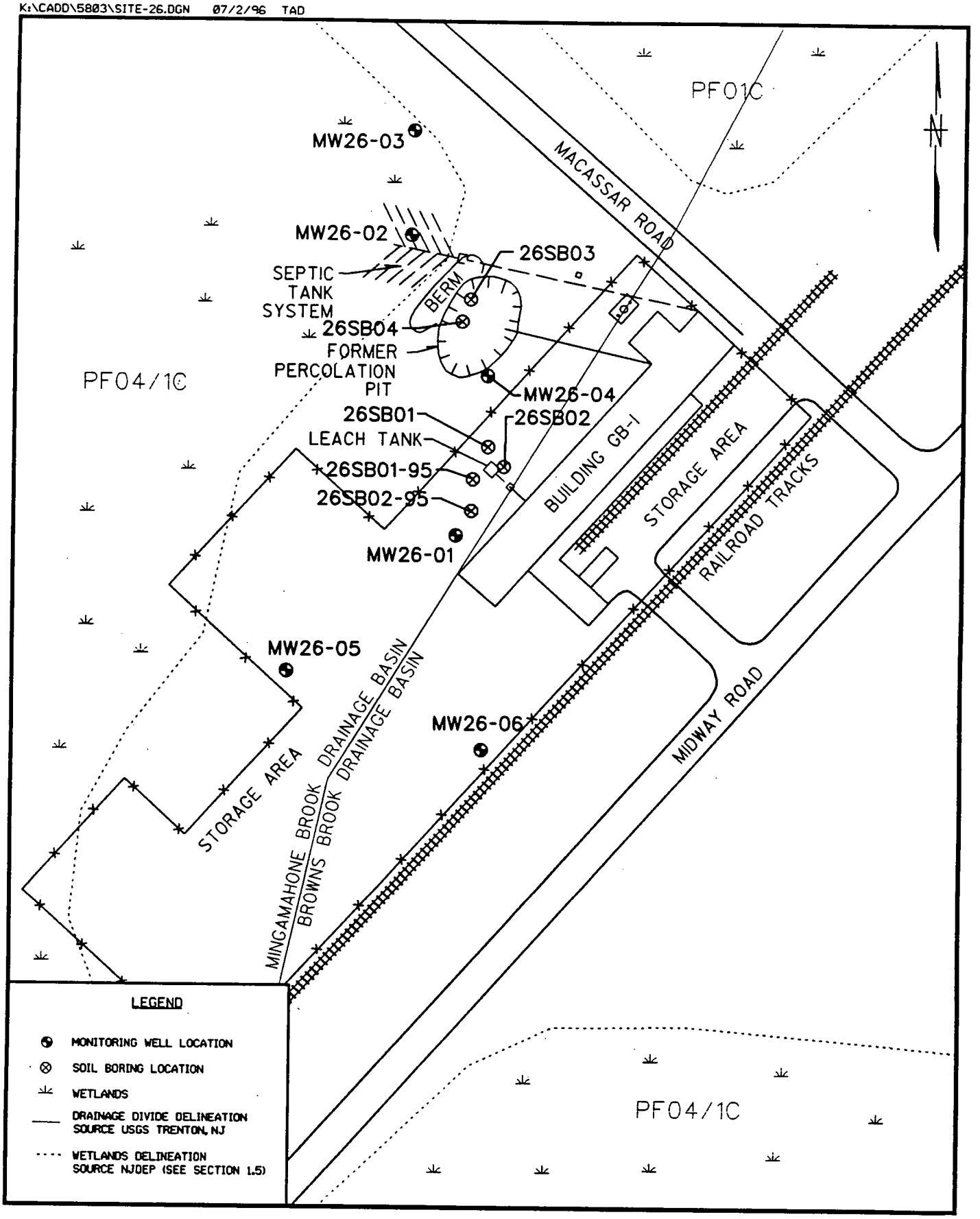

FIGURE 1-5

SITE 26 - EXPLOSIVE "D" WASHOUT AREA

0 80 160

SCALE IN FEET

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1.3 SITE INVESTIGATION SUMMARY

Site investigation activities related to areas of potential environmental concern at NWS Earle have been undertaken by the Navy since approximately 1982. Early work included an Initial Assessment Study (IAS) conducted by Fred C. Hart and Associates; the results are included in a report prepared in 1982. Studies and field investigation efforts continued under the Installation Restoration Program (IRP) by Roy F. Weston, Incorporated. Several documents prepared by Weston were submitted to the Navy, NJDEP, and EPA. These documents include the Draft Report for Naval Weapons Station Earle, Colts Neck, New Jersey, IRP Phase II Confirmation Study, dated September 1986; the Draft Report of Current Situation and Draft Plan of Action, dated December 1988; an IRP Phase II Site Inspection Work Plan dated September 1991; a Draft Phase II Site Inspection Study for Naval Weapons Station Earle, Colts Neck, New Jersey, dated February 1993; and a final version of the SI report, dated December 1993. In addition, in September 1993, Weston submitted the Installation Restoration Program Remedial Investigations/Feasibility Study for 11 Sites at NWS Earle, Colts Neck, New Jersey, Volumes 1 to 3.

In 1995-96, Brown & Root Environmental (B&R Environmental) conducted a remedial investigation (RI) for 27 sites at NWS Earle. The RI included field investigations performed in 1995 and a review of data generated during previous investigations. The final RI report was prepared in July 1996. Results of the RI indicated that further RI data collection activities were required at seven sites and that a feasibility study was required for the sites comprising OU-1.

Results of the previous investigations for the sites in OU-1 are discussed below.

1.3.1 Site 4

1.3.1.1 Initial Assessment and Confirmation Study

The 1983 IAS consisted of interviews and on-site observations. Based on the potential for groundwater impacts and the documented disposal of hazardous wastes, Site 4 was recommended for a confirmation study. The 1986 site inspection (SI) included the installation and sampling of three monitoring wells and the sampling of two on-site springs.

During the 1993 SI, four surface water and sediment samples were collected from the spring-fed stream and drainage along the southeastern portion of the site. No seeps were encountered at the sides of the landfill. Sediment samples contained very low levels of Volatile Organic Compound (VOCs), Semivolatile Organic Compounds (SVOCs), and elevated levels of metals and Aroclor 1260 (1.4 mg/kg). No other Polychlorinated Bihenyl (PCB) or pesticide compounds were found. The surface water samples were analyzed for VOCs and

Total Petroleum Hydrocarbons (TPH). No VOCs were detected that were not also identified in blanks. No TPH was detected.

1.3.1.2 Phase I Remedial Investigation

Phase I RI/FS activities were conducted by Weston in 1993 at NWS Earle. The sites in OU-1 were included for investigation. The RI/FS field investigation included test pit excavation, surface water and sediment sampling, and installation of three additional monitoring wells. No seeps were encountered at the edge of the landfill. Six test pits were excavated to characterize the waste materials. The waste consisted primarily of metal scrap such as steel banding, pipes, and empty metal trash barrels. Lumber, concrete, brick, and other construction debris were also encountered. No anomalous organic vapor readings were detected in any of the test pits. In two of the test pits, samples were collected and analyzed for full Target Compound List (TCL)/Target Analyte List (TAL) analytes and TPH. One SVOC compound [bis(2-ethylhexyl) phthalate] was detected in a sample from Test Pit 3. The pesticide 4,4'-DDT (13 ug/kg) and TPH (2,100 mg/kg) were detected in a sample form Test Pit 2. No other pesticides or PCBs were detected in either sample.

In 1993, groundwater samples were collected from all SI and RI/FS wells. One round was analyzed for full TCL/TAL compounds. 1,2-Dichloroethene (DCE) was detected in MW4-02 and MW4-05 at 20 ug/L and 7 ug/L, respectively, and trichloroethene (TCE) was found at 14 ug/L in MW4-05 during the first sampling round. A second and third round were analyzed for VOCs, drinking water metals, and landfill indicator parameters. VOCs such as methylene chloride and acetone, which are commonly associated with laboratory contamination, were detected in some samples. TCE at concentrations of 78 ug/L and 46 ug/L, respectively, and DCE at concentrations of 33 ug/L and 21 ug/L, respectively, exceeded the comparison regulatory standards in the sample from MW4-05 in the second and third sampling rounds. DCE at concentrations of 13 ug/L and 8 ug/L, respectively, were detected in MW4-02 during the second and third sampling rounds. Lead was detected at a concentration of 17.3 ug/L in a sample from MW4-04. Results of the landfill parameters indicated slightly elevated levels of Chemical Oxygen Demand (COD) and sulfates in the downgradient wells, MW4-02 and MW4-05, relative to the upgradient well, MW4-04.

1.3.1.3 Phase II Remedial Investigation

B&R Environmental conducted Phase II RI activities in 1995; the final report, including a human health risk assessment and ecological risk assessment, were performed for 27 sites at NWS Earle, including the four sites in OU-1. The results of the B&R Environmental RI are discussed in Sections 1.4 through 1.7. Activities performed during this investigation of OU-1 sites are summarized below.

Between June and October 1995, B&R Environmental conducted the following field investigation activities at Site 4:

- Sampling and analysis of groundwater samples from five hydropunch locations
- Sampling and analysis of surface water and sediment
- Drilling and installation of one shallow permanent monitoring well
- Measurement of static-water levels in the wells
- Sampling and analysis of groundwater from the newly installed well and existing wells

B&R Environmental conducted a survey to establish the horizontal locations and vertical elevations of hydropunch sample locations, surface water and sediment sample locations, surface soil sample locations, the newly installed monitoring well, and selected existing wells.

1.3.1.4 Summary of 1995 RI Results

Site 4 is an open area surrounded by woodlands. The landfill is primarily covered with a sandy soil and is not closed with an impermeable cap. Erosion of the cover is present on the eastern side of the landfill. The site is moderately vegetated with grasses and some scrub pines, although there are a few bare areas. The site is bordered by Macassar Road to the west and by an unpaved road to the north, east, and south. The ground surface slopes downward to the southeast from approximately 170 feet above Mean Sea Level (MSL) near MW4-01 to approximately 150 feet above MSL at MW4-06. Along the southeastern portion of the site, the fill face is approximately 25 feet high but tapers to the original ground surface. No seeps were encountered at the edge of the landfill. A broad, low-lying wetland extends from the eastern portion of the site beyond the unpaved boundary road. Surface water and groundwater flow is to the east and east-southeast toward the wetland, based on measured groundwater levels.

1.3.1.4.1 Site Geology, Hydrogeology, and Hydrology

Geology

Regional mapping places Site 4 within the outcrop area of the Cohansey Sand. The Cohansey Sand ranges between 0 and 30 feet in thickness and the soil borings are no more than 35 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the Cohansey Sand. The thickness of the sediments penetrated in the on-site borings indicates the Cohansey Sand may have a regional thickness of greater than 30 feet. In general, the borings encountered alternating beds of light-colored, silty, fine- to coarse-grained sand with varying amounts of gravel. A 0.5-foot reddish-yellow clay seam was penetrated in one of the borings.

Hydrogeology

Groundwater in the Cohansey aquifer beneath the site occurs under unconfined conditions. Static-water-level measurements and water-table elevations were recorded in August and October 1995. Groundwater contour maps are presented in Figures 1-6 (August) and 1-7 (October). The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater elevations, is toward the east and east-southeast. There does not appear to be a significant seasonal variation in groundwater flow direction.

The hydraulic conductivity calculated for MW4-04 is 4.48×10^{-4} cm/sec (1.27 ft/day).

1.3.1.4.2 Nature and Extent of Contamination

Sediment

One site-related sediment sample (04 SD 4B5) was collected at Site 4. Concentrations of metals in the site-related sediment sample were similar to background ranges. For organics, only nitrobenzene (66 ug/kg) was detected in the site-related sediment sample. This compound was not detected in background sediment samples. The Site 4 sediment analyses included chemical oxygen demand (COD), chlorides, moisture, nitrates, TOC, and totalphosphorus as phosphate. None of these indicator parameters exceeded the range detected in background samples to suggest any evidence of influence from the landfill on the wetlands. Figure 1-7 shows sample locations and concentrations of compounds that exceed applicable or relevant and appropriate requirements (ARARs) and other guidance to be considered (TBCs).

Groundwater

Six site-related groundwater samples (04 GW 01, 04 GW 02, and 04 GW 04 through 04 GW 07) were collected at Site 4. Concentrations of most site-related metals were similar to background levels. The site-related samples showed the presence of all the metals found in background samples. Barium and zinc were detected in upgradient well sample 04 GW 01 and also in downgradient well 04 GW 05 at levels greater than background. Iron was detected in downgradient well sample 04 GW 02 at levels greater than background. Beryllium was detected at levels greater than background but near the instrument detection limit in upgradient well sample 04 GW 04 (1.6 ug/L). Results of organic analysis showed that 1,2-dichloroethene (19 ug/L to 25 ug/L) and TCE (1 ug/L to 55 ug/L) were each detected in two groundwater samples. Chloroform (1 ug/L) and vinyl chloride (3 ug/L) were each detected in one groundwater sample. 04 GW 05 exhibited the highest levels of TCE, with the highest level of 1,2-DCE and vinyl chloride present in 04 GW 02. Neither of these compounds were detected in background groundwater samples. Hydropunch samples indicate that VOCs had not migrated vertically in measurable quantities. The Site 4 groundwater sample analyses included

ammonia nitrogen, BOD, COD, chlorides, sulfates, and TOC. Sample 04 GW 02 revealed levels of COD, sulfate, and TOC greater than those detected in upgradient sample 04 GW 04 and greater than background ranges. However, results are considerably below the concentration range associated with concentrated landfill leachate (Chian and DeWalle, 1976; Brunner and Keller, 1972; and ASCE, 1976). These findings are consistent with the generally low-level detections of these indicator parameters during the previous 1993 sampling investigation. Figure 1-8 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

Surface Water

Four site-related surface water samples (04 SW 01 through 04 SW 03 and 04 SW 4B5) were collected at Site 4. Metals detected in site-related surface water samples at concentrations notably greater than background ranges include the following: aluminum at 1,220 ug/L in 04 SW 01 and 04 SW 03; iron at 15,500 ug/L in 04 SW 02 and 9,020 ug/L in 04 SW 04; lead at 22.6 ug/L in 04 SW 03; and manganese at 383 ug/L in 04 SW 04 and 333 ug/L in 04 SW 02. Arsenic was detected in 04 SW 03 at a low level (near the instrument detection limit) but was not detected in background surface water samples.

Aldrin (0.0023 ug/L), dieldrin (0.0008 ug/L), and bis(2-ethylhexyl) phthalate (26 ug/L) were each detected in a site-related surface water sample collected at Site 4. None of these compounds were detected in background surface water samples.

The Site 4 surface water sample analyses included ammonia nitrogen, BOD, COD, chloride, nitrate, nitrite, sulfate, TOC, phosphate, and turbidity. Samples 04 SW 01 and 04 SW 03 had measured COD levels slightly greater than background ranges. However, these levels are in the lower end of the range associated with landfill leachate (Chian and DeWalle, 1976; Brunner and Keller, 1972; and ASCE, 1976). Figure 1-8 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

1.3.1.4.3 Contaminant Fate and Transport

Nitrobenzene was detected in one sediment sample at a low concentration. In contrast to most semivolatile compounds, nitrobenzene is considered to be water soluble and does not bind as strongly to organic matter in sediment. This compound is therefore considered fairly mobile in the environment. Sediment containing nitrobenzene may be subject to leaching to groundwater or surface water transport through erosional dispersion or leachate migration. Nitrobenzene, like other monocyclic aromatics, is considered susceptible to biodegradation in the environment. The rate of degradation depends on several factors including nutrients, oxygen, moisture, carbon source, pH, and the presence of appropriate acclimatized microorganisms.

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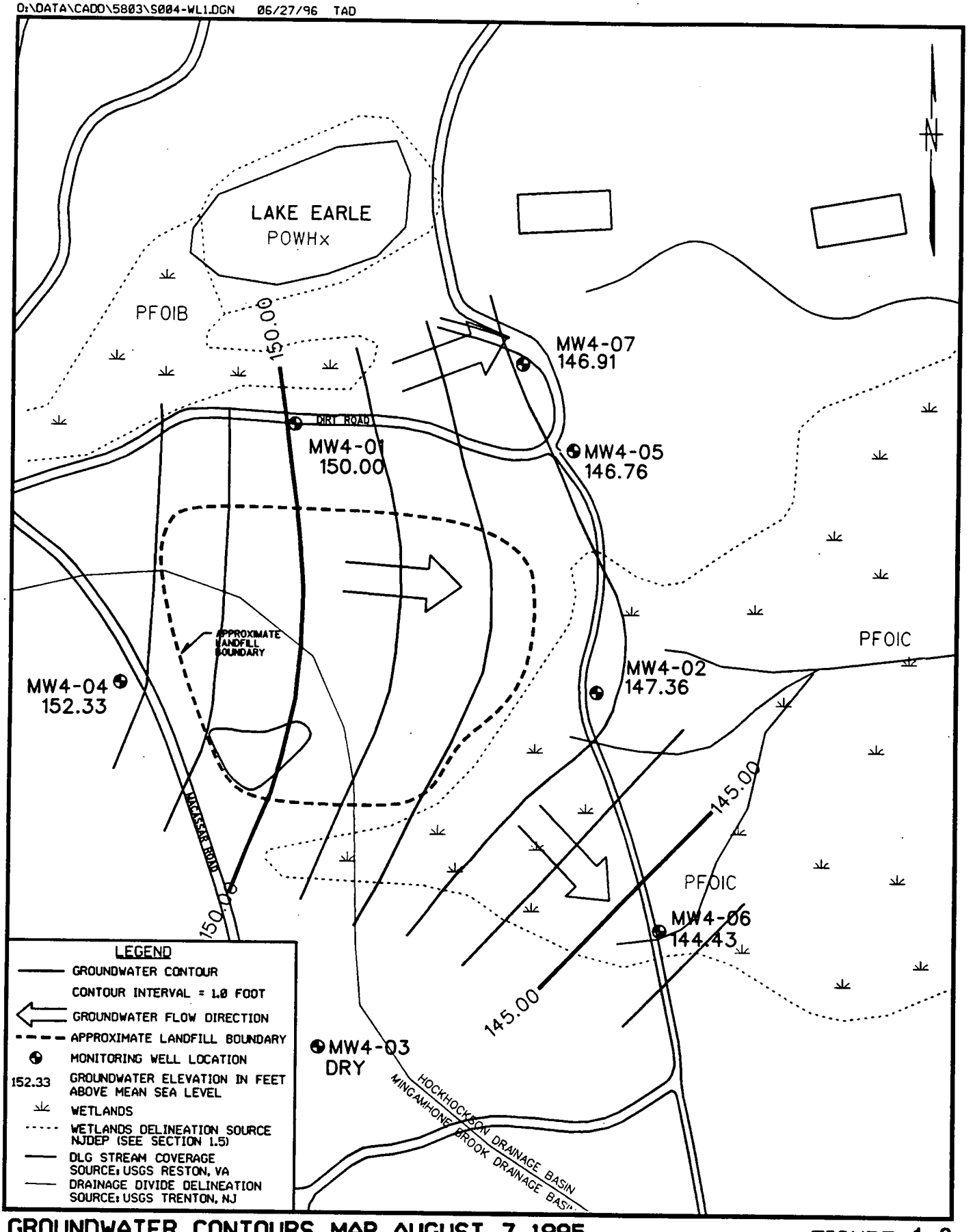

GROUNDWATER CONTOURS MAP AUGUST 7, 1995

SITE 4 - LANDFILL WEST OF "D" GROUP

FIGURE 1-6

0 200 400

SCALE IN FEET

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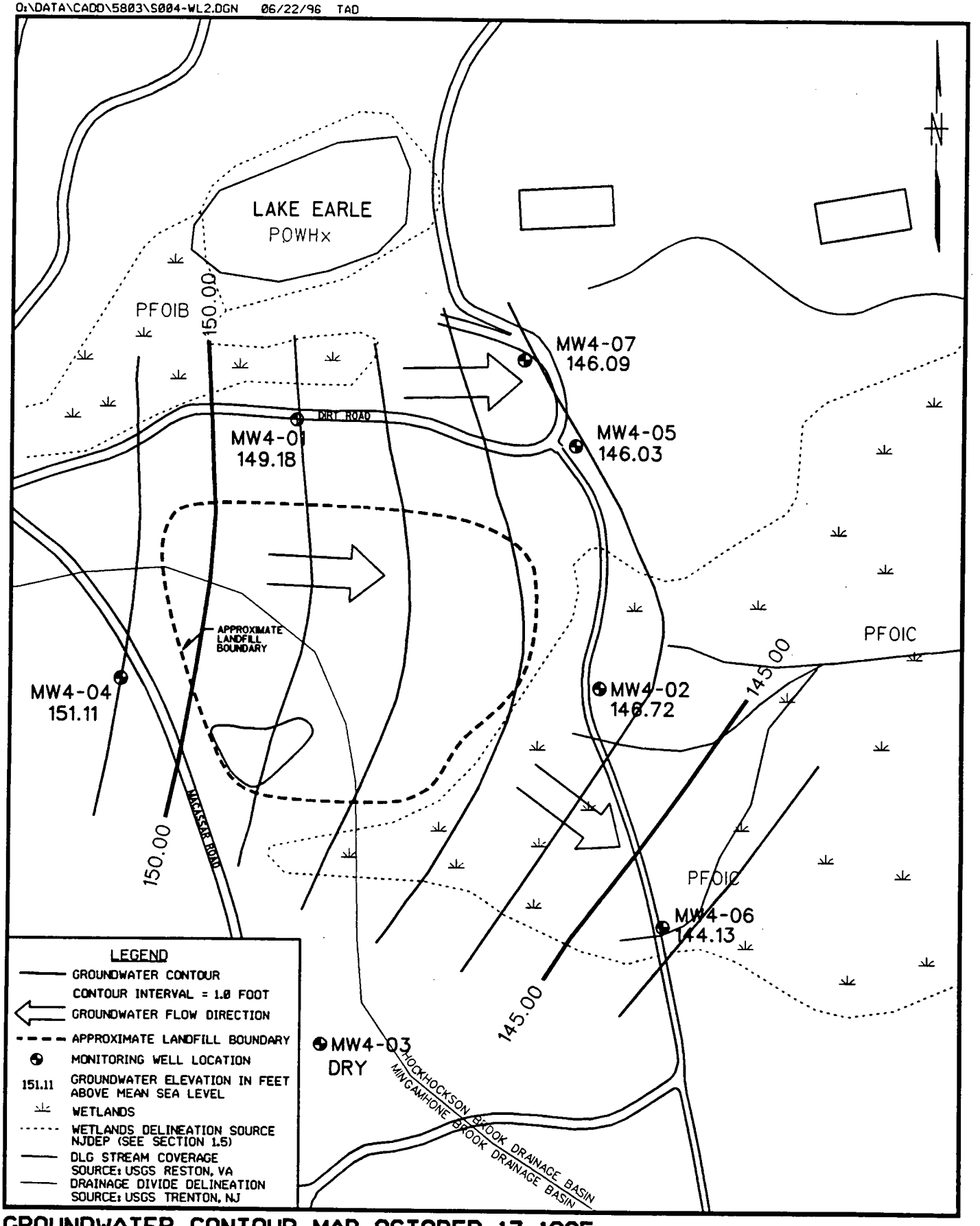

GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 4 - LANDFILL WEST OF "D" GROUP

FIGURE 1-7

0 200 400

SCALE IN FEET

Brown & Root Environmental

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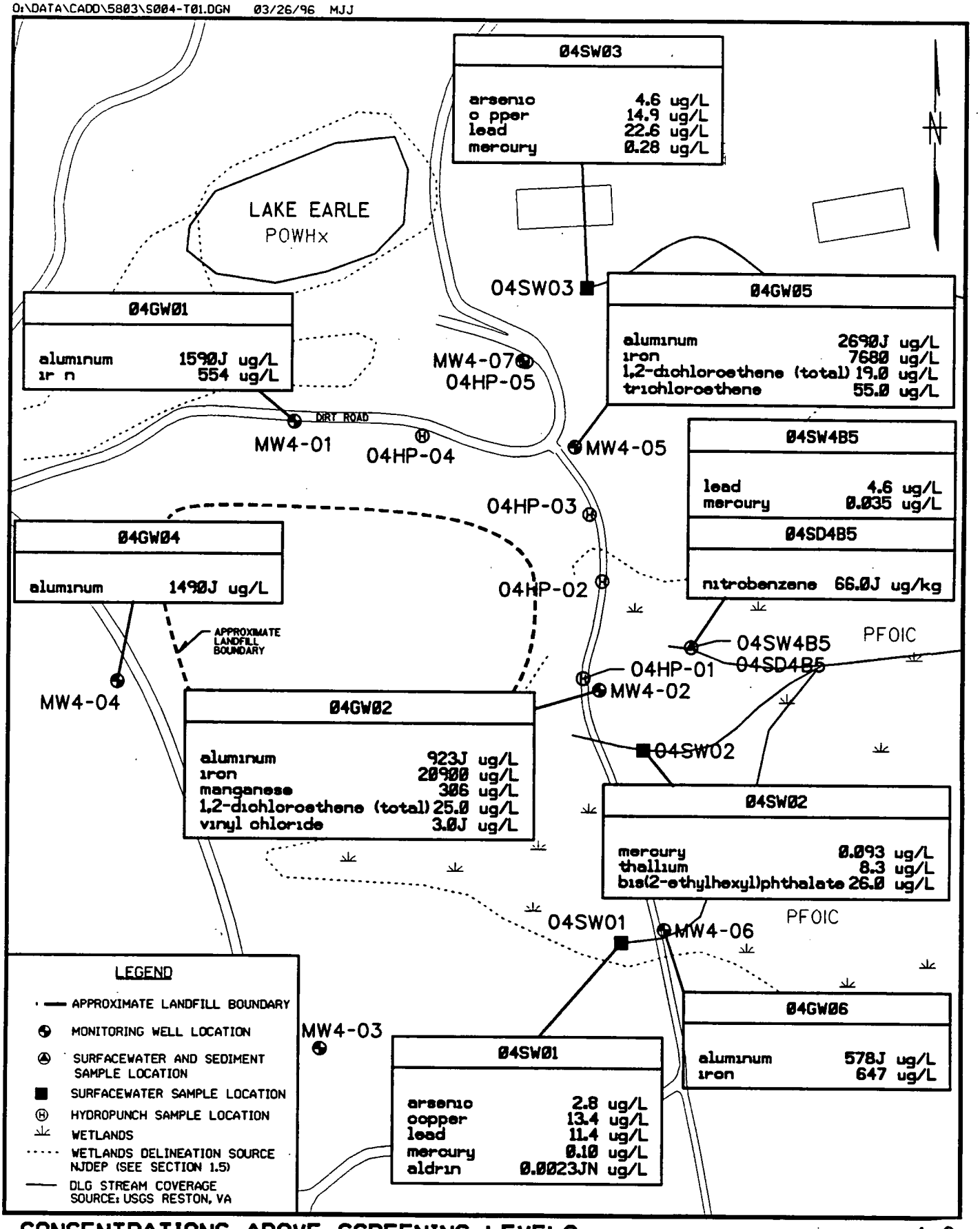


CONCENTRATIONS ABOVE SCREENING LEVELS

SITE 4 - LANDFILL WEST OF "D" GROUP

FIGURE 1-8

Brown & Root Environmental

All detected organic groundwater contaminants are volatile and characteristically mobile in the environment (either through soil gas migration or groundwater transport) and may have originated at landfill source locations not identified in this investigation or from source locations that have since been depleted of these contaminants. The chlorinated ethenes detected in groundwater have been associated with degradation of PCE and TCE (Cline and Viste, 1983). 1,1-DCE and 1,2-DCE are associated with degradation of PCE and TCE (Cline and Viste, 1983) and may further degrade to vinyl chloride. Concentrations of the parent compounds (TCE and PCE) may diminish over time, depending upon the presence of contaminated source materials that could continue to leach new product into groundwater. TCE and 1,2-DCE concentrations neither increased nor decreased when the 1995 sampling results were compared to the 1993 results.

Arsenic and lead were detected at low levels in one site-related surface water sample. The presence of elevated levels of aluminum suggests that suspended solids, rather than dissolved metals, represent a significant portion of the total metals in this sample. Iron and manganese were also detected at elevated levels in two surface water samples. The corresponding sediment samples did not reveal elevated levels of metals.

1.3.1.4.4 Baseline Human Health Risk Assessment

The potential receptors considered for this site were future industrial, residential, and recreational receptors. The Reasonable Maximum Exposure (RME) cancer risk associated with the future residential (groundwater) exposure scenario was approximately 1E-04, the upper end of the target acceptable risk range. However, the RME estimate for the future residential receptor is probably overly conservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range of 1E-04 to 1E-06. Vinyl chloride (via ingestion of groundwater and inhalation during showering) was the major COPC that contributed to the cancer risk for this exposure scenario.

RME estimates for noncarcinogenic Hazard Indices (HIs) associated with the future residential (groundwater) exposure scenario exceeded 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Iron and barium (both via ingestion of groundwater) were the Chemicals of Potential Concern (COPCs) that exceeded 1.0 or contributed to the HI exceeding 1.0 for this exposure scenario. Central tendency risk estimates for residential exposure to groundwater yielded also yielded HIs greater than 1.0 for the same target organs and COPCs.

Lead groundwater concentrations at the site were below EPA guidelines. These lead concentrations are not expected to be associated with significant increases in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99). Lead surface water concentrations were greater than the guideline range; however, this would not adversely affect the future recreational receptor exposed to surface water because of very low ingestion rates.

1.3.1.4.5 Ecological Risk Assessment

The ecological risk assessment concluded that contaminants do not appear to be significantly migrating to surface water and sediment in the wetlands via overland runoff and/or groundwater to surface water discharge at a level of ecological concern. Significant contaminant inputs from future discharge are unlikely since the landfill has been inactive since 1960 and any effects of discharge would most likely have already occurred. Contaminant inputs to Lake Earle are not considered likely since surface drainage and groundwater do not flow toward the lake.

1.3.2 Site 5

1.3.2.1 Initial Assessment and Confirmation Study

The 1983 IAS, consisted of interviews and on-site observations. Based on the potential for groundwater impacts and the documented disposal of industrial wastes, the site was recommended for a confirmation study. In 1986, four monitoring wells were installed and sampled at the site. No surface seeps were encountered at the edge of the landfill.

1.3.2.2 Phase I Remedial Investigation

During the 1993 Weston RI/FS, four test pits were excavated and four additional monitoring wells were installed. The test pits were excavated to characterize the wastes that had been disposed at the site. A layer of trash, ranging in thickness from 6 to 13 feet, was encountered in all four test pits. The trash consisted of foam rubber, glass, paper, plastic, metal scrap materials, lumber, concrete, bricks, and other construction debris. The cover material was thin to non-existent. Groundwater was not encountered in the test pits. No surface seeps were encountered at the edge of the landfill. Elevated organic vapor readings (HNu) were detected in one of the four test pits (TP5-1). Two soil samples were analyzed for full TCL/TAL analytes. Test pit TP5-1 showed chromium (117mg/kg), toluene (22 ug/kg), and xylene (12 ug/kg). Several volatile and semivolatile compounds were detected below detection limits. No pesticides or PCBs were detected.

Groundwater samples were collected from all SI and RI/FS wells during the 1993 RI/FS and analyzed for TCL/TAL analytes, cyanide, and landfill indicator parameters. No surface seeps were encountered at the edge of the landfill. Chloroform was detected in samples from wells MW5-04 and MW5-08 (an upgradient well). Beryllium, chromium, cadmium, and, to a lesser extent, lead, were detected in samples from several wells. Lead and chromium levels were highest in the sample from MW5-06. VOCs, including DCE, TCE, and benzene, were also detected in the sample from MW5-06. Results of samples analyzed for landfill

parameters indicated elevated levels of sulfate. No distinction was made between the upgradient well (MW5-08) and downgradient wells for other landfill parameters.

1.3.2.3 Phase II Remedial Investigation

Between June and October 1995, B&R Environmental conducted the following field investigation activities:

- Sampling and analysis of groundwater samples from seven hydropunch locations
- Sampling and analysis of groundwater from eight existing monitoring wells
- Measurement of static-water levels in the wells

A survey was conducted to establish the horizontal locations and vertical elevations of the hydropunch sample locations and selected existing wells.

1.3.2.4 Summary of Results

Site 5 is characterized as an open area moderately vegetated with grasses and scrub pines and surrounded by woodlands. A narrow forested wetland is located to the west of the railroad tracks. Loose silty sand (ranging in thickness from 1.5 feet to greater than 3 feet) from the surrounding area was used as the cover material. An impermeable cap was not used for closure. Railroad tracks run of the southwestern boundary of the landfill and the wetland is located to the west of the landfill between the dirt access road and the railroad tracks. Topography across the site slopes gently to the southwest from approximately 115 feet to 105 feet above MSL. Groundwater flow is generally to the northeast (at a slight gradient), based on measured groundwater levels.

1.3.2.4.1 Site Geology, Hydrogeology, and Hydrology

Geology

Regional mapping places Site 5 within the outcrop area of the Kirkwood Formation. The Kirkwood Formation ranges between 60 and 100 feet in thickness. The lithology of the soils encountered in the on-site borings generally agrees with the published descriptions of the Kirkwood and Vincentown Formations. The on-site borings were no greater than 55 feet deep. Assuming a portion of the Kirkwood Formation was removed by erosion, it is possible that at least one of the soil borings penetrated the underlying Vincentown Formation. In general, the borings encountered brown and gray, very fine- to medium-grained sand and dark-colored silt (probably representative of the Kirkwood Formation) and olive and olive brown, slightly glauconitic, fine- to coarse-grained sand (probably representative of the Vincentown Formation). The Mainside area is located

above the updip limit of the Piney Point, Shark River, and Manasquan Formations; therefore, the glauconitic sand is interpreted to be part of the Vincentown Formation.

Hydrogeology

Based upon the boring log descriptions, well MW5-06 penetrated the Kirkwood Formation, wells MW5-02, MW5-03, MW5-05, MW5-07, and MW5-08 penetrated both the Kirkwood and Vincentown Formations, and wells MW5-01 and MW5-4 penetrated the Vincentown Formation.

Groundwater in the Kirkwood and Vincentown aquifer beneath the site occurs under unconfined conditions and the formations are interpreted to be hydraulically interconnected. Groundwater contour maps are presented in Figures 1-9 (August 1995 levels) and 1-10 (October 1995 levels). The direction of shallow groundwater flow in the aquifer is toward the northeast. There does not appear to be a significant seasonal variation in groundwater flow direction. The hydraulic conductivities calculated for MW5-02 (Kirkwood and Vincentown Formation), MW5-06 (Kirkwood Formation), and MW5-07 (Vincentown Formation) are 3.18×10^{-4} cm/sec (0.90 ft/day), 6.46×10^{-4} cm/sec (1.83 ft/day), and 2.08×10^{-4} cm/sec (0.59 ft/day), respectively.

Hydrology

A small drainage ditch is located approximately 100 feet west of the dirt road that borders the western edge of the site, and water is present in the ditch only after periods of heavy rainfall. The closest surface water is a tributary of Hockhockson Brook, located approximately 1,000 feet east of Site 5. The site is located on the border of the Hockhockson Brook and Pine Brook watersheds. The topography of the site is flat, inhibiting off-site runoff; therefore, precipitation perches and infiltrates on the site. No surface seeps exist at the landfill.

1.3.2.4.2 Nature and Extent of Contamination

Eight site-related groundwater samples (05 GW 01 through 05 GW 08) were collected at Site 5. Figure 1-11 shows sample locations and concentrations of compounds that exceed ARARs and TBCs. Seven hydropunch samples were also taken as a screening tool to determine if existing groundwater monitoring wells were sufficient to characterize lateral extent of groundwater contamination.

Inorganics

Aluminum, arsenic, cadmium, and cobalt were detected in sample 05 GW 07 at levels greater than background. Iron and cadmium were also detected at levels greater than background in 05 GW 06, and aluminum was detected at levels greater than background in 05 GW 02. Beryllium was detected at levels

greater than background but near the instrument detection limit in sample 05 GW 07 (1.6 ug/L). Thallium was detected at low levels in 05 GW 01 and 05 GW 02 but was not found in background samples.

Organics

1,2-DCA (2 ug/L to 3 ug/L), 1,2-DCE (2 ug/L to 9 ug/L), TCE (2 ug/L to 4 ug/L), and benzene (2 ug/L to 3 ug/L) were each detected in two groundwater samples collected at Site 5 (05 GW 06 and 06 GW 07). Sample 05 GW 06 also contained low levels of ethylbenzene (2 ug/L), xylenes (4 ug/L), methylene chloride (2 ug/L), and xylene (4 ug/L). Vinyl chloride (2 ug/L) was detected in the sample from 05 GW 05 and chloroform was detected at 22 ug/L in the sample from 05 GW 01. Low levels of volatile organics (xylene, ethybenzene, benzene, and 1,2-DCE) in the hydropunch samples generally confirm the presence of these VOCs, but the data quality of these hydropunch results does not allow their use in human health risk assessment. Hydropunch samples were used only for screening purposes, to guide additional well placement.

Miscellaneous Parameters

The Site 5 groundwater analyses consisted of BOD, COD, chlorides, sulfates, TOC, phosphates, and turbidity. Sulfate was detected in MW5-06 (downgradient) and MW5-07 (crossgradient and adjacent to the landfill) at concentrations greater than those found in upgradient wells MW5-03 and MW5-06 and greater than background groundwater levels. MW5-07 slightly exceeded the Secondary Maximum Contaminant Level (SMCL) for sulfate. These data confirm the presence of elevated sulfate levels also found during the previous 1993 sampling investigation. Other indicator parameters (BOD, COD, and TOC) were also present at slightly greater levels in downgradient versus upgradient wells; however, results are below the range associated with concentrated landfill leachate (Chian and DeWalle, 1976; ASCE, 1976; Brunner and Keller, 1972).

1.3.2.4.3 Contaminant Fate and Transport

VOCs and several inorganics were present in Site 5 groundwater samples. No soil samples were collected at the site during the 1995 RI. The chlorinated ethenes detected in groundwater have been associated with degradation of PCE and TCE (Cline and Viste, 1983). Several chlorinated ethenes (1,2-DCA, 1,2-DCE, TCE, and vinyl chloride), benzene, and other volatile aromatics were detected at low levels in groundwater downgradient of the landfill. All detected volatile organic groundwater contaminants exhibit relatively high solubilities, vapor pressure, and air-water partition coefficients (Henry's law constant). These compounds are characteristically mobile in the environment (either through soil gas migration or groundwater transport). Inorganics detected in the groundwater at levels above background were aluminum, arsenic, beryllium, cadmium, cobalt, and thallium.

For the classes of detected chemicals, environmental persistence varies considerably. Vinyl chloride and 1,2-DCE are associated with degradation of PCE and TCE (Cline and Viste, 1983). Concentrations of the parent compounds (TCE and PCE) may diminish over time, depending upon the presence of source materials that could continue to leach product into groundwater. Benzene and related alkyl-substituted aromatics are also considered susceptible to biodegradation in the environment.

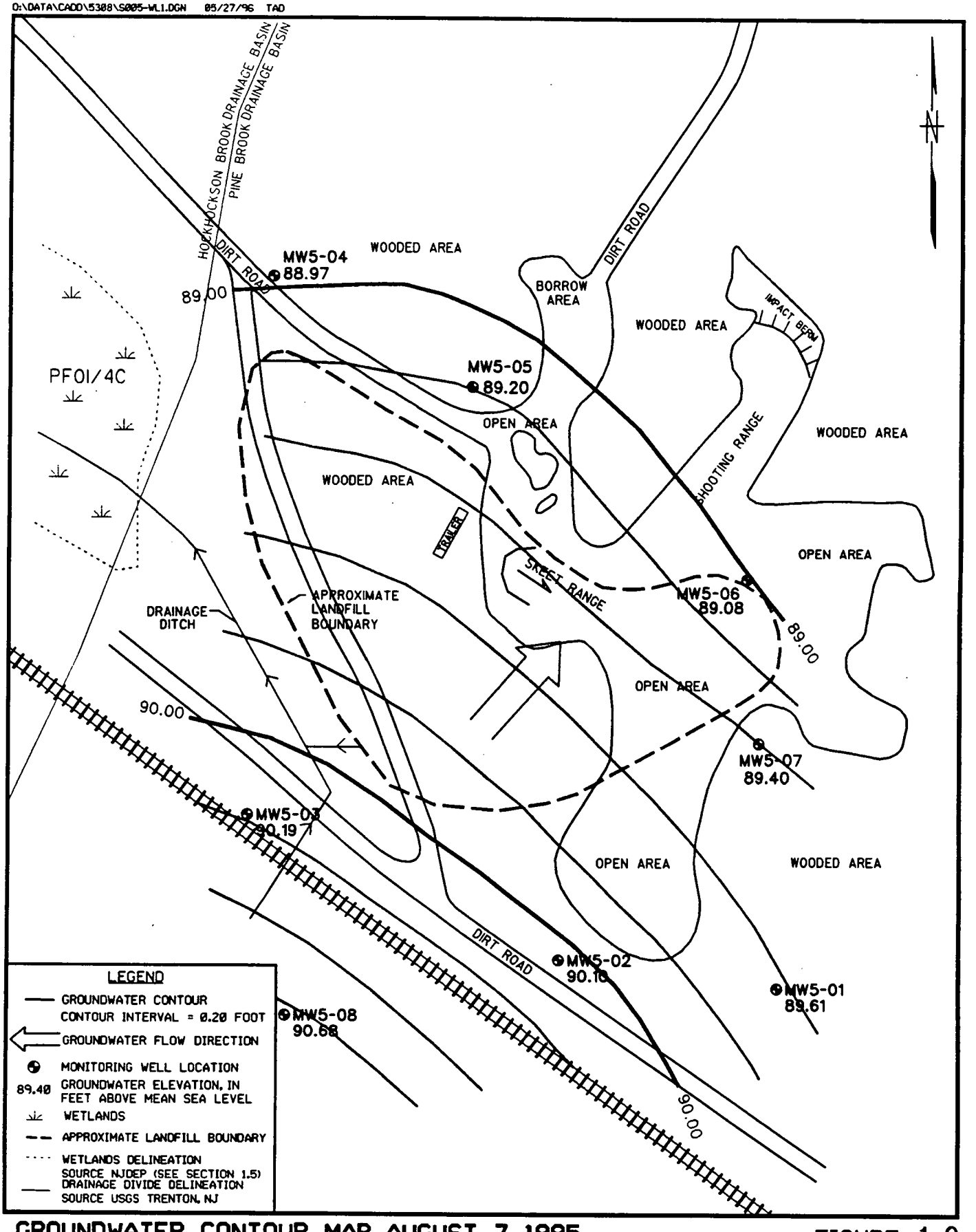
1.3.2.4.4 Baseline Human Health Risk Assessment

The potential receptors considered for this site were future industrial receptors and residential receptors. The RME cancer risk associated with the future residential (groundwater) exposure scenario is greater than 1E-04, the upper end of the target acceptable risk range. Vinyl chloride (via ingestion of groundwater and inhalation during showering) and arsenic (via ingestion of groundwater) are the principal COPCs that contribute to this cancer risk. However, the RME estimate for the future residential receptor is probably overconservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range of 1E-04 to 1E-06.

Noncarcinogenic Hazard Quotients (HQs) associated with the future residential (groundwater) exposure scenario exceeded 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Iron is the COPC that exceeded 1.0 for this exposure scenario. In addition, central tendency risk estimates for residential exposure to groundwater yielded HIs greater than 1.0 for the liver and digestive systems as target organs.

Lead groundwater concentrations at the site were below the EPA action level for public water supplies and are not expected to be associated with a significant increase in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99).

O:\DATA\CADD\5308\S005-WL1.DGN 05/27/96 TAD



GROUNDWATER CONTOUR MAP AUGUST 7, 1995

SITE 5 - LANDFILL WEST OF ARMY BARRICADES

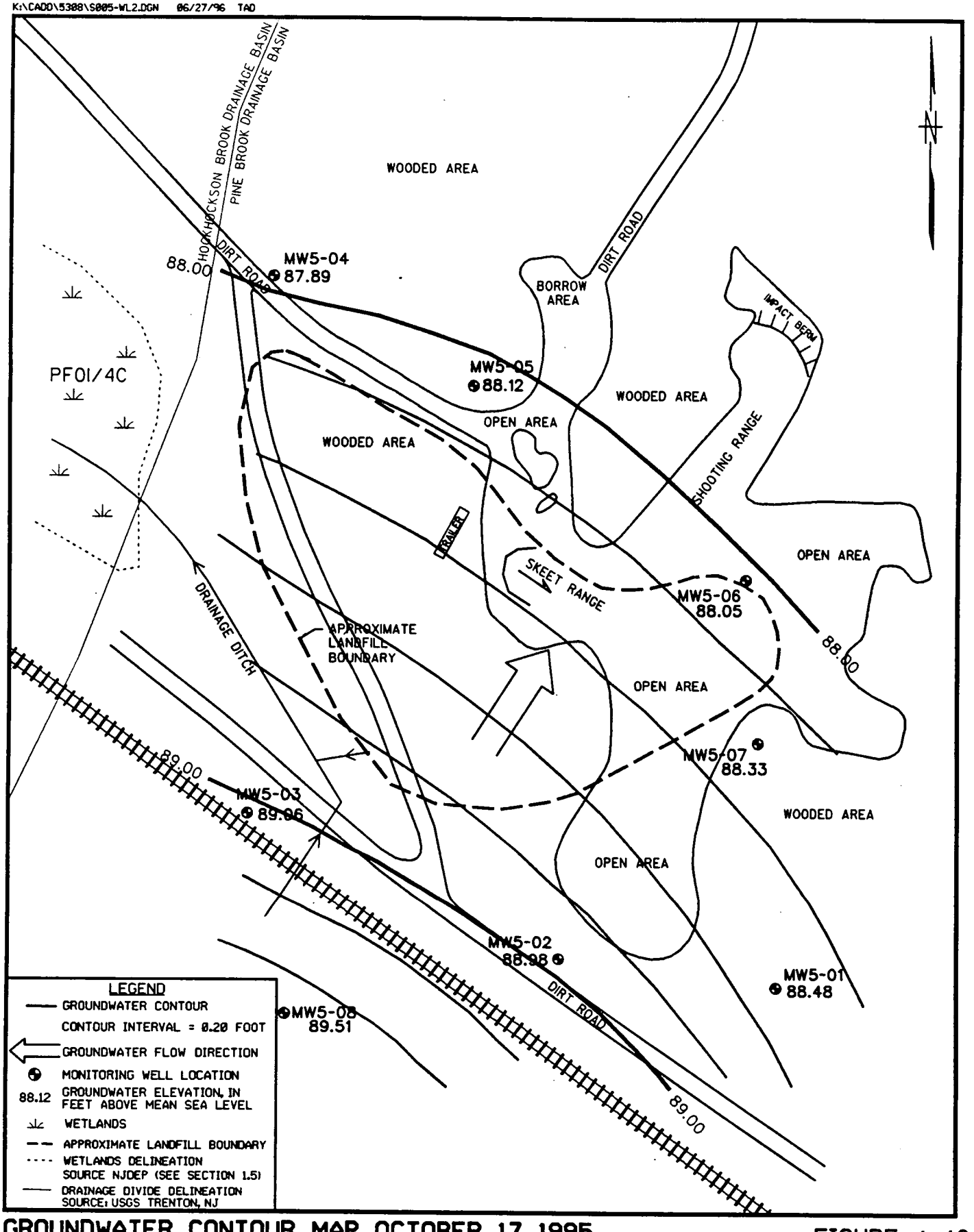
FIGURE 1-9

0 150 300

SCALE IN FEET

Brown & Root Environmental

K:\CADD\5308\S005-WL2.DGN 06/27/96 TAD



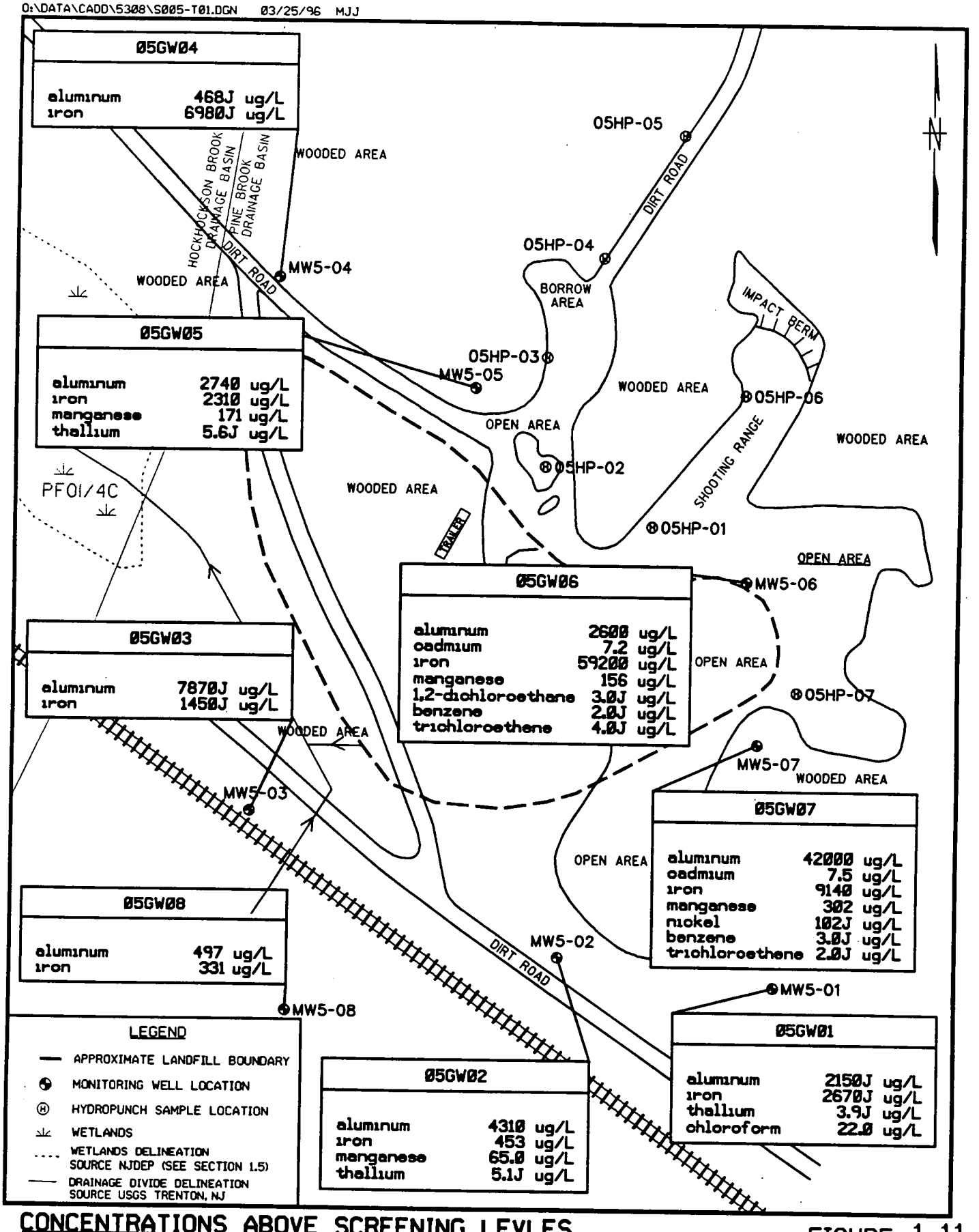
GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 5 - LANDFILL WEST OF ARMY BARRICADES

FIGURE 1-10

Brown & Root Environmental

O:\DATA\CADD\5308\S005-T01.DGN 03/25/96 MJJ



CONCENTRATIONS ABOVE SCREENING LEVLES

SITE 5 - LANDFILL WEST OF ARMY BARRICADES

FIGURE 1-11

Brown & Root Environmental

1.3.2.4.5 Ecological Risk Assessment

Some bare areas are present on the 5-acre inactive landfill, but the majority of the site is dominated by young pitch pines. Upland habitats surround most of the site and are dominated by mature white oak, chestnut oak, and mountain laurel. Soils in these areas are classified as Lakewood sand. A narrow forested wetland is located to the west, along the railroad tracks. Vegetation in the forested wetland is dominated by red maple and blackgum, and standing water in the wetland is rarely present. A small drainage ditch is located approximately 100 feet west of the dirt road that borders the western edge of the site, and water is present in the ditch only after periods of heavy rainfall. The closest surface water is a tributary of Hockhockson Brook, located approximately 1,000 feet east of Site 5. The site is located on the border of the Hockhockson Brook and Pine Brook watersheds. The topography of the site is flat, inhibiting off-site runoff; therefore, precipitation perches and infiltrates on the site.

The landfill provides fair terrestrial habitat, and the adjacent uplands and wetlands provide excellent habitat, mainly for terrestrial ecological receptors. Most species of mammals and birds found in the Mainside area are expected to utilize these areas, and the border of the site provides an "edge effect" that may attract a wide variety of terrestrial receptors. No sensitive habitats, other than the wetland, and no threatened or endangered species are known to be present on or around the site.

The major potential contaminant release pathway from the landfill is overland runoff. Precipitation runoff may carry constituents to nearby areas, but the flat nature of the site precludes significant overland migration to off-site areas, including the wetlands. Infiltrating precipitation may cause the contamination of subsurface soil and groundwater. Groundwater to surface water contaminant migration is limited since no surface water is present near the site and groundwater flows away from the wetlands and drainage ditch.

Some VOCs, SVOCs, and metals were detected in groundwater samples collected during 1993 RI/FS activities. Several metals and VOCs were detected in 1995 RI groundwater samples. Groundwater flows to the northeast, away from the wetland area. Data from two soil samples taken from 1993 RI/FS test pit samples were used for quantitative assessment. HQs for inorganics and organics in soils were indicative of low potential risk, with the exception of chromium. This metal was not detected significantly above background, and the elevated HQ is most likely due to the only Ecotoxicity Threshold value (ET) that was available for chromium; this ET is heavily conservative. Beryllium was conservatively retained as a final COPC since no suitable ET was available, but this metal was not detected significantly above background. HQs for terrestrial plants from exposure to contaminated surface soils were indicative of low potential risk, except for aluminum, chromium, and vanadium. Nonetheless, aluminum was lower than background, and chromium and vanadium were not detected significantly above background. Moreover, the only ETs available for these metal were heavily conservative. No ET was available for selenium, but selenium was only detected in one sample at a relatively low concentration. No terrestrial plant ETs were available for organics, but concentrations were low for all organics detected, and plants do not translocate most organics significantly.

In summary, off-site migration of contaminants to the surrounding wetland areas, upland areas, and Hockhockson Brook or Pine Brook watersheds via overland runoff of groundwater to surface water migration is limited. HQ values for some metals detected were moderately high but are mitigated by several factors. In addition, some cover material has been placed on the landfill, limiting potential exposure to soil contaminants. Extensive vegetation is present on the site and no signs of plant stress are evident. For these reasons, potential risks to ecological receptors at Site 5 are low.

1.3.3 Site 19

1.3.3.1 Initial Assessment and Confirmation Study

The 1983 IAS, which consisted of interviews and observations, concluded that significant paint-wastes disposal to surface soil occurred over approximately 10 years. The site was not recommended for confirmation study because it was believed that impacted soils were removed for construction of new barricade facilities in the early 1970s.

During the 1993 SI, three monitoring wells were installed, and soil, sediment, surface water, and groundwater samples were analyzed. Cadmium, lead, and zinc were detected at elevated concentrations in soil. The upgradient well contained a detectable level of cadmium.

1.3.3.2 Phase I Remedial Investigation

During the 1993 Weston RI/FS, 24 surface soil samples were collected. Four surface soil samples were analyzed for TAL inorganics, and 20 were analyzed for cadmium and lead. Four shallow soil boring samples were collected from the drainageway exiting the site and were analyzed for VOCs and TPH. Thirteen sediment samples were collected from the depression and adjoining drainage swale and analyzed for TAL inorganics. Low levels of volatiles and metals were detected in surface soil samples. Elevated levels of metals were detected in sediments at levels above regulatory guidelines, most notably from samples taken within the depression and drainage swale.

Three additional monitoring wells were also installed to further characterize groundwater conditions. Groundwater samples were collected from all six monitoring wells on site and analyzed for TCL organics and TAL inorganics. Samples from MW19-02 and MW19-06 were also analyzed for explosives. Two volatile compounds, methylene chloride and acetone, were detected in almost all samples and in blanks. These detections are likely due to laboratory/field contamination. DDE and DDT were detected in a sample from MW19-02 from one sampling round (of three). These compounds were not undetected in samples later

rounds. Metals were detected at all monitoring wells. Chromium, lead, and antimony exceeded primary drinking water standards.

1.3.3.3 Phase II Remedial Investigation

Between June and October 1995, B&R Environmental conducted the following field investigation activities at Site 19:

- Sampling and analysis of surface water
- Sampling and analysis of sediment
- Sampling and analysis of surface and subsurface soil
- Drilling and installation of one shallow permanent monitoring well
- Sampling and analysis of groundwater from the newly installed well and existing wells
- Measurement of static-water levels in the wells

B&R Environmental conducted a survey to establish the horizontal locations and vertical elevations of the surface water and sediment sample locations, surface and subsurface soil sample locations, and the newly installed and selected existing monitoring wells.

1.3.3.4 Summary of Results

Site 19 is an ordnance maintenance area where paint chips and paint sludge were discharged to a topographic depression near Building S-34. The site was in operation from the early 1940s until the early 1960s. Paint slurries and solvent residues were discharged into the open drainage swale. During construction at the site, a significant portion of the contaminated material may have been removed. The site is a 300-foot circular area that is surrounded by woodlands. Half the site, from Building S-34 south to the site perimeter, is paved. The remainder has a gravel surface. The depression that received the sludge discharge is approximately 50 feet in diameter and 5 to 10 feet deep and is located in the center of the site, south of a barricade. A small drainage ditch runs from the depression to the west, toward a wetlands area. General groundwater flow direction is toward the west.

1.3.3.4.1 Site Geology, Hydrogeology, and Hydrology

<u>Geology</u>

Regional mapping places Site 19 within the outcrop area of the Kirkwood Formation. The Kirkwood Formation ranges between 60 and 100 feet in thickness. The 1995 soil borings are no more than 25 feet deep. The lithology of the sediments encountered in the on-site soil borings generally agrees with the published descriptions of the Kirkwood and Vincentown Formations. Assuming a portion of the Kirkwood

Formation was removed by erosion, it is possible that the soil borings penetrated the underlying Vincentown Formation. In general, the borings encountered brown and yellowish-brown, fine- to medium-grained sand, silty sand, sandy silt, and silt (probably representative of the Kirkwood Formation) and glauconitic, fine- to medium-grained sand (probably representative of the Vincentown Formation). Mainside is located above the up-dip limit of the Piney Point, Shark River, and Manasquan Formations; therefore, the glauconitic sand is interpreted to be part of the Vincentown Formation. Based upon the boring log descriptions, the wells penetrated the Kirkwood and Vincentown Formations.

Hydrogeology

Groundwater in the Kirkwood and Vincentown aquifer beneath the site occurs under unconfined conditions and the formations are interpreted to be hydraulically interconnected. Groundwater contour maps are presented in Figures 1-12 (August 1995 levels) and 1-13 (October 1995 levels). The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October 1995 groundwater measurements, is toward the west. There does not appear to be significant seasonal variation in groundwater flow direction.

Based on boring log descriptions, the wells are screened across the contact between the Kirkwood and Vincentown Formations. The hydraulic conductivities calculated for MW19-04 and MW19-05 are 6.91×10^{-4} cm/sec (1.96 ft/day) and 1.06×10^{-3} cm/sec (3.00 ft/day), respectively.

Hydrology

A small drainage ditch runs from the depression to a stream approximately 500 feet to the southwest. The site is at a higher elevation than the stream. The stream is a tributary of Mingamahone Brook, and as a result, the site is located within the Mingamahone Brook watershed. Water is present in the drainage depression only after periods of heavy rainfall. The stream southwest of the site is surrounded by wetlands. The wetlands, including the stream, drain to the south. The stream is dammed near the power lines west of the site, which has created a small pond north of the dam.

1.3.3.4.2 Nature and Extent of Contamination

Nine site-related subsurface soil samples (19 SB 01-00 through 19 SB 04-00, 19 SB 01-03 through 19 SB 04-03, and 19 SB 05-02) were collected at Site 19. Figure 1-14 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

Sediment

One site-related sediment sample (19 SD 01) was collected at Site 19. The sample exhibited total chromium at a level seven times the upper range of background samples. Aluminum, iron, manganese, and vanadium were detected at levels slightly greater than background.

PAHs including benz(a)anthracene, benzo(a)pyrene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and fluoranthene were detected in background sediment samples at a range from 140 ug/kg to 1,800 ug/kg. Similar PAHs were detected in the sediment sample collected at Site 19 at concentrations one to four times higher. 4,4'-DDT (19 ug/kg), 4,4'-DDD (4.9 ug/kg to 21 ug/kg), and gamma chlordane (0.095 ug/kg) were detected in background sediment samples. These pesticides were detected in the site-related sediment sample at levels of 38 ug/kg (4,4'-DDT), 330 ug/kg (4,4'-DDD), and 1.4 ug/kg (gamma chlordane). Toluene was detected in the site-related sample at 5.8 ug/kg and in a background sediment sample at 480 ug/kg.

Groundwater

Six groundwater samples were collected at Site 19, 19 GW 01 through 19 GW 03 and 19 GW 05 through 19 GW 07. No organics were detected in Site 19 groundwater samples. Antimony, arsenic, cadmium, thallium, and zinc were detected at levels greater than background in one monitoring well, MW19-07, which is located adjacent to the drainage ditch approximately 60 feet south-southwest of the former disposal area. Barium and zinc were detected at levels greater than background in monitoring well MW19-03.

Surface Water

One surface water sample was collected at Site 19, 19 SW 01. Concentrations of metals in the site-related surface water sample were similar to the range of background samples. Beta-BHC (0.0068 ug/L) and endosulfan I (0.001 ug/L) were each detected in one site-related surface water sample, 19 SW 01, which was located in the surface water discharge pathway approximately 300 feet southwest of the disposal area. These pesticides were not detected in background surface water samples.

1.3.3.4.3 Contaminant Fate and Transport

Hexavalent chromium was found at an elevated level in one near-surface soil sample at Site 19 and may have the potential to impact groundwater. Levels of chromium in groundwater observed in the current investigation were similar to background. Historical groundwater data, while indicating substantially greater chromium levels at one location, are not viewed as representing only dissolved metals and are suspected to reflect a high level of suspended solids. Chromium was detected at elevated levels in sediment from the toe of the drainage pathway, which suggests that migration of chromium has occurred through the surface water drainage pathway.

Certain metals (notably lead and zinc) were detected at elevated levels in one subsurface soil but were not found at elevated levels in subsurface soil collected in the drainage ditch or in the wetland sediment sample.

Therefore, impacts of lead and zinc migration appear limited to surficial drainage ditch sediments. Historical data indicate that these metals were detected at elevated levels in groundwater, but the ratio of suspended versus dissolved metal concentrations is suspected to be high. One monitoring well exhibited levels of antimony, arsenic, cadmium, lead, thallium, and zinc greater than background. Of these metals, only zinc was found at elevated levels in samples from other media collected at the site. Data does not present evidence of a trend toward the presence of elevated levels of metals in groundwater.

Trace levels of PCE were detected only in several subsurface soils collected at the shallow depth. This compound is considered highly mobile but was not detected in groundwater. The low levels detected may suggest only low-level contamination is present.

Less mobile contaminant species (PAHs and pesticides) were found only in sediment and not groundwater. These compounds exhibit a high affinity for soils/sediments and are not expected to migrate significantly except through erosional dispersion. These substances were not detected at elevated levels in the subsurface soils associated with the source area.

1.3.3.4.4 Baseline Human Health Risk Assessment

Subsurface soil, sediment, groundwater, and surface water were sampled at Site 19. The potential receptors for this site were future industrial, residential, and recreational receptors.

The RME cancer risks associated with future residential (subsurface soil and groundwater) exposure scenarios exceeded 1E-04, the upper end of the target risk range. Arsenic (via ingestion of groundwater) was the major COPC that contributed to the cancer risks for these exposure scenarios. However, these RME estimates are probably overconservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range.

RME estimates for noncarcinogenic HIs associated with future industrial (groundwater) and future residential (groundwater) exposure scenarios exceeded 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur. Thallium and arsenic (both via ingestion of groundwater) were the COPCs that exceeded 1.0 or contributed to the HI exceeding 1.0 for these exposure scenarios. The RME estimates of non-cancer risk from exposure to groundwater for the future industrial receptor are probably overconservative because associated central tendency non-cancer HIs are less than 1.0. However, central tendency risk estimates for residential exposure to groundwater yielded HIs greater than 1.0 for the target organs liver, kidney, skin, and central nervous system (thallium and arsenic were the principal COPCs).

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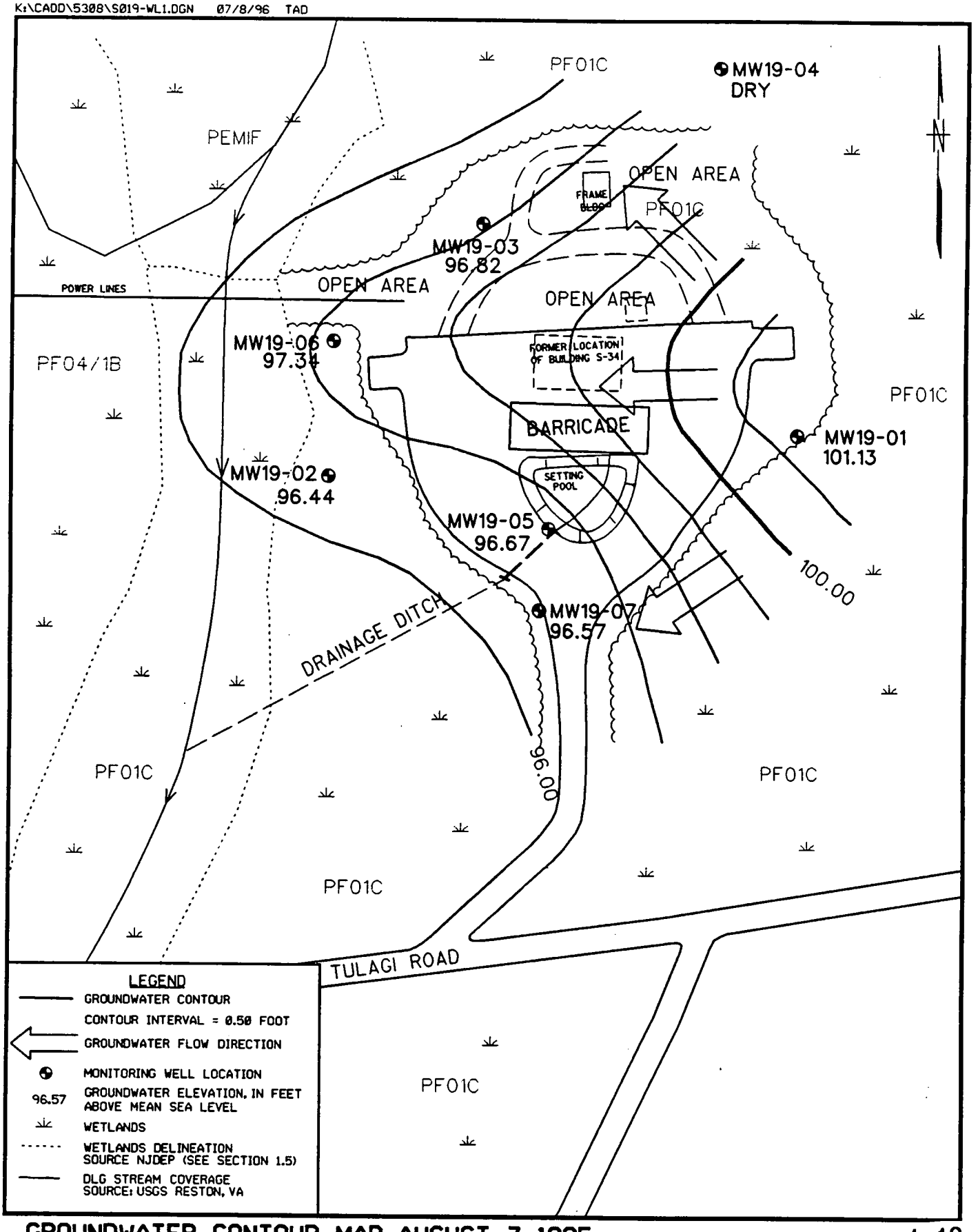


GROUNDWATER CONTOUR MAP AUGUST 7, 1995

SITE 19 - PAINT CHIP AND SLUDGE DISPOSAL AREA

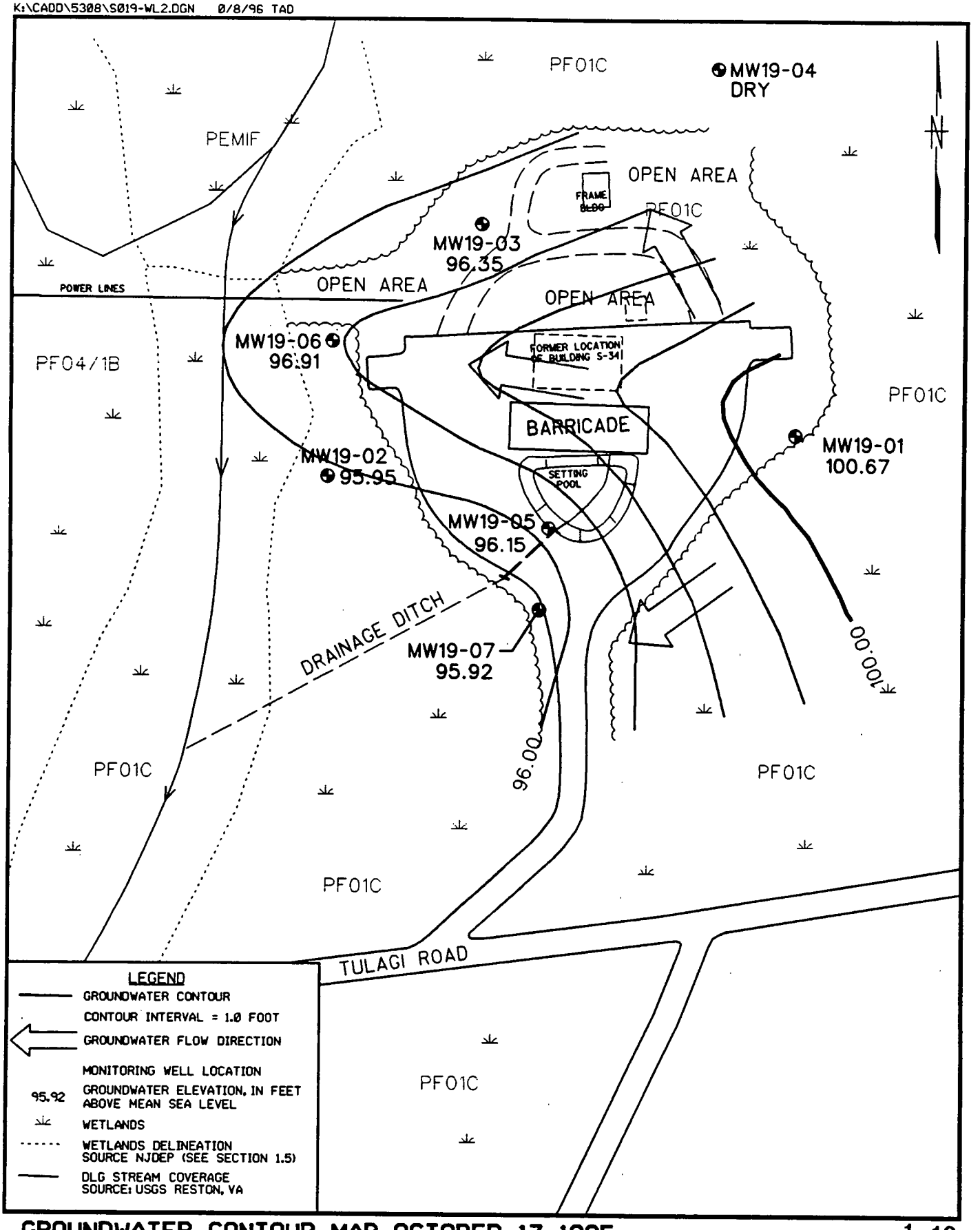
FIGURE 1-12

0 100 200

SCALE IN FEET

Brown & Root Environmental

K:\CADD\5308\S019-WL2.DGN 0/8/96 TAD



GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 19 - PAINT CHIP AND SLUDGE DISPOSAL AREA

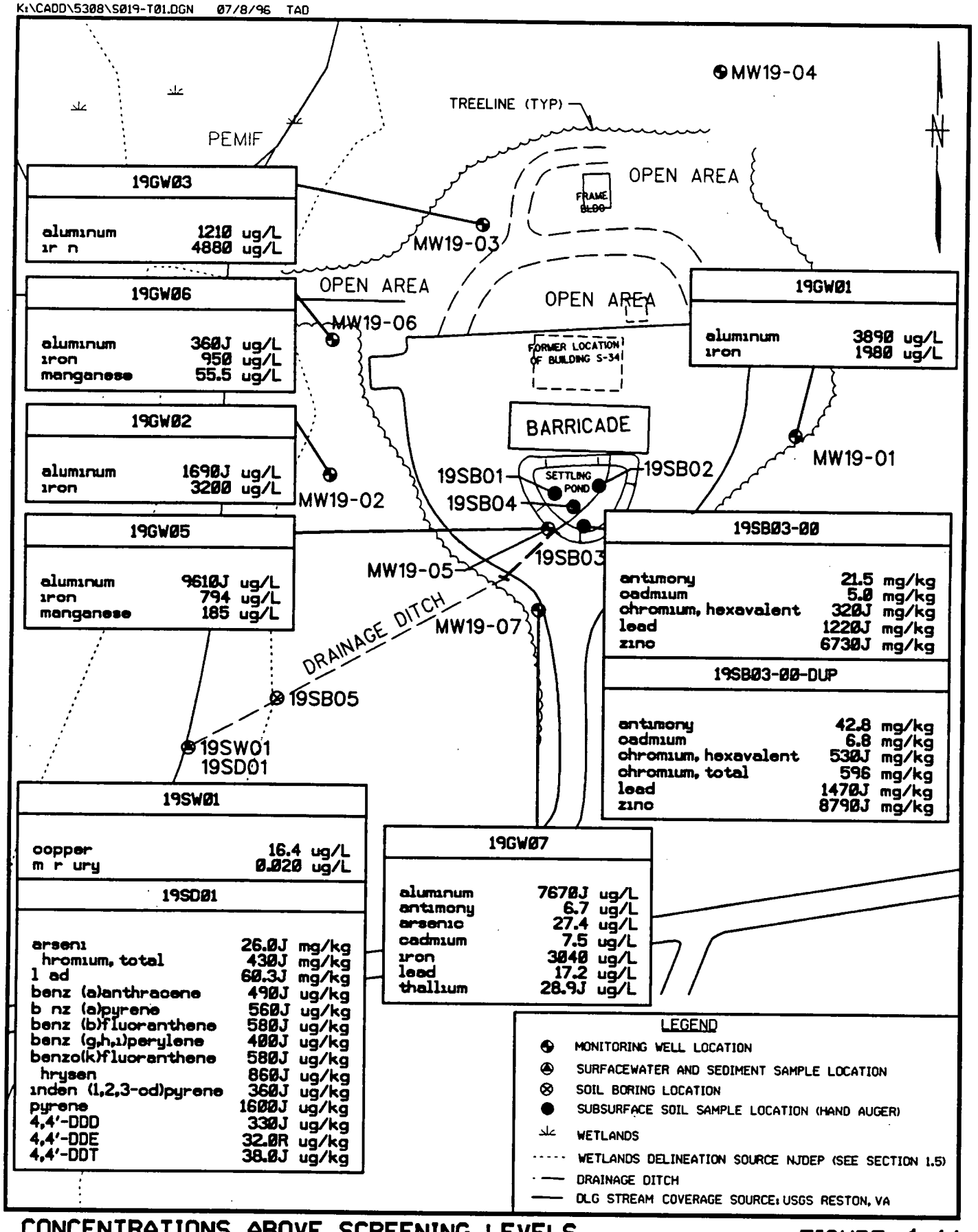
FIGURE 1-13

0 100 200

SCALE IN FEET

Brown & Root Environmental

K:\CADD\5308\S019-T01.DGN 07/8/96 TAD



CONCENTRATIONS ABOVE SCREENING LEVELS

SITE 19 - PAINT CHIP AND SLUDGE DISPOSAL AREA

FIGURE 1-14

0 100 200

SCALE IN FEET

Brown & Root Environmental

Lead was detected in subsurface soil and groundwater at the site at levels greater than the EPA screening guidelines. Based on the results of the IEUBK Lead Model (v. 0.99), the maximum detected soil concentration and the representative groundwater concentration might be expected to be associated with significant increases in blood-lead levels (i.e., above 10 ug/dL) in 16 percent of children from a population exposed under similar conditions.

Because sampling was biased to fill in data gaps and questions remaining after earlier studies, the conclusions of this risk assessment conditionally assume that other areas (i.e., surface soils/sediments in the drainage depression and ditch) will be remediated.

1.3.3.4.5 Ecological Risk Assessment

Most of Site 19 is paved or graveled, affording little ecological habitat. Forested upland areas surround most of the site and provide excellent terrestrial habitat. A tributary of Mingamahone Brook is located about 500 feet west of the site and is surrounded by wetlands. The upland and wetland areas are expected to be utilized by a wide variety of ecological receptors. The major contaminant release pathway from the depression behind the barricade is overland runoff, primarily to the wetlands via a drainage ditch. Groundwater-to-surface water contaminant migration is possible, but the levels of metals in the drainage depression indicate that runoff is much more significant.

The Phase II SI at the site indicated that levels of several metals, including cadmium, lead, and zinc were elevated in site sediments and soils. Soil samples collected as part of 1993 RI/FS activities at the site contained elevated levels of several metals, mainly lead, and low levels of some VOCs in the depression behind the barricade and in the drainage ditch southwest of the site.

In RI/FS groundwater samples, low levels of some VOCs and pesticides were detected, and elevated levels of metals were detected. Groundwater samples were also collected during 1995 RI sampling activities at Site 19. Several metals concentrations were elevated in sample MW10-07, located approximately 60 feet south-southwest of the site. Slightly elevated levels of barium and zinc were detected in well MW19-03, located in the open area northwest of the site. In 1995 RI subsurface soil samples taken in the barricade depression and drainage depression, antimony, chromium, cadmium, lead, and zinc were elevated. A low level of PCE was also detected. Also as part of 1995 RI activities, a surface water and sediment sample was taken where the drainage ditch meets the stream to confirm results from the 1993 RI/FS. Concentrations of metals were similar to background in the surface water sample, and low levels of two pesticides were detected. In the sediment sample, a high concentration of chromium was detected, along with slightly elevated concentrations of aluminum, iron, manganese, and vanadium. Low levels of some organics, including some PAHs and pesticides, were also detected.

Several sediment samples were taken in the depression and ditch as part of 1993 RI/FS activities and were used for quantitative assessment. HQs for most inorganics were indicative of low potential risk. However, HQs for chromium, lead, and zinc were indicative of moderate potential risk; each of these inorganics exceeded both most and conservative ET values. Aluminum and vanadium were conservatively retained as final COPCs since no suitable ET values were available, but these elements were detected in concentrations similar to background.

The results of 1993 RI/FS sediment samples, along with subsurface soil and sediment samples from other studies at Site 19, indicate that contaminants, primarily inorganics, have migrated from the site to the drainage ditch that leads to the stream and wetlands. Results of groundwater sampling indicate that contaminant impacts to groundwater, mainly inorganics, may have occurred. Although no extensive groundwater contaminant migration has been documented, groundwater at the site flows towards the wetlands. Surface-water concentrations of metals in a surface water/sediment sample taken from the stream in the wetlands west-northwest of Site 19, upstream of the confluence with the drainage ditch from Site 19, were low, suggesting limited groundwater to surface water migration. Future groundwater to surface water migration is possible, but available data indicate that overland migration of sediments via the drainage ditch poses a much greater potential risk to the stream and wetlands. The sediment samples taken in the drainage ditch indicate that contaminant concentrations decrease as the drainage ditch gets closer to the stream, and only an elevated detection of chromium was present at the confluence.

1.3.4 Site 26

1.3.4.1 Initial Assessment and Confirmation Study

The 1983 IAS, which consisted of interviews and site observations, concluded that there was a minimal probability of impact, based on the presumption that lost material would have been lost as a direct discharge to surface water and would no longer be present. The site was not recommended for a confirmation study.

During the 1993 SI, three monitoring wells were installed. Groundwater samples were analyzed for picric acid and pH. Picric acid was not detected, and pH was within expected levels.

1.3.4.2 Phase I Remedial Investigation

During the 1993 Weston RI/FS, four soil samples were collected from the percolation pit. Lead was detected at elevated levels defined in three samples. All other metals were within normal background ranges. Picric acid was detected in one sample. No other explosive compounds were detected.

One monitoring well was installed near the percolation pit. Groundwater samples from all SI and RI/FS wells were collected and analyzed for TCL/TAL analytes and explosive compounds. TCE was detected in the sample from MW26-01 at elevated levels (660 ug/L). Other VOCs, such as dichloroethanes (related to TCE as impurities or breakdown products) were also present. The source of TCE may be associated with the process leaching system of Building GB-1. Low concentrations of several explosive compounds were detected in samples from wells MW26-01 and MW26-04.

1.3.4.3 Phase II Remedial Investigation

Between June and October 1995, B&R Environmental conducted the following field investigation activities at Site 26:

- Soil gas survey at 68 locations
- Sampling and analysis of subsurface soil samples from four soil borings
- Drilling and installation of two shallow permanent monitoring wells
- Sampling and analysis of groundwater from the newly installed well and existing wells
- Measurement of static-water levels in the wells

B&R Environmental conducted a survey to establish the horizontal locations and vertical elevations of the soil gas grid corners, soil boring locations, selected existing monitoring wells, and the newly installed wells.

1.3.4.4 Summary of Results

Site 26, which is approximately 200 by 200 feet in size, is situated at the intersection of Macassar and Midway Roads. Two railway lines adjacent to the site run toward the northeast. The ground surface at the site is relatively flat, approximately 150 feet above MSL. The percolation pit is located in the center of the site and measures approximately 30 feet in diameter and 10 feet in depth. A tile-lined open pipe runs from Building GB-1 to the percolation pit. A process leaching system north of the western end of Building GB-1, thought to consist of a grease trap and a cesspool-type leach tank, was used for process waste disposal.

It should be noted that additional RI investigative activities, including lithologic profiling utilizing cone penetrometry and groundwater sampling for VOCs, will be performed in October 1996. These data are not available for evaluation for the selection of remedial alternatives for this FS. In addition, based on results of the new data, the baseline risk assessment and ecological risk assessment may require revision.

1.3.4.4.1 Site Geology, Hydrogeology, and Hydrology

Geology

Regional mapping places Site 26 in the outcrop area of the Kirkwood Formation; upland gravel may be present at the site. The upland gravel has a maximum thickness of 10 feet, the Kirkwood Formation ranges between 60 to 100 feet in thickness, and the soil borings are no more than 24 feet deep. The lithology of the sediments encountered in the on-site borings generally agrees with the published description of the upland gravel and the Kirkwood Formation. In general, the borings encountered light yellowish-brown sand and gravel (probably representative of the upland gravel) and brownish-yellow, brown and gray, fine- to medium-grained and medium- to coarse-grained sand (probably representative of the Kirkwood Formation).

Based upon the boring log descriptions, wells MW26-02, MW26-03, MW26-05, and MW26-06 penetrated the upland gravel and the Kirkwood Formation, and wells MW26-01 and MW26-04 penetrated the Kirkwood Formation.

Hydrogeology

Groundwater in the Kirkwood aquifer beneath the site occurs under unconfined conditions. Groundwater contour maps are presented in Figures 1-15 (August 1995 levels) and 1-16 (October 1995 levels). The direction of shallow groundwater flow in the aquifer, as indicated by both the August and October groundwater measurements, is toward the southwest. There does not appear to be a significant seasonal variation in groundwater flow direction.

Based on boring log descriptions, the wells are screened in the Kirkwood Formation. The hydraulic conductivities calculated for MW26-01, MW26-03, and MW26-04 are 3.85×10^{-4} cm/sec (1.09 ft/day), 1.92×10^{-3} cm/sec (5.44 ft/day), and 7.09×10^{-4} cm/sec (2.01 ft/day), respectively.

Hydrology

The septic system is surrounded by wooded upland areas. The upland areas are dominated by pitch pine, blackjack oak, blueberry, and *Clethra* sp. NJDEP Geographic Information System data initially indicated the presence of wetlands where the wooded upland areas are located. However, on-site inspection revealed that no wetlands are present in the area. Soils in this area contain no evidence of saturation, no wetland hydrology is present, and no streams or watercourses exist near the site. The closest wetlands are located approximately 300 yards to the northwest. The East Branch of Mingamahone Brook is located approximately 300 yards southwest of Site 26, and the site is in the Mingamahone Brook watershed.

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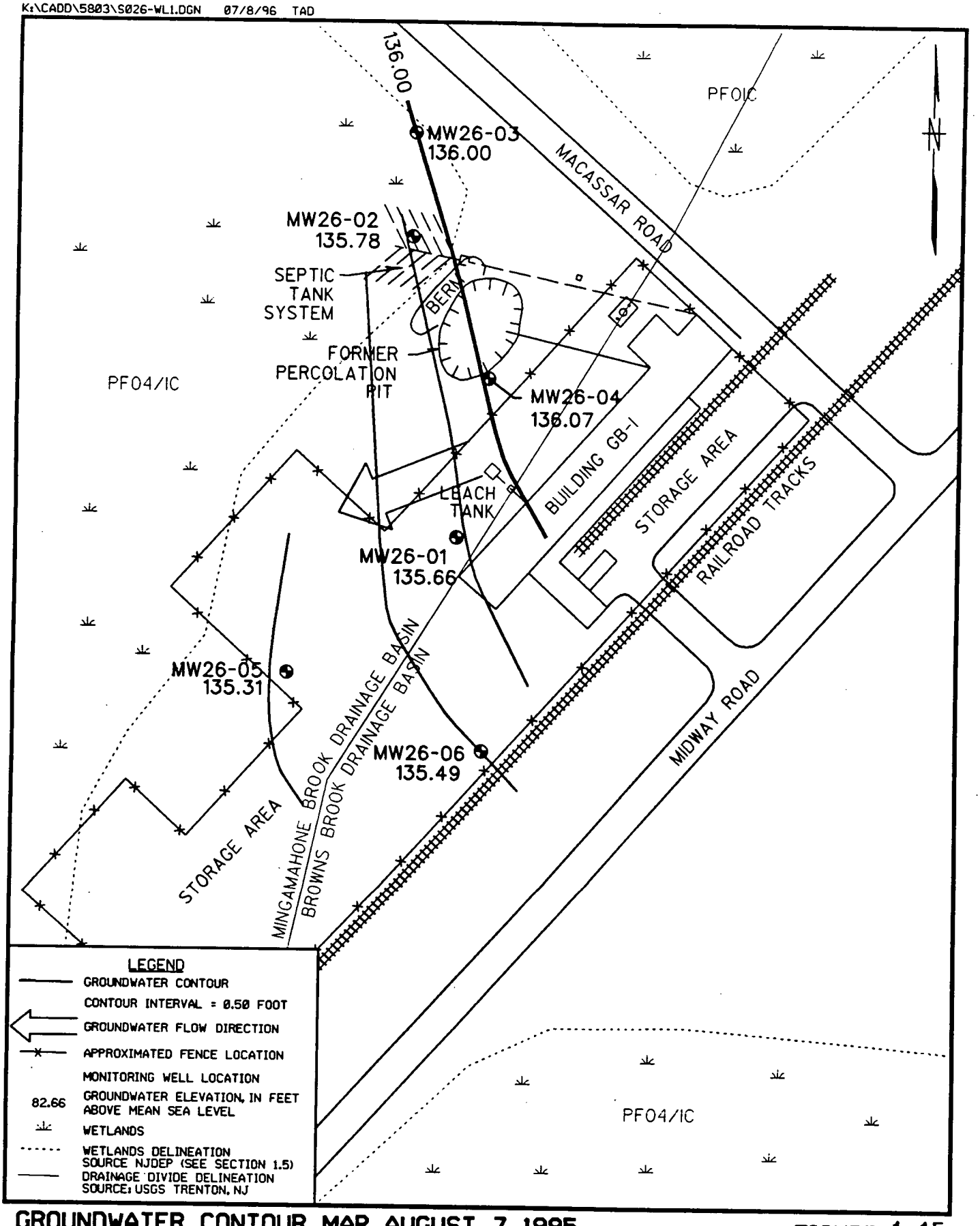

GROUNDWATER CONTOUR MAP AUGUST 7, 1995
SITE 26 - EXPLOSIVE "D" WASHOUT AREA

FIGURE 1-15

0 80 160
SCALE IN FEET

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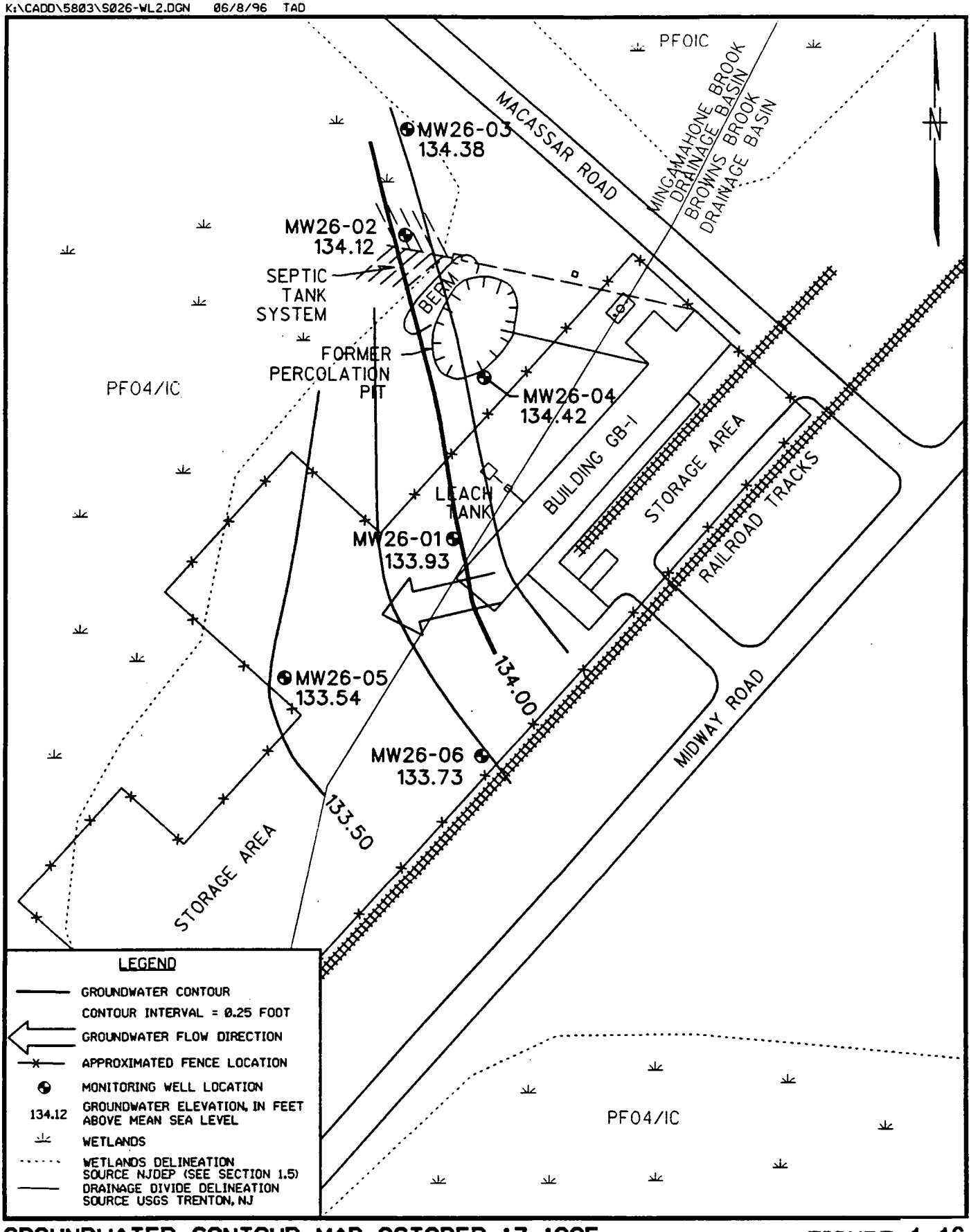

GROUNDWATER CONTOUR MAP OCTOBER 17, 1995

SITE 26 - EXPLOSIVE "D" WASHOUT AREA

FIGURE 1-16

0 80 160

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1.3.4.4.2 Nature and Extent of Contamination

Subsurface Soils

Six site-related subsurface soil samples (26 SB 01-02, 26 SB 02-04, 26 SB 03-06, 26 SB 04-02, and 26 SB 04-06) were collected at Site 26. Figure 1-17 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

Concentrations of most metals in site-related subsurface soil samples were within the same ranges as background samples. Antimony was detected at low levels, near the instrument detection limit, in two site-related subsurface soil samples but was not found in background samples. Barium was detected in one site-related sample, 26 SB 02-04, at levels greater than the concentration range associated with background samples.

Explosives and volatile organics were analyzed for but not detected in the first round of subsurface soil samples at Site 26.

In the two soil borings taken in December 1995 to further investigate TCE near the Leach Tank (26SB01-95 and 26SB02-95), TCE (2.0J ug/kg and 74.0 mg/kg respectively) and 1,2-dichloroethane (3.0 ug/kg and 140 ug/kg respectively) were found at concentrations above regulatory levels.

Groundwater

Six site-related groundwater samples (26 GW 01 through 26 GW 06) were collected at Site 26. Figure 1-17 shows sample locations and concentrations of compounds that exceed ARARs and TBCs.

Concentrations of most metals in site-related groundwater samples were within ranges similar to background samples. Zinc was detected in four site-related groundwater samples (26 GW 01 through 26 GW 03, and 26 GW 05) at levels greater than the concentration range associated with background samples. Barium was found at elevated levels in samples 26 GW 01 through 26 GW 03 and cadmium and silver were detected in sample 26 GW 04 at levels greater than background ranges.

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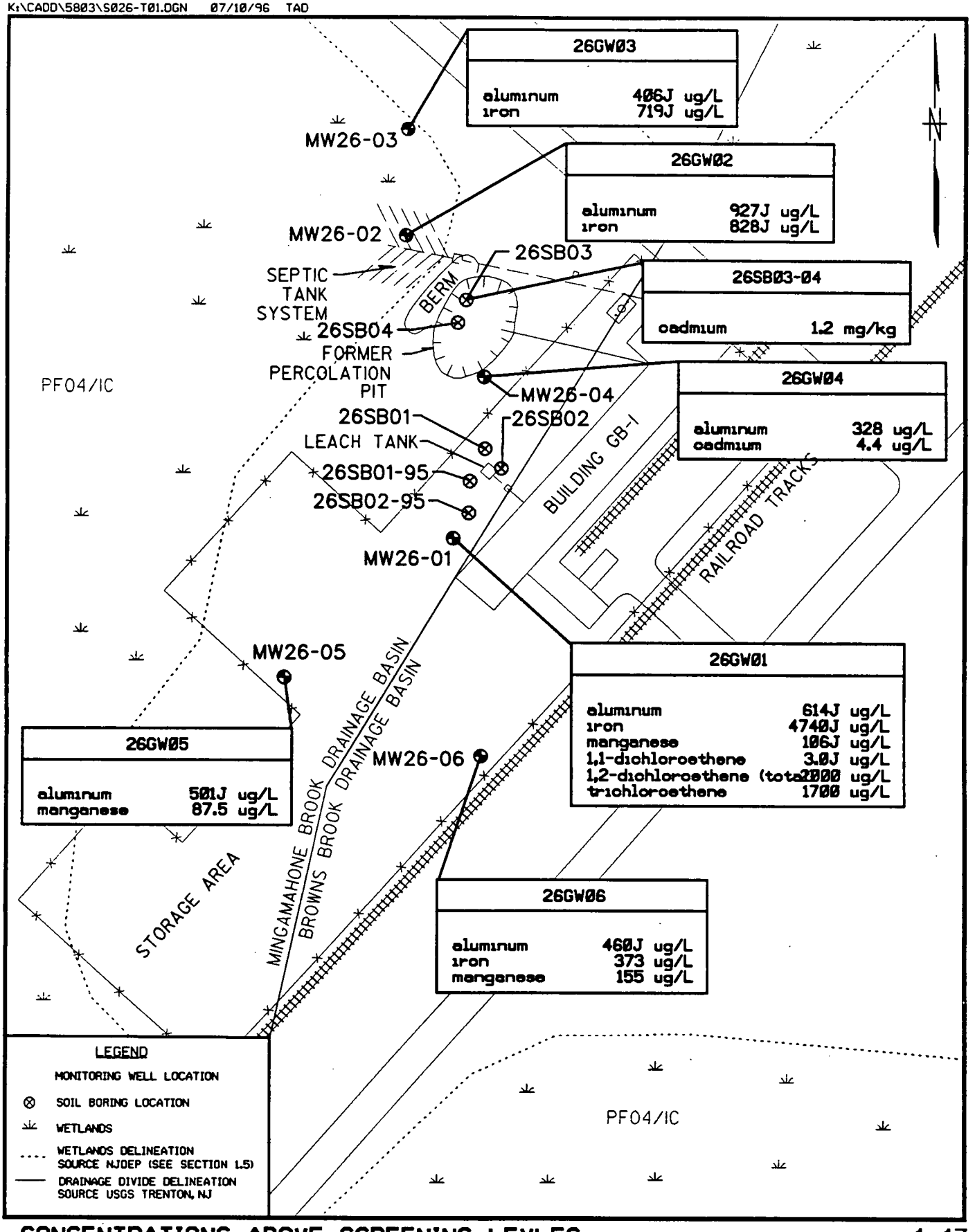

CONCENTRATIONS ABOVE SCREENING LEVLES
SITE 26 - EXPLOSIVE "D" WASHOUT AREA

FIGURE 1-17

Brown & Root Environmental

TCE (1 ug/L to 1,700 ug/L) was detected in two groundwater samples collected at Site 26. 1,1-DCE (3 ug/L), 1,2-DCE (2,000 ug/L), chloroform (1 ug/L), and PCE (1 ug/L) were each detected in one groundwater sample collected at Site 26. Sample 26 GW 01 contained the highest levels of TCE, 1,1-DCE, and 1,2-DCE. This monitoring well is located near a leach tank along the northwestern end of Building GB-1. Trace levels of TCE, PCE, and chloroform were also detected in 26 GW 06, which is located approximately 90 feet south of the southwestern corner of Building GB-1. Explosives were analyzed for but not detected in groundwater samples collected at Site 26.

1.3.4.4.3 Contaminant Fate and Transport

Analytical results for groundwater sampled at Site 26 indicate significant levels of TCE and associated degradation products in one monitoring well and trace levels of TCE, PCE, and chloroform in another well. Barium was detected in one subsurface soil sample at a level greater than the range associated with background samples. Zinc was detected in four site-related groundwater samples at levels that are greater than the concentration range associated with background samples. Barium was found at similarly elevated levels in three groundwater samples, and cadmium and silver were detected in sample 26 GW 04 at low levels that are greater than background.

The organic compounds detected in the groundwater are volatile and characteristically mobile in the environment (either through soil gas migration or groundwater transport). The detected chlorinated VOCs all possess specific gravities greater than 1, which indicates that a product source will tend to sink to the bottom of an aquifer rather than float on the water table.

The inorganic compounds have a strong tendency to adsorb onto soil/sediment particles, a factor that greatly reduces their mobility.

For the classes of detected chemicals, environmental persistence varies considerably. Transformation of a chemical to its degradation by-product(s) can be the result of numerous processes including biotransformation and uptake, photolysis, acid- or base-catalyzed reaction, or hydrolysis. The by-product chemical(s) may or may not be significantly different from a toxicological or a physical transport perspective.

Although most chemicals are resistant to chemical change because of their stability and/or lack of reaction sites, many of the more mobile species are subjected to at least limited transformation. Because of more frequent contact with reactive dissolved species and catalysts when compared to

unsaturated conditions, the contaminants found in saturated media (groundwater and saturated zone soils) are most likely to be transformed in the environment.

1,1-DCE and 1,2-DCE are associated with degradation of PCE and TCE (Cline and Viste, 1983) and may further degrade to vinyl chloride. Concentrations of the parent compounds (TCE and PCE) may diminish over time, depending upon the presence of contaminated source materials that could continue to leach into groundwater.

1.3.4.4.4 Baseline Human Health Risk Assessment

Subsurface soil and groundwater were sampled at Site 26. The potential receptors for this site were future industrial and residential receptors.

The RME cancer risks associated with future residential (subsurface soil and groundwater) exposure scenarios exceeded 1E-04, the upper end of the target risk range. However, these RME estimates are probably overconservative because a central tendency calculation shows that cancer risks are more likely to be within the mid-range of the target acceptable risk range. TCE and 1,1-dichloroethene (via groundwater ingestion and inhalation during showering) and arsenic (via ingestion of and dermal contact with soil) are the principal COPCs that contributed to the cancer risks for these exposure scenarios.

RME estimates for noncarcinogenic HIs associated with future industrial and future residential (groundwater) exposure scenarios exceeded 1.0, the cutoff point below which adverse noncarcinogenic effects are not expected to occur. TCE and 1,2-dichloroethene were the COPCs that exceeded 1.0 or contributed to the HI exceeding 1.0 for these exposure scenarios. In addition, central tendency risk estimates for residential and industrial exposure to groundwater yielded HIs greater than 1.0; affected target organs include liver, cardiovascular system, and central nervous system.

Lead concentrations detected at the site during this RI were below the EPA guidelines and are not expected to be associated with a significant increase in blood-lead levels based on the results of the IEUBK Lead Model (v. 0.99).

1.3.4.4.5 Ecological Risk Assessment

Site 26 is relatively small and consists of turfgrass or developed areas, providing little ecological habitat. Wooded uplands are present northwest of the site. These upland areas provide excellent

habitat for a wide variety of terrestrial organisms. No wetlands, other sensitive habitats, or threatened or endangered species of any kind exist in the vicinity of Site 26.

No significant contaminant migration pathways to the upland habitats exist at the site. Overland runoff of contaminants from the percolation pit is unlikely since water percolates through and is not expected to overflow the edges of the pit. Water in the leaching tank/grease trap area is not expected to migrate via overland runoff to the upland areas since water tends to settle in this area, and the wooded areas are a few feet higher on grade than the area next to Building GB-01. Groundwater discharge of contaminants to surface water is also insignificant since no wetlands or other surface waters are present near the site. Groundwater contaminants are not expected to migrate several hundred yards to the nearest substantial surface waters.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

Remedial alternatives are developed by assembling combinations of technologies and the media to which they would be applied into an appropriate range of alternatives that address site contamination, risks, or threats. This section presents the preliminary phase of the remedial alternatives development process, which consists of the identification and screening of remedial technologies and includes the following:

- Developing remedial action objectives (RAOs) that are protective of human health and the environment with regard to the contaminants and media of concern, exposure pathways, and the preliminary remediation goals (PRGs), that permit a range of treatment and containment alternatives to be developed.

- Developing general response actions for each medium of interest that define measures that may be taken singly or in combination to satisfy the RAOs for the site.

- Identifying the numbers, volumes, or areas of media to which the general response actions might be applied.

- Identifying and screening the technologies applicable to each general response action.

Section 2.1 presents a preliminary listing of applicable or relevant and appropriate requirements (ARARs) and other guidance to be considered (TBCs) in the development of RAOs for the NWS Earle OU-1 Sites. Section 2.2 briefly presents the overall approach used to develop RAOs. Section 2.3 summarizes the overall approach used in development of preliminary remediation goals (PRGs). Section 2.4 identifies the general response actions that may be implemented at NWS Earle. The site-specific development of RAOs, PRGs, general response actions, and screening of remedial technologies and process options for Sites 4, 5 and 19 is presented in Sections 2.6, 2.7, and 2.8, respectively.

2.1 POTENTIAL ARARs AND TBCs

ARARs are promulgated, enforceable federal and state environmental or public health requirements that are determined to be legally applicable or relevant and appropriate to the hazardous substances, remedial actions, or other circumstances at a CERCLA site. The NCP Section 300.430 states that on-site remedial actions at CERCLA sites must meet ARARs unless there are grounds for invoking a waiver. A waiver is required if ARARs cannot be achieved. The two classes of ARARs "applicable" and "relevant and appropriate," are defined below.

- **Applicable Requirements** - Section 300.5 of the NCP defines applicable requirements as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. For example, if a new municipal landfill is being considered, then regulatory requirements that specifically govern its construction, operation, and closure are applicable.

- **Relevant and Appropriate Requirements** - Section 300.5 of the NCP defines relevant and appropriate requirements as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site. For example, a municipal landfill that was constructed and operated prior to the promulgation of landfill regulations may be closed in accordance with the "relevant and appropriate" requirements of those regulations that identify activities needed to close the landfill.

TBCs (standards and guidance To Be Considered) are non-promulgated advisories or guidance issued by federal or state governments that are not legally binding but may be considered during development of remedial alternatives. For example, EPA Health Advisories and Reference Doses are non-promulgated criteria that are used to assess health risks from contaminants present on CERCLA sites.

ARARs and TBCs are divided into three categories: chemical-specific, location-specific, and action-specific. In Sections 2.1.1 through 2.1.3, these categories are briefly described and general types of potential ARARs and TBCs that may be applied to the site are identified. The detailed discussions of the potential ARARs and TBCs for specific remedial alternatives are provided in Section 4.0.

2.1.1 Potential Chemical-Specific ARARs and TBCs

Chemical-specific ARARs and TBCs are usually health- or risk-based numerical values that are used to establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the environment. In general, chemical-specific requirements are set for a single chemical or a close related group of chemicals. These requirements do not consider the mixture of chemicals. Typical chemical-specific ARARs are federal and state drinking water standards. Summaries of the potential

federal and state chemical-specific ARARs and TBCs and their consideration in the FS are provided in Tables 2-1 and 2-2, respectively.

The aquifer underlying NWS Earle is classified as Class II-A, a potential source of potable water under New Jersey regulations [N.J.A.C. 7:9-6]. Groundwater at Sites 4, 5, and 19 is not currently used for drinking water and potable water is provided by a public water supply. Federal chemical-specific ARARs such as the Safe Drinking Water Act (SDWA) Maximum Containment Levels (MCLs) [40 CFR 141] and the Resource Conservation and Recovery Act (RCRA) MCLs and Alternate Concentration Limits (ACLs) [40 CFR 264.94] may be relevant and appropriate requirements in establishing groundwater cleanup levels, or may be used to help derive potential soil remediation levels. Non-zero MCL Goals (MCLGs) are non-promulgated health-based drinking water supply limits that are to be considered during the development of groundwater cleanup goals. EPA reference doses, carcinogen potency factors, and health advisories, when available, are all factors used to assess potential risks, and can be used to derive risk-based cleanup limits. The disposal of contaminated soils may be restricted by the RCRA Land Disposal Restrictions [40 CFR 268], which may potentially be applicable.

Chemical-specific ARARs for the NWS Earle Sites include the New Jersey Ground Water Quality Standards (GWQSs) [N.J.A.C. 7:9-6] that regulate groundwater quality. Potential chemical-specific ARARs include the Surface Water Quality Standards [N.J.A.C. 7:9B] that provide guidelines for surface water quality. These state ARARs may potentially be relevant and appropriate and may be used to establish cleanup levels that are protective of human health and the environment.

While there are no specific promulgated soil cleanup standards, OSWER Directive No. 9355.4-12, Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, and the New Jersey Soil Cleanup Criteria may be considered in developing site-specific cleanup levels.

2.1.2 Potential Location-Specific ARARs and TBCs

Location-specific ARARs are restrictions placed on the concentrations of hazardous substances or the conduct of activities solely because the substances or activities are in specific areas. The general types of location-specific ARARs that may be applied to the sites are briefly described below. Summaries of the potential federal and state location-specific ARARs and TBCs and their consideration in this FS are provided in Tables 2-3 and 2-4, respectively..

Several federal and state regulations govern activities in wetlands and floodplains that may result in their degradation or impairment of their functions. Potential location-specific ARARs include: Executive Orders 11990 and 11988 for wetlands and floodplains, respectively; the RCRA Location Standards governing the

TABLE 2-1
POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Safe Drinking Water Act (SDWA) - Maximum Contaminant Levels (MCLs) (40 CFR 141.11-141.16)	Potentially Relevant and Appropriate	MCLs have been promulgated for a number of common organic and inorganic contaminants to regulate the concentration of contaminants in public drinking water supply systems. MCLs may be relevant and appropriate for groundwater because the aquifer beneath the site is a potential drinking water supply.	MCLs may be used to establish clean-up levels for the portion of the aquifer underlying the OU-1 sites. MCLs can be used to derive potential soil cleanup levels.
Resource Conservation and Recovery Act (RCRA) - Groundwater Protection Standard (40 CFR 264.94)	Potentially Relevant and Appropriate	The RCRA groundwater protection standard is established for groundwater monitoring of RCRA permitted treatment, storage or disposal facilities. The standard is set at either an existing or proposed RCRA-MCL, background concentration, or an alternate concentration limit (ACL) protective of human health and the environment.	RCRA-MCLs may be used or ACLs may be developed to identify levels of contamination in the aquifer above which human health and the environment are at risk and to provide an indicator when corrective action is necessary.
RCRA Land Disposal Restrictions (40 CFR 268)	Potentially Applicable	These regulations identify hazardous wastes that are restricted from land disposal and establish waste analysis and recordkeeping requirements and "treatment standards" (concentration levels or methods of treatment) that wastes must meet in order to be eligible for land disposal.	Contaminated soil must be analyzed and disposed in accordance with the requirements of these regulations. If necessary, soils will be treated to attain applicable "treatment standards" prior to placement in a landfill, or other land disposal facility. This requirement would be considered for alternatives involving land disposal.
Clean Water Act - Ambient Water Quality Criteria (AWQC)	To be Considered	AWQC are non-promulgated health-based surface water quality criteria that have been developed for carcinogenic and non-carcinogenic compounds for the protection of human health. AWQC have also been developed for the protection of aquatic organisms.	AWQC may be used to assess need for remediation of discharges to surface water, or to use as benchmarks during long-term monitoring.
SDWA Maximum Contaminant Level Goals (MCLGs) (40 CFR 141.50 and 141.51)	To Be Considered	MCLGs are health-based limits for contaminant concentrations in drinking water. MCLGs are established at levels at which no known or anticipated adverse effects on human health are anticipated and which allow for an adequate margin of safety. MCLGs are set without regard for cost or feasibility.	Non-zero MCLGs may be used as clean-up levels if conditions at the site justify setting cleanup levels lower than MCLs.

TABLE 2-1
POTENTIAL FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (OSWER Directive No. 9355.4-12) (Jul 1994)	To Be Considered	This OSWER Directive recommends a lead soil screening level of 400 ppm for residential land use based on the IEUBK model. The screening value may be used to determine whether sites or portions of sites warrant further evaluation and evaluations of risks.	If any of the OU-1 sites is to be considered for eventual residential use, then the screening value may be used to assess whether site-specific lead levels require further evaluation and possible remediation.
EPA Groundwater Protection Strategy	To Be Considered	Provides classification and restoration goals for groundwater based on its vulnerability, use, and value.	This strategy was considered in conjunction with the Federal SDWA and State Groundwater Protection Rules in order to determine groundwater cleanup levels.
EPA Risk Reference Doses (RfDs)	To Be Considered	RfDs are dose levels developed by EPA for use in estimating the non-carcinogenic risk resulting from exposure to toxic substances.	RfDs were used to assess health risks due to exposure to non-carcinogenic contaminants present at the site. RfDs may also be used in the development of acceptable contaminant concentrations.
EPA Carcinogen Assessment Group Potency Factors (CPFs)	To Be Considered	EPA CPFs are used to compute the individual incremental cancer risk resulting from exposure to carcinogens.	CPFs were used to assess health risks from carcinogens present at the site. These factors may also be used in the development of acceptable contaminant concentrations.
EPA Health Advisories and Acceptable Intake Health Assessment Documents	To Be Considered	Intended for use in qualitative human health evaluation of remedial alternatives.	These advisories and health assessment documents were used in assessing health risks from contaminants present at the site.
Clean Air Act - Standards for Air Emissions from Municipal Solid Waste Landfills (40 CFR 60.752 and 60.753)	Potentially Relevant and Appropriate	Active landfills with design capacities equal to or greater than 2.5 million cubic meters are required to have landfill gas collection and control systems if greater than 50 megagrams of non-methane organic compounds are expected to be emitted. The collection system shall be operated so that the methane concentration is less than 500 ppm above background at the surface of the landfill.	Both Sites 4 and 5 landfills are estimated to be much less than 2 million cubic feet in capacity. However, soil gas studies and measurement of methane concentrations at the landfill surfaces need to be conducted during the pre-design phase to determine whether landfill gas controls need to be included as part of the control systems.

TABLE 2-2
POTENTIAL STATE CHEMICAL-SPECIFIC ARARs AND TBCs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
New Jersey Ground Water Quality Standards (GWQS) (N.J.A.C. 7:9-6)	Applicable	This regulation establishes the rules to protect ambient ground water quality through establishing groundwater protection and clean up standards, and setting numerical criteria limits for discharges to ground water. The Ground Water Criteria (GWQC) (N.J.A.C. 7:9-6.7) are the maximum allowable pollutant concentrations in ground water that are protective of human health. This regulation also prohibits the discharges to groundwater that subsequently discharges to surface water, which do not comply the Surface Water Quality Standards (SWQS).	Because contaminated groundwater is present underneath the OU-1 sites in excess of GWQS, these regulations will be considered in determining groundwater action levels. Application for Classification Exception Area (CEA) may be required if GWQS will not be met during the term of proposed remediation. The CEA procedure ensures that designated groundwater uses at remediation sites are suspended for the term of the CEA.
New Jersey Surface Water Quality Standards (SWQS) (N.J.A.C. 7:9B)	Applicable	These standards establish rules to protect and enhance surface water resources, define surface water classifications and uses, establish water quality based criteria, and effluent discharge limitations. The Surface Water Criteria (SWQC) (N.J.A.C. 7:9B-14) are the maximum allowable pollutant concentrations in surface water for the designated use.	For alternatives where surface water may be affected, remedial measures may be needed so that the SWQC are attained in the long term. Remedial alternatives shall consider action to mitigate the continued contamination of surface waters.
New Jersey Safe Drinking Water Act (N.J.A.C. 7:10)	Potentially Relevant and Appropriate	These regulations were promulgated to assure the provision of safe drinking water to consumers in public community water systems. Maximum Contaminant Levels (MCLs) (N.J.A.C. 7:10-16) have been established to regulate the concentration of organic and metal contaminants in water supplies. MCLs may be relevant and appropriate for groundwater because the aquifer beneath the site is a potential drinking water supply.	MCLs may be used to establish clean-up levels for groundwater underlying the OU-1 sites. MCLs can be used to derive potential soil cleanup levels.
New Jers y Soil Cleanup Criteria	To Be Considered	These are non-promulgated soils cleanup criteria for residential direct contact, non-residential direct contact, and impact to ground water (through leaching).	These criteria will be considered in the development of soil cleanup goals.

TABLE 2-3
POTENTIAL FEDERAL LOCATION-SPECIFIC ARARs AND TBCs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Wetlands Executive Order (E.O. 11990) & 40 CFR 6, App. A (Policy on Implementing E.O. 11990)	Potentially Applicable	Federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands.	Remedial alternatives that involve excavation or deposition of materials will include all practicable means of minimizing harm to the wetlands adjacent to the OU-1 sites. Wetlands protection consideration will be incorporated into the planning, decision-making, and implementation of remedial alternatives.
Floodplains Executive Order (E.O. 11988) & 40 CFR 6, App. A (Policy on Implementing E.O. 11988)	Potentially Applicable	Federal agencies are required to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial value of floodplains.	The potential effects on floodplains will be considered during the development and evaluation of remedial alternatives. All practicable measures will be taken to minimize adverse effects on floodplains.
Resource Conservation and Recovery Act (RCRA) Location Standards, Floodplains (40 CFR 264.18 (a))	Potentially Applicable	Any RCRA facility that treats, stores, or disposes of hazardous waste, if situated in a 100-year floodplain, must be designed, constructed, operated, and maintained to avoid washout.	Where possible, remedial alternatives that include construction of a treatment, storage, or disposal facility will be sited outside of a 100-year floodplain.
Endangered Species Act of 1973 (16 USC 1531 et seq.); (50 CFR Part 200)	Potentially Applicable, if present	Actions shall be taken to conserve endangered or threatened species, or to protect critical habitats. Consultation with the Department of the Interior is required.	The RI determined that there were no sensitive habitats (except for wetlands), endangered or threatened species present at the OU-1 sites.
Fish and Wildlife Coordination Act Of 1958 (16 U.S.C. 661) Protection of Wildlife Habitats	Potentially Applicable	This regulation requires that any Federal agency that proposes to modify a body of water must consult with the U.S. Fish and Wildlife Service, and requires that actions be taken to avoid adverse effects, minimize potential harm to fish or wildlife, and to preserve natural and beneficial uses of the land.	During the evaluation of alternatives, potential remediation effects on the wetlands and floodplains are evaluated. If it is determined that an impact may occur, then the U.S. Fish and Wildlife Service, the NJDEP, and EPA would be consulted.

TABLE 2-3
POTENTIAL FEDERAL LOCATION-SPECIFIC ARARs AND TBCs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
National Historic Preservation Act of 1966 Section 106 (16 USC 470 et. seq.)	Potentially Applicable, if present	Action will be taken to recover and to preserve historic artifacts that may be threatened as the result of terrain alteration.	Potential ARAR if artifacts are encountered during active site remediation (e.g. excavation, consolidation, grading). To date, no such artifacts have been encountered at the OU-1 sites.
National Archeological and Historic Preservation Act of 1974 (132 CFR 229)	Potentially Applicable, if present	Action will be taken to recover and to preserve scientific, prehistoric, historic, or archaeologic artifacts that may be threatened as the result of terrain alteration.	Potential ARAR if artifacts are encountered during active site remediation (e.g. excavation, consolidation, grading). To date, no such artifacts have been encountered at the OU-1 sites.

TABLE 2-4
POTENTIAL STATE LOCATION-SPECIFIC ARARs AND TBCs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
New Jersey Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A)	Potentially Applicable	Regulate activities that result in the disturbance in and around fresh water wetland areas including: removing or dredging wetland soils, disturbing the water level or water table, driving piles, placing of obstructions, destroying plant life, and discharging dredged or fill materials into open water.	Remedial alternatives will be developed to avoid activities that would be detrimental to the wetlands located adjacent to the OU-1 sites.
New Jersey Freshwater Wetlands Protection Act Rules, Mitigation (N.J.A.C. 7:7A-14)	Potentially Applicable	This regulation requires mitigation of the disturbed wetlands or filled open water. Generally requires the restoration, creation, or enhancement of area, or donations to the Mitigation Bank, of equal ecological value.	If a remedial alternative action results in the loss of wetlands through dredging, filling, or construction activities, then mitigation measures will need to be incorporated into the alternative's design.
New Jersey Flood Hazard Area Control (N.J.A.C. 7:14)	Potentially Applicable	These regulations control development in floodplains and water courses that may adversely affect the flood-carrying capacity of these features, subject new facilities to flooding, increase storm water runoff, degrade water quality, or result in increased sedimentation, erosion, or environmental damage.	This requirement is applicable to remedial alternative actions that may adversely affect floodplains adjacent to the OU-1 sites.
New Jersey Siting Criteria for New Major Commercial Hazardous Waste Facilities (N.J.A.C. 7:26-13)	Potentially Relevant and Appropriate	These regulations specify siting requirements and limitations for commercial hazardous waste facilities including protection of nearby residents, surface water, groundwater, air, and environmentally sensitive areas.	If remedial alternatives employs an on-site or on-base treatment of contaminated soils, sediments, or materials, then remediation activities will need to be consistent with these requirements.

siting of treatment, storage, and disposal facilities in a 100-year floodplain; the New Jersey Freshwater Wetlands Protection Act Rules; the New Jersey Flood Hazard Area Control regulations; and the State Siting Criteria for New Major Commercial Hazardous Waste Facilities (if on-base treatment of contaminated materials is enacted within a wetland).

The Federal Fish and Wildlife Coordination Act and the Endangered Species Act are potential ARARs that are promulgated protect wildlife and endangered species (if present or encountered) during remediation.

If historic or archeological artifacts are encountered during remediation, then the National Historic Preservation Act of 1966 and the National Archeological and Historic Preservation Act of 1974 may be potential ARARs that would be invoked to prevent their loss.

2.1.3 Potential Action-Specific ARARs and TBCs

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are generally focused on actions taken to remediate, handle, treat, transport, or dispose of hazardous wastes. These action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved. Summaries of the potential action-specific ARARs and TBCs and their consideration in the FS are provided in Tables 2-5 and 2-6, respectively.

If the OU-1 soils, sediments, or landfill materials are determined to be hazardous by characteristic or are listed wastes (per RCRA Identification and Listing of Hazardous Waste [40 CFR 261]), then these action-specific ARARs may potentially be applicable to the how they are treated, stored, or disposed, or to the treatment processes considered. These ARARs include federal regulations governing the off-site transport of hazardous wastes [40 CFR 262 and 263], general facility standards [40 CFR 265 Subpart B], preparedness and prevention [40 CFR 265 Subpart C], contingency plan and emergency procedures [40 CFR 265 Subpart D], manifesting and record keeping [40 CFR 265 Subpart E], closure and post closure of municipal landfills [40 CFR 258 Subpart F], land treatment [40 CFR 265 Subpart P], thermal treatment [40 CFR 265 Subpart X], and miscellaneous treatment units [40 CFR 264 Subpart X].

State ARAR regulations that may be applicable to remedial actions for hazardous wastes include: off-site transport of hazardous wastes [N.J.A.C. 7:26-7]; general facility standards, preparedness and prevention, contingency and emergency procedures, record keeping, closure and post-closure requirements [N.J.A.C. 7:26-9]; closure, and post-closure of sanitary landfills [N.J.A.C. 7:26-2A.9]; thermal treatment [N.J.A.C. 7:26-11.6]; and physical, chemical, and biological treatment [N.J.A.C. 7:26-11.7].

TABLE 2-5
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs AND TBCs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
Resource Conservation and Recovery Act (RCRA) - Hazardous Waste Generator and Transporter Requirements (40 CFR parts 262 and 263)	Potentially Applicable	These regulations establish the responsibilities of generators and transporters of hazardous waste in the handling, transportation, and management of waste. The regulations specify the packaging, labeling, recordkeeping, and manifest requirements.	Activities performed in connection with off-site transport of hazardous wastes will comply with the requirements of these regulations.
RCRA - General Facility Standards (40 CFR 265 Subpart B)	Potentially Applicable	General facility requirements outline general waste analysis, security measures, inspections, and training requirements.	If a remedial alternative includes the establishment of an on-base treatment facility for hazardous wastes (characterisitic or listed), then this regulation will be considered. This regulation specifies TSD facilities construction, fencing, postings, and operations. All workers will be properly trained. Process wastes will be evaluated for the characteristics of hazardous wastes to assess further handling requirements.
RCRA - Preparedness and Prevention (40 CFR 265 Subpart C)	Potentially Applicable	Outlines requirements for safety equipment and spill control.	If a remedial alternative includes treatment, storage, or disposal of hazardous wastes, then this regulation will be considered. Safety and communication equipment will be maintained at the site. Local authorities will be familiarized with the site operations.
RCRA - Contingency Plan and Em rgency Procedures (40 CFR 265 Subpart D)	Potentially Applicable	Outlines requirements for emergency procedures to be used following explosions, fires, etc.	If the alternative includes treatment, storage, or disposal of hazardous wastes, then contingency plans will be developed. Copies of the plans will be kept on-site.
RCRA - Manifesting Recordkeeping, and Reporting (40 CFR 265 Subpart E)	Potentially Applicable	Specifies the recordkeeping and reporting requirements for RCRA facilities.	If the alternative includes treatment, storage, or disposal of hazardous wastes, then records of facility activities will be developed and maintained during remedial actions.

TABLE 2-5
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs AND TBCs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
Page 2 of 3

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
RCRA - Closure and Post-Closure (40 CFR 258, Subpart F)	Potentially Relevant and Appropriate	Details specific requirements for closure and pos-closure of municipal solid waste landfills. Final cover requirements that address minimizing infiltration and erosion are identified in this regulation. Following closure, post-closure requirements include preparing a post-closure plan, maintaining integrity and effectiveness of the final cover, groundwater monitoring, and maintaining and operating a gas collection system.	If an alternative includes closure of a solid waste landfill, then these requirements will be considered in formulating the alternative.
RCRA - Land Treatment (40 CFR 265 Subpart M)	Potentially Applicable	These regulations detail the requirements for conducting land treatment of RCRA hazardous waste.	Alternatives that involve on-site treatment of hazardous wastes (contaminated soil or sediments) will comply with these regulations.
RCRA - Thermal Treatment (40 CFR 265 Subpart P)	Potentially Applicable	This regulation details operating requirements and performance standards for thermal treatment of hazardous wastes.	Alternatives that include thermal or catalytic oxidation of offgases would be designed and operated in compliance with this regulation.
RCRA - Miscellaneous Treatment Units (40 CFR 264 Subpart X)	Potentially Applicable	This regulation details design and operating standards for units in which hazardous waste is treated.	Hazardous waste treatment units used for on-site or on-base treatment of contaminated media must meet these requirements.
RCRA - Air Emission Standards for Process Vents (40 CFR 265 Subpart AA)	Potentially Applicable	This regulation contains air pollutant emission standards for process vents, closed-vent systems, and control devices at hazardous waste TSD facilities. This subpart applies to equipment associated with solvent extraction or air/steam stripping operations that treat wastes that are identified or listed RCRA hazardous wastes and have a total organics concentration of 10 ppm or greater.	These standards will be considered during the development and design of alternatives that include treatment of VOC-contaminated soils. Air emissions from treatment units will be monitored to ensure compliance with this ARAR.

TABLE 2-5
POTENTIAL FEDERAL ACTION-SPECIFIC ARARs AND TBCs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
OSWER Directive 9355.0-62FS Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance) (April 1996)	To Be Considered	This EPA directive provides guidance in evaluating military landfill sites and determining whether presumptive remedies can be applied.	The procedures and suggested remedial actions will be considered in formulating remedial alternatives for Sites 4 and 5.
OSWER Directive 9355.0-49FS Presumptive Remedy for CERCLA Municipal Landfill Sites (Sep 1993)	To Be Considered	This EPA directive provides guidance in evaluating CERCLA municipal landfill sites and determining if presumptive remedies can be applied.	The procedures and suggested remedial actions will be considered in formulating remedial alternatives for Sites 4 and 5.

TABLE 2-6
POTENTIAL STATE ACTION-SPECIFIC ARARs AND TBCs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FS
New Jersey Labeling, Records, and Transportation Requirements (N.J.A.C. 7:26-7)	Potentially Applicable	These regulations establish the responsibilities of generators and transporters of hazardous waste in the handling, transportation, and management of waste. The regulations specify the packaging, labeling, recordkeeping, and manifest requirements.	Activities performed in connection with off-site transport of hazardous wastes will comply with the requirements of these regulations.
New Jersey Requirements for Hazardous Waste Facilities (N.J.A.C. 7:26-9)	Potentially Applicable	These regulations identify requirements for facilities in general, groundwater monitoring, preparedness and prevention, contingency and emergency procedures, and general closure and post-closure.	If a remedial alternative includes the establishment of an on-base treatment facility for contaminated soils and materials, then this regulation will be complied with during implementation.
New Jersey Closure and Post-Closure Care of Sanitary Landfills Regulations (N.J.A.C. 7:26-2A.9)	Potentially Relevant and Appropriate	Details specific requirements for closure and pos-closure of municipal solid waste landfills. Final cover requirements that address minimizing infiltration and erosion are identified in this regulation. Following closure, post-closure requirements include preparing a post-closure plan, maintaining integrity and effectiveness of final cover, groundwater monitoring, and maintaining and operating a gas collection system.	If an alternative includes closure of a solid waste landfill, then these requirements will be considered in formulating the alternative.
New Jersey Thermal Treatment Regulations (N.J.A.C. 7:26-11.6)	Potentially Applicable	These regulations detail operating requirements, waste analyses and monitoring of treatment conditions, performance standards, and closure of existing facilities that thermally treat hazardous wastes.	Alternatives that include thermal treatment of contaminated soils, sediments, and materials would be designed and operated in consistent with this regulation.
New Jersey Chemical, Physical, and Biological Treatment Regulations (N.J.A.C. 7:26-11.7)	Potentially Applicable	These regulations detail operating requirements, waste analyses and monitoring of treatment conditions, and closure of existing facilities that physically, chemically, or biologically treat hazardous wastes. Also governs handling and compatibility of wastes in treatment processes.	Alternatives that include physical, chemical, or biological treatment of contaminated soils, sediments, and materials would be designed and operated in consistent with this regulation.

Because Sites 4 and 5 are military municipal landfills, two OSWER Directives are TBC guidance documents that may be considered in developing remedial alternatives that employ presumptive remedies.

These guidance documents are OSWER Directive 9355.0-62FS, Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance) (April 1996); and OSWER Directive 93550.0-49FS, Presumptive Remedy for CERCLA Municpal Landfill Sites (September 1993).

2.2 METHOD USED FOR DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

The development of the medium-specific RAOs for a site is typically based on the risks posed by site-related contaminants to human and ecological receptors, threats or continued degradation of environmental media (groundwater, surface water, and wetlands), and comparison of detected contaminant levels with available regulatory standards.

Generally, human health RAOs are formulated to prevent exposures to site-related contaminants that result in excess carcinogenic and non-carcinogenic health risks or to contaminants that exceed regulatory requirements (e.g., MCLs in potable water).

Ecological RAOs are formulated to reduce or prevent the detrimental effects of site-related contaminants on environmental media (e.g., degradation of groundwater quality) or to address contaminant concentrations that exceed regulatory standards (e.g., New Jersey GWQS).

RAO development for Sites 4, 5, and 19 is presented in Sections 2.6, 2.7, and 2.8, respectively.

2.3 METHOD USED FOR DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS

The determination of numerical remediation goals is an iterative process beginning with the development of a range of medium and chemical-specific contaminant levels that would be protective of human health or the environment if present in site soils and groundwater. Remediation goals that establish acceptable contaminant levels or ranges of levels that must be achieved under the remedial action are ultimately chosen from the range of PRGs when the remedy is selected.

A range of PRGs for each OU-1 site was developed for soil and groundwater COCs based on the results of the RI, human health risk assessment, and chemical-specific ARARs. Additionally, background concentrations of COCs and analytical detection limits were identified as potential PRGs to ensure

selection of clean-up goals that are reasonably attainable and measurable. Each type of PRG is briefly discussed below. For each site, a set of PRGs was developed and the basis for selection is presented.

Typically, a promulgated regulated ARAR is selected as the proposed PRG unless background levels or the analytical detection limit is higher. If no ARAR is available, then the higher of either the risk-based value or the maximum background value (inorganic) was selected, assuming that value was higher than the detection limit. Otherwise, the detection limit (CRQL or CRDL) was chosen as the proposed PRG.

Each type of PRG is briefly discussed below. PRGs developed for each OU-1 site are presented in Sections 2.6, 2.7, and 2.8, respectively.

2.3.1 ARAR/TBCs Basis

There are no promulgated chemical-specific federal or state ARARs for soils. However, the state has established a set of non-promulgated soil cleanup criteria (TBCs) for residential direct contact, non-residential direct contact, and impact to groundwater. The Interim Soil Lead Guidance (EPA 1994) is a TBC for lead in soils. Although the screening criterion presented in the guidance is not intended for use as a PRG, the guidance will be considered in the development of PRGs.

There are no promulgated chemical-specific federal groundwater ARARs. The state GWQS are promulgated under the New Jersey Administrative Code Title 7, Chapter 9-6 (N.J.A.C. 7:9-6) and establish allowable contaminant concentrations in groundwater. The New Jersey surface water quality criteria (SWQCs) are promulgated under N.J.A.C. 7:9B and establish allowable contaminant concentrations in surface water.

2.3.2 Human Health Risk Basis

Human-health-risk-based PRGs were developed for the future industrial worker and resident exposure scenarios, based on carcinogenic risks of 10^{-6} and a Hazard Index (HI) of 1.0. Risk-based concentrations (RBCs) will be considered in the PRGs development. It should be noted that there are no plans to use any of the OU-1 sites for residential purposes.

2.3.3 Ecological Risk Basis

The RI did not identify any significant risk to potential biological receptors associated with contamination present in the OU-1 sites. Therefore, there are no contaminants of concern to be addressed or PRGs to be developed under this FS on an ecological risk basis.

2.3.4 Protection of Groundwater Basis

The PRGs for protection of groundwater represent soil contaminant concentrations that, when leached into groundwater, would be protective of groundwater. The New Jersey Soil Clean-up Criteria identified a set of non-promulgated soil organic chemical concentrations that would be protective of groundwater if leaching of contaminants occurred.

2.3.5 Analytical Detection Limits Basis

The analytical detection limits for the COCs may also be used to develop the PRGs. Because the remediation goals have to be detectable by analytical means to ascertain attainment of clean-up levels, analytical detection limits were designated as the lowest reasonable PRGs. The EPA contract-required quantitation limit (CRQL) and detection limit (CRDL) values for organics and inorganics respectively, are presented in the PRG summary tables for each site. The CRQL and CRDL are analytical limits specified in the EPAs Contract Laboratory Program's Statement of Work for chemical analysis

2.3.6 Background Concentrations Basis

Some inorganic COCs (natural components of soil) are present in site soils and in the background locations (areas deemed not to be affected by the sites) at concentrations higher than the risk-based or groundwater protection-based PRGs calculated for the sites. Because it is not reasonable and may not be possible to remediate site soils to concentrations lower than are present naturally in area soils, background concentrations may be considered as reasonable PRGs for inorganics. Under the RI, eight representative background soil samples were collected and the mean and 95 percent upper tolerance limit (UTL) values were calculated and are presented in Tables 31-7 and 31-8 of the RI. Representative background groundwater concentration values for formations underlying NWS Earle are presented in Tables 31-4, 31-5, and 31-6 of the RI Report. These values are also presented in the site-specific PRG tables of this FS.

2.4 METHOD USED FOR DEVELOPMENT OF GENERAL RESPONSE ACTIONS

The RAOs were used to develop general response actions that describe medium-specific measures that will satisfy the RAOs. General response actions presented in OSWER Directive No. 9355.3-01, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, were evaluated for their applicability to each site's specific conditions, environmental media, the nature of the contaminants, and how the potential risks would be mitigated.

General response actions that may be applicable to the contaminated soils and landfill materials at the OU-1 at sites include:

- No Action
- Limited Action (Institutional Controls)
- Containment
- Excavation and Treatment Actions
- Excavation, Treatment, and Disposal Actions

The soil general response actions can also be applied to sites where contaminated sediments need to be addressed.

General response actions that may be applicable to the contaminated groundwater at the OU-1 sites include:

- No Action
- Limited Action (Institutional Controls)
- Containment Actions
- Collection and Discharge (clean groundwater only)
- Collection, Treatment, and Discharge Actions

General response actions specific to Sites 4, 5, and 19 are presented in Sections 2.6, 2.7, and 2.8 of this FS.

2.5 METHOD USED FOR IDENTIFICATION, SCREENING, AND EVALUATION OF REMEDIAL TECHNOLOGIES

During this phase of alternatives formulation, preliminary screening is performed to reduce the universe of potentially applicable technology types and process options. The purpose of screening is to investigate all available technologies and process options and to eliminate those obviously not applicable to specific conditions at each site, based on the established remedial action objectives and general response actions. The technology identification considers the demonstrated performance of each technology with site conditions and contaminants.

Potential remedial technologies and process options are identified and screened according to their overall applicability (technical implementability) to the media (soils, groundwater, etc.), primary contaminants of

concern (metals, volatile organic compounds), and conditions present at each of the sites, including heterogeneous soils, landfill materials, leaching of contaminants to underlying groundwater, erosion and runoff of contaminated materials, vertical hydraulic gradients, etc.

A detailed evaluation of technologies and process options retained in the preliminary screening step is conducted to further focus the alternatives development process. In this step, process options are evaluated with respect to other processes in the same technology category. One representative process option is selected, if possible, for each technology type, to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedy selection or remedial design. The evaluation of technologies and process options utilizes three criteria: effectiveness, implementability, and relative cost. The Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final), (EPA, 1988) suggests that this evaluation focus on the effectiveness criterion, with less emphasis directed at the implementability and relative cost criteria. Brief definitions of effectiveness, implementability, and relative cost, as they apply to the evaluation process, follow:

- Effectiveness - This criterion focuses on the potential effectiveness of process options in handling the estimated volume of media and meeting the remediation goals; the potential impacts to human health and the environment during construction and implementation; and how proven and reliable the process is with respect to the contaminants and conditions at the site.

- Implementability - The implementability evaluation encompasses both the technical and institutional feasibility of implementing a process. Technical implementability was used in developing general response actions as an initial screen of technology types and process options, to eliminate those that are clearly ineffective or unworkable at a site. Therefore, this subsequent, more detailed evaluation of process options places greater emphasis on the institutional aspects of implementability, such as the ability to obtain permits, availability of treatment, storage, and disposal services, and availability of necessary equipment and resources.

- Cost - Cost plays a limited role in this screening. The cost analysis is based on engineering judgment, and each process is evaluated as to whether costs are high, low, or medium relative to the other options in the same technology type. If there is only one process option, costs are compared to other candidate technologies.

The screening and detailed evaluation of technology types and process options are presented in summary tables for each site.

2.6 SITE 4 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 4 is presented in this section.

2.6.1 Site 4 Remedial Action Objectives

The results of the RI, previous investigations, and the human health and ecological risk assessments for Site 4 were evaluated to determine the remedial action objectives that may be needed to protect human health and the environment.

Human Health Protection Considerations

Because Site 4 is an inactive military landfill with no known deposition of military-specific wastes (e.g., chemical warfare agents), the presumptive remedy guidance for CERCLA municipal landfills was applied to the site. Landfill materials and soils likely contain a variety of chemicals based on the chemicals that were detected in downgradient groundwater and the adjacent Wetlands and on information obtained under previous investigations regarding materials that were disposed in the landfill. Therefore, exposure to contaminated landfill soils and materials may pose excess health risks to humans and remedial action would be warranted to protect human health.

Risk assessment results indicated that, under the future residential land use scenario, exposure to contaminated groundwater through ingestion, dermal contact, and inhalation poses potential risks that would exceed EPA's target risk range of 1 E-06 to 1 E-04 carcinogenic risk, and the HI for target organs would exceed 1.0. Therefore, remedial actions may be needed to mitigate potential human health risks through exposure to contaminated groundwater.

The underlying groundwater is not used as a potable water supply, and there are no plans for base closure or realignment that would result in Site 4 being considered for future residential land use.

Ecological Receptors Risk Considerations

The Site 4 ecological risk assessment (ERA) identified the presence of wetlands adjacent to the landfill and indicated that runoff and groundwater discharge could convey landfill contaminants into the wetlands. However, review of the RI findings indicates the metals present did not exceed any benchmark toxicity values and only nitrobenzene exceeded a screening value. The ERA concluded that, because of the low

contaminant concentrations present in the wetland surface water and sediment adjacent to the landfill, Site 4 does not pose significant potential risks to ecological receptors. Therefore, active remedial actions for the wetlands sediments and surface water may not be warranted to protect ecological receptors.

Environmental Media Protection Considerations

The RI determined that the Site 4 landfill was a continuing source of metals and VOCs that degraded the groundwater quality and that groundwater adjacent to the landfill contained contaminants in concentrations in excess of the state GWQS (see Table 2-7). Review of the RI data revealed that although iron and manganese levels exceeded the GWQS, most metal analytes of concern were present at levels that were comparable to or slightly higher than the GWQS. RI data indicated VOCs in excess of GWQS at 2 of the 4 wells (04GW02 and 04GW05) downgradient of the landfill. The VOCs were detected at concentrations that were comparable to or slightly greater than the regulatory standards. The extent of groundwater contamination is limited, and only a few chemicals exceeded the state ARARs.

If source control measures are implemented, then a reduction in groundwater contaminant concentrations can be expected in the long term. Based on available information, anticipated risks, the limited extent of observed groundwater contamination, and likely implementation of source control measures under a presumptive remedy approach, no active groundwater response actions are needed at this time.

The RI concluded that surface runoff from the landfill and groundwater discharge likely conveyed contaminants into the nearby wetlands sediments and surface water. Several metals and organics were detected in surface water at levels exceeding the state SWQCs. If source control measures are implemented to reduce landfill erosion and groundwater contamination, then contaminant migration to the wetlands is likely to diminish in the long term. Therefore, if the presumptive remedy is applied at Site 4, then no active remediation of the wetland sediments and adjacent surface water may be necessary.

Based on the information developed to date, remedial actions may be warranted to minimize or mitigate the continued discharge of landfill contaminants to groundwater, surface water, and sediments.

RAOs Selection

For the reasons provided above, the following remedial action objectives have been selected for Site 4:

Protection of Human Health RAOs

- Prevent potential human exposure to contaminated landfill soils and materials.

TABLE 2-7
SITE 4 GROUNDWATER CONTAMINANTS OF CONCERN
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ GWQS	Exceeds SDWA MCLs	Poses Human Health Risk
Barium	–	–	X (2)
Iron	X	(1)	X (2)
Manganese	X	(1)	–
1,2-dichloroethene	X	–	X (2)
Trichloroethene	X	X	X (3)
Vinyl Chloride	X	X	X (3)

Notes:

- X indicates the basis for selection of the compound or element as a COC.
- New Jersey state ground water quality standards (GWQS) [N.J.A.C. 7:9-6] are ARARs.
- Safe Drinking Water Act (SDWA) maximum contaminant levels regulate organic and inorganic constituents in public drinking water supplies, and are included for comparison purposes.
- – Does not exceed GWQS, SWDA MCLs, or pose a potential human health risk.

(1) No SDWA MCL for this analyte.
(2) COC contributes to HI greater than 1.0 for future residential child under RME and CT exposures.
(3) COC contributes to excess carcinogenic risks for the future residential adult through RME ingestion, dermal, and inhalation exposures.

- Prevent potential human exposure to VOCs and metals in groundwater.

Protection of the Environment RAO

- Minimize migration of landfill contaminants to groundwater and the adjacent wetlands (surface water and sediments).

2.6.2 Site 4 Preliminary Remediation Goals

Data from the RI, the human health risk assessment, and ARARs were reviewed to identify contaminants of concern (COCs) for Site 4. A summary and the basis for selecting the COCs are provided in Table 2-7

.

Because Site 4 is an inactive military municipal landfill, the presumptive remedy for CERCLA municipal landfill will be applied. Therefore, sampling of soils and landfill materials was limited to visual inspection and field instruments testing.

The organics and metal contaminants in groundwater that would contribute to excess human health carcinogenic risk (greater than 1 E-04 total) or on HI greater than 1.0 were selected as human health risk-based COCs, which are presented in Table 2-8.

Because several organic and metal contaminants in groundwater underlying and adjacent to the site exceed the state GWQS, these COCs were selected and the GWQS were selected as the ARAR-based PRGs. Table 2-8 lists the metal contaminants whose concentration ranges exceeded these of the maximum detected background groundwater concentrations.

Potential PRGs based on ARARs/TBCs, the organic compound and metal analyte detection limits, and the maximum detected background concentrations are presented in Table 2-8.

A set of proposed groundwater PRGs for Site 4 is presented on Table 2-9, along with the basis for selection. These proposed PRGs may be used to assist in the delineation of the volume of contaminated groundwater that may need to be evaluated for potential remedial action, and may also be used in establishing Classification Exception Areas (CEAs) as defined under the N.J.A.C. 7:9-6.

TABLE 2-8
COMPARISON OF GROUNDWATER CRITERIA WITH SITE 4 RI DATA
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

C ntaminant of Concern	ARARS NJ GWQS	SDWA MCLs	Human Health Risk (carcinogen)	Human Health Risk (toxicant)	Maximum Background Conc.	CRDL/CRQL	Maximum Detected Site Conc.
Barium	--	--	--	104	518	200	961
Iron	300	(1)	--	452	7690	100	20900
Manganese	50	(1)	--	--	65	15	306
1,2-Dichloroethene	10	100/70 (2)	--	13.3	BDL	10	25
Trichloroethene	1	5	3.65	--	BDL	10	55
Vinyl Chloride	5	2	0.028	--	BDL	10	3

Notes:
- All units in µg/L
- NJ GWQSs are the state ground water quality standards, which are ARARs
- Safe Drinking Water Act (SDWA) maximum contaminant levels regulate organic and inorganic constituents in public drinking water supplies, and are presented for comparison purposes.
- PRG numerical values for carcinogens and non-carcinogens developed for estimated carcinogenic risk equals 1E-06 or HQ equals 0.1, respectively, based on exposure scenarios and factors applied in the NWS Earle human health risk assessment.
- CRQLs are the EPA contract required quantitation limits for organic compounds.
- CRDLs are the EPA contract require detection limits for metals.
- -- not a COC under this parameter.
- BDL Below detection limit.

(1) No MCL established for this constituent.
(2) 100 µg/L for trans-1,2 DCE and 70 µg/L for cis-1,2 DCE.

TABLE 2-9
SITE 4 PROPOSED GROUNDWATER PRGs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Proposed PRG	Basis of Selection
Barium	518	Background
Iron	7690	Background
Manganese	65	Background
1,2-dichloroethene	10	NJ GWQS
Trichloroethene	10	CRQL
Vinyl Chloride	10	CRQL

Notes:

- all units in µg/L
- New Jersey state ground water quality standards (GWQS) [N.J.A.C. 7:9-6] are ARARs.
- CRQL - contract required quantitation limit as specified in the EPA contract laboratory statement of work.

2.6.3 Site 4 General Response Actions

General response actions were selected based on the RAOs for Site 4 and the consideration that the site is an inactive military municipal landfill, thus incorporating the application of a presumptive remedy. Treatment of contaminated landfill soils and materials is considered technically impracticable. The general response actions for Site 4 that address potential human exposures to contaminated landfill soils and materials and potential contaminant migration into groundwater and the wetlands include

- No action
- Institutional controls (limited action)
- Containment
- Removal and disposal

General response actions that address potential human exposure to groundwater contaminants associated with the landfill materials include

- No action
- Institutional controls (limited action)
- Natural attenuation

Table 2-10 presents a summary of the Site 4 RAOs and corresponding general response actions.

2.6.4 Identification, Screening, and Evaluation of Technologies and Process Options for Site 4

Table 2-10 presents a summary of potential remedial technologies and process options that apply to the Site 4 RAOs and general response actions. Screening of the remedial technologies considered their overall applicability to the media of concern (soil and landfill materials, groundwater), primary contaminants (metals, VOCs), and current site conditions. During the screening step, process options and entire technology types were eliminated from further consideration on the basis of technical implementability.

Site conditions that were considered include fill materials consisting of heterogeneous construction debris possibly mixed with minor quantities of military waste materials, the location of the landfill adjacent to a wetlands area, relatively sparse top cover of the landfilled materials, leaching of soil contaminants into underlying groundwater, discharge of groundwater into adjacent wetlands and erosion and runoff from landfill soils and materials into the adjacent wetlands.

TABLE 2-10
SITE 4 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Envir nmental Medium	Remedial Action Objectives (from site characterization)	General Response Action (for all RAOs)	Remedial Technology Type (for general response actions)	Process Options
S ils and Landfill Materials	<u>Protection of Human Health</u> Prevent human exposure to contaminated landfill soils and materials.	No Action	No Action	Not Applicable
		Limited Action	Institutional Controls	- Deed restrictions - Local ordinances
			Access Restrictions	- Fencing
			Monitoring	- Monitoring of groundwater (to assess contaminant status)
	<u>Protection of the Environment</u> Minimize contaminant migration into groundwater.	Containment	Surface Controls	- Grading - Revegetation
			Cap	- Soil cover - Single barrier - Double barrier
		Removal and Disposal	Excavation	- Mechanical excavation - Drum removal
			Disposal On Site	- Consolidation (into existing landfill) - New landfill
			Disposal Off Site	- RCRA Landfill

TABLE 2-10
SITE 4 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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Envir nmental Medium	Remedial Action Objectives (from site characterization)	General Response Action (for all remedial action objectives)	Remedial Technology Type (for general response actions)	Process Options
Groundwater	Protection of Human Health	No Action	No Action	- Not applicable
	Prevent human exposure to VOC and metal contaminants in groundwater.	Natural Attenuation	Natural Attenuation	- Biological processes - Chemical processes - Physical processes
		Limited Action	Limited Action Technologies - Institutional Controls - Long-Term Monitoring	- Deed restrictions - Groundwater monitoring

The preliminary screening of soils and landfill material remedial technologies is presented and summarized in Table 2-11, and the screening of groundwater response remedial technologies is summarized in Table 2-12. Detailed evaluations of the remedial technologies and process options for contaminated soils/landfill materials and groundwater presented in Tables 2-13 and 2-14, respectively.

2.6.5 Summary of Site 4 Selected Remedial Technologies and Process Options

Tables 2-13 and 2-14 identify the remedial technologies that were retained after the detailed evaluation process. The technologies and process options that are not likely to be implementable and effective or that would result in higher implementation costs were eliminated from further consideration.

For the contaminated soils and landfill materials options, local ordinances were eliminated from further consideration because this action may be difficult to implement and would not offer any greater protection than other institutional controls. The composite cap was eliminated since it did not offer substantially greater protectiveness than the single barrier cap, and the current leaching of landfill contaminants does not appear to constitute a major problem.

All candidate technologies and process options to address contaminated groundwater were retained after the screening phase.

2.7 SITE 5 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 5 is presented in this section. The identification and evaluation of remedial technologies and process options for Site 5 are similar to these performed for Site 4 because both are inactive military municipal landfills. Because Site 5's surficial features differ from those of Site 4, there are differences in the selection of remedial technologies.

2.7.1 Site 5 Remedial Action Objectives

The results of the RI, previous investigations, and the human health and ecological risk assessments for Site 5 were evaluated to determine the remedial action objectives that may be needed to protect human health and the environment.

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 4 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	No Action	No remedial actions taken.	Retained as baseline for comparison, in accordance with the NCP.
Limited Action	Institutional Controls	Deed Restrictions	Administrative action used to restrict future site activities on NWS Earle within potentially contaminated area. Activities such as excavation, installation of drinking water supply wells (without treatment), or residential development could be restricted or prohibited.	Potentially viable. Retained.
		Local Ordinances	Administrative actions, such as zoning by-laws and Board of Health regulations, used to limit property use and activities such as well installation.	Not viable, local ordinances may not be applicable to military bases. Eliminated.
	Access Restrictions	Fencing	Security fence installed around contaminated areas to restrict access.	Potentially viable. Retained.
	Monitoring	Groundwater Monitoring	Periodic monitoring of groundwater to evaluate contaminant presence and migration from the landfill.	Potentially viable. Retained.
Containment	Surface Controls	Grading	Reshaping of topography to manage precipitation infiltration and surface runoff.	Grading of current cover material of varied thickness may not be effective in promoting precipitation infiltration management. Grading would be potentially viable if additional cover materials added. Retained.
		Revegetation	Seeding and maintaining site surface to establish vegetation to minimize erosion and to promote evapotranspiration of precipitation, thus reducing infiltration.	Potentially viable. Retained.

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 4 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Containment (continued)	Cap	Soil (Permeable) Cover	Soil with a vegetative cover to prevent direct contact and minimize erosion and surface migration of contaminated soils.	Potentially viable if direct contact and erosion are the prime threats. Offers limited effectiveness for reducing infiltration. Retained.
		Single Barrier	Cap constructed with one low-permeability layer (clay or synthetic membrane) over the site to prevent direct contact, to minimize erosion, and to reduce leaching of contaminants from the landfill into groundwater. Additional layers would be required to protect the barrier.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Retained.
		Composite (Double) Barrier	Multi-media cap with two low-permeability layers (clay and/or synthetic membranes) constructed over the site to prevent direct contact and reduce leaching of landfill contaminants into groundwater. Provides greater reduction in infiltration and better protection against failure than a single-barrier cap.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Retained.
Removal and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Potentially viable for hot spot areas if encountered during remediation. However, no hot spots were identified at Site 4. Retained.
		Drum Removal	Removal of buried drums or containers using mechanical equipment such as a drum grappler, a drum cradle, a sling attached to a backhoe, or a front-end loader.	Potentially viable if drums or containers are encountered during remediation. Retained.

TABLE 2-11
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 4 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Removal and Disposal (continued)	Disposal Off Base	RCRA Landfill	Transport and disposal of excavated materials in a RCRA-permitted landfill.	Technically impracticable to excavate and dispose of entire landfill, the bulk of which is construction debris. Eliminated. Retained for hot spots and drums, if encountered.
	Disposal On Site	New RCRA-Type Landfill	Disposal of untreated bulk landfill materials in a specially constructed on-base landfill.	Technically impracticable to excavate and dispose of entire landfill, the bulk of which is construction debris. Eliminated.
		Consolidation (into existing landfill)	Relocation of landfill materials into another on-base landfill. Or relocation of small, isolated quantities of contaminated materials into an existing on-base landfill so that one closure action can accommodate both.	Technically impracticable to excavate and relocate landfill. Eliminated. Retained for consolidating small quantities of contaminated materials into existing on-base landfill.

TABLE 2-12
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
FOR SITE 4 CONTAMINATED GROUNDWATER
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	No Action	No active remediation would be conducted to address contamination.	Retained for baseline comparison purposes in accordance with NCP.
	Natural Attenuation	Natural Attenuation	Natural subsurface biological, chemical, or physical processes would attenuate dissolved organics and inorganics and limit migration of the contaminants.	Potentially applicable.
Limited Action	Institutional Controls	Deed Restrictions	Administrative action used to restrict future activities on base properties. Installation of drinking water wells without treatment would be prohibited under property deeds.	Potentially applicable.
	Long-Term Monitoring	Groundwater Monitoring	Periodic sampling and analysis of media to assess groundwater contaminant status and potential migration downgradient.	Potentially applicable.

TABLE 2-13
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 4 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
No Action	No Action	No Action	Would not achieve remedial action objectives.	Implementable.	Capital: None O & M: Low	Retained.
Limited Action	Institutional Controls	Deed Restrictions	Effectiveness dependent on continued future enforcement to prevent use of underlying groundwater or use of landfill for development. No contaminant reduction anticipated.	Can be added to property deed (or Base Master Plan) and is implementable.	Capital: Low O & M: Low	Retained.
	Access Restrictions	Fencing	Would limit access to contaminated soils. No contamination reduction.	Readily implementable; numerous companies available to perform construction.	Capital: Low O & M: Low	Retained.
	Monitoring	Groundwater Monitoring	Would allow assessment of landfill contaminant status and leaching/migration in groundwater. Would enable action to be taken to reduce continuing groundwater contamination. No contaminant reduction.	Readily implementable; numerous companies with personnel and equipment to perform sampling.	Capital: Low O & M: Low	Retained.
Containment	Surface Controls	Grading	Would be effective in promoting precipitation runoff, thus decreasing infiltration and subsequent contaminant leaching. Would be applicable to top layer of cap system.	Implementable, numerous companies with personnel and heavy equipment to perform earth moving and grading.	Capital: Low O & M: None	Retained.

TABLE 2-13
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 4 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Containment (continued)	Surface Controls	Revegetation	Would be effective in reducing precipitation infiltration through promotion of evapotranspiration and reduction of surface erosion.	Implementable; numerous companies with personnel and equipment available to perform revegetation.	Capital: Low O & M: Low	Retained.
	Cap	Soil (Permeable) Cover	Would prevent direct exposure to contaminated soils. Would reduce precipitation infiltration and contaminant leaching to groundwater and would reduce erosion of landfill materials to adjacent wetlands. No contaminant reduction.	Implementable using standard methods and readily available equipment.	Capital: Low O & M: Low	Retained.
		Single Barrier	Would limit infiltration and significantly reduce contaminant leaching to groundwater. Would prevent exposure to contaminated soils and surface migration of contaminated soils. No contaminant reduction.	Implementable by standard construction techniques; would require specialized, but readily available, equipment and materials to install synthetic cap.	Capital: Moderate O & M: Low	Retained.
		Composite (Double) Barrier	Same as single barrier. Second impermeable barrier would provide greater assurance against cover failure. Level of protection offered by composite barrier cap not required at Site 4 since groundwater contamination is low and groundwater is not used.	Implementable by standard construction; would require specialized equipment and materials to install double barrier cap. More care required to install than soil cover or single barrier.	Capital: High O & M: Low	Eliminated.

TABLE 2-13
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 4 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSIONS
Removal and Disposal	Excavation	Mechanical Excavation	Effective method for removing highly contaminated soils and hot spots, if encountered during remediation.	Implementable with standard construction equipment. Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Retained.
		Drum Removal	Effective for drum removal, if encountered during remediation.	Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Retained.
	Disposal Offbase	RCRA Landfill (for hot spot removals only)	Effectively controls release of hot spot contaminants to environment, if encountered during remedial actions. Would probably handle volume of hot spot materials encountered. Landfill materials may require treatment prior to disposal to meet land disposal requirements.	Implementable. Commercial landfill facilities are available. Implementation becomes more difficult if excavated materials require segregation or treatment prior to disposal.	Capital: Moderate O & M: None	Retained.
	Disposal On Base	Consolidation	Allows small volumes of material from other isolated locations to be consolidated and addressed with the majority of landfill materials.	Readily implementable for small or moderate soil volumes. No implementability concerns.	Capital: Low O & M: Low	Retained.

TABLE 2-14
EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 4 CONTAMINATED GROUNDWATER
OU-1 FEASIBILITY STUDY
NAVAL WEAPONS STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	RETAIN/ ELIMINATE
No Action	No Action	No Action	Does not achieve remedial action objectives.	Implementable	Capital: None O&M: Low	Retained.
Natural Attenuation	Natural Attenuation	Natural Attenuation	Effectiveness dependent on subsurface biological, chemical, and physical conditions. Attenuation of organics and metals is anticipated to be gradual.	Implementable. Would require monitoring to determine whether attenuation is ongoing.	Capital: None O&M: Low	Retained.
Limited Action	Institutional Controls	Deed Restrictions	Effectiveness depends on future enforcement. Does not reduce contamination.	Can be added to property deeds (or Base Master Plan) and is implementable.	Capital: Low O&M: Low	Retained.
	Long-Term Monitoring	Groundwater Monitoring	Effective method for observing contaminant extent and potential migration and for assessing effectiveness of remedial action.	Readily implementable; numerous companies available with resources to perform monitoring.	Capital: Low O&M: Low	Retained.

Human Health Protection Considerations

Because Site 5 is an inactive military landfill with no known deposition of military specific wastes (e.g., chemical warfare agents) the presumptive remedy guidance for CERCLA municipal landfills was applied to the site. Landfill materials and soils likely contain a variety of chemicals, based on the chemicals detected in downgradient groundwater and information obtained under previous investigations regarding materials that were disposed in the landfill. However, the majority of the landfill is currently covered by a layer of loose sand and is heavily treed. There is no evidence of exposed landfill materials. In these areas of the landfill, there does not appear to be any potential direct contact threats posed by the covered landfill materials.

The skeet and shooting range comprise an open area that overlies a portion of the Site 5 landfill. The skeet and shooting area surface soils are periodically groomed by base personnel who use sweeping machines to collect spent shells and clay pigeons. There is a concern that the underlying landfill materials may be exposed through the periodic groundskeeping activities needed to support the continued use of the skeet and shooting range. It is the Navy's intention to continue the use of the skeet and shooting range after the implementation of a remedial action.

Potential exposure to contaminated landfill soils and materials may result through the continued use of the skeet and shooting range, if contaminated landfill soils and materials are exposed. A remedial action may be warranted to protect human health by preventing exposures to landfill soils and materials in this area.

Risk assessment results indicated that, under the future residential land use scenario, exposure to contaminated groundwater through ingestion, dermal contact, and inhalation posed potential risks that would exceed EPA's target risk range of 1 E-06 to 1 E-04 carcinogenic risk for an adult receptor, and the HI for target organs would exceed 1.0 for a child receptor. Therefore, remedial actions may be needed to mitigate potential human health risks through exposure to contaminated groundwater.

The underlying groundwater is not used as a potable water supply, and there are no plans for base closure or realignment that would result in Site 5 being considered for future residential land use.

Ecological Receptors Risk Considerations

The RI identified the presence of wetlands adjacent to the Site 5 landfill but concluded that surface runoff and groundwater discharge from the landfill were unlikely to convey landfill contaminants into those wetlands. The surface topography of the landfill is relatively flat and precipitation that falls in the landfill area generally perches and infiltrates into the soils. Precipitation does not appear to runoff into the

adjacent wetlands. Based on measured hydraulic heads, the groundwater underlying the Site 5 landfill flows away from the wetland area and would be unlikely to discharge contaminants to the wetland sediments and soils. The ERA concluded that, because migration of landfill contaminants to the adjacent wetlands is limited and the landfill appears to be adequately covered to limit terrestrial organism exposures, Site 5 poses very low potential risks. Therefore, active remedial actions may not be warranted to protect ecological receptors.

Environmental Media Protection Considerations

The RI determined that the Site 5 landfill was a continuing source of metals and VOCs that degraded the groundwater quality and that groundwater adjacent to the landfill contained contaminants concentrations in excess of the state GWQS (see Table 2-15).

Review of the RI data revealed that aluminum, cadmium, cobalt, iron, manganese, nickel, and thallium levels exceeded the state GWQS and the background concentration range. RI data indicated VOCs presence in excess of GWQS at three of the four wells (05MW05, 05MW06, and 05MW07) located downgradient of the landfill. The VOCs were detected at concentrations that were comparable to or slightly greater than the regulatory standards. The extent of groundwater contamination is limited, and only a few chemicals exceeded the state ARARs.

If source control measures are implemented, then a reduction in groundwater contaminant concentrations can be expected in the long term. Based on available information, anticipated risks, limited extent of groundwater contamination, and likely implementation of source control measures under a presumptive remedy approach, no active groundwater response actions are needed at this time.

Based on the information developed to date, remedial actions may be warranted to minimize or mitigate the continued migration of landfill contaminants to the underlying groundwater.

RAOs Selection

For the reasons provided above, the following remedial action objectives have been selected for Site 5:

Protection of Human Health RAO

- Prevent potential human exposure to contaminated landfill soils and materials underlying the skeet and shooting range.

TABLE 2-15
SITE 5 GROUNDWATER CONTAMINANTS OF CONCERN
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ GWQS	Exceeds SDWA MCLs	Poses Human Health Risk
Aluminum	X	(1)	–
Arsenic	–	–	X (2)
Cadmium	X	X	–
Iron	X	(1)	X (3)
Manganese	X	(1)	–
Nickel	X	X	–
Thallium	–	X	–
Benzene	X	X	–
Chloroform	X	X	–
Trichloroethene	X	X	–
Vinyl chloride	–	–	X (2)

Notes:

- X indicates the basis for selection of the compound or element as a COC.
- The New Jersey state ground water quality standards (GWQS) are ARARs.
- Safe Drinking Water Act (SDWA) maximum contaminant levels regulate organic and inorganic constituents in public drinking water supplies.
- Human health COC selected if it is one of the primary contributors to total estimated carcinogenic risk greater than 1E-04 or to HQ greater than 1.0.
- – Does not exceed GWQS, SWDA MCLs, or pose a potential human health risk.

(1) No SDWA MCL for this analyte.
(2) COC contributes to excess carcinogenic risks for the future residential adult through RME ingestion, dermal, and inhalation exposures.
(3) COC contributes to HI greater than 1.0 for future residential child under RME and CT exposures.

Protection of the Environment RAO

- Minimize migration of landfill contaminants to groundwater.

2.7.2 Site 5 Preliminary Remediation Goals

Data from the RI, the human health risk assessment and ARARs were reviewed to identify COCs for Site 5. The summary and basis for selecting the COCs are presented in Table 2-15.

Because Site 5 is an inactive military landfill that is not known to contain military-specific wastes, the presumptive remedy for CERCLA municipal landfills will be applied. Therefore, sampling of soils and landfill materials was primarily limited to visual inspection and field instrument testing from test pits at site.

The organics and metal contaminants in groundwater that would contribute to excess human health carcinogenic risk (greater than 1 E-04 total) or HIs greater than 1.0 were selected as human health risk-based COCs and are presented in Table 2-16.

Because several organic and metal contaminants in groundwater underlying and adjacent to the site exceed the state GWQS, these contaminants were selected as COCs and the GWQS were selected as the ARAR-based PRGs. Table 2-16 lists the metal contaminants whose concentration range exceeded those of the maximum detected background groundwater concentrations

A set of proposed groundwater PRGs for Site 5 is presented on Table 2-17, along with the basis for selection. These proposed PRGs may be used to assist in the delineation of the volume of contaminated groundwater that may need to be evaluated for potential remedial action, and may also be used in establishing Classification Exception Areas (CEAs) as defined under the N.J.A.C. 7:9-6.

2.7.3 Site 5 General Response Actions

General response actions were selected based on the RAOs for Site 5 and the consideration that the site is an inactive military landfill, thus incorporating the application of a presumptive remedy. Treatment of contaminated landfill soils and materials is considered technically impracticable. The general response actions for Site 5 that address potential human exposures to contaminated landfill soils and materials and potential contaminant migration into groundwater include

- No action
- Institutional controls (limited action)

TABLE 2-16
COMPARISON OF GROUNDWATER CRITERIA WITH SITE 5 RI DATA
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	ARARS NJ GWQS	SDWA MCLs	Human Health Risk (carcinogen)	Human Health Risk (toxicant)	Maximum Background Conc.	CRDL/CRQL	Maximum Detected Site Concentration
Aluminum	200	(1)	--	--	7870	200	42000
Arsenic	--	--	0.045	--	5.8	10	5.3
Cadmium	4	5	--	--	1.9	5	7.5
Iron	300	(1)	--	452	7690	100	59200
Manganese	50	(1)	--	--	65	15	302
Nickel	100	100	--	--	25.5	40	102
Thallium	10	2	--	--	5.1	10	5.6
Benzene	1	5	--	--	BDL	10	3
Chloroform	6	100 (2)	--	--	BDL	10	22
Trichloroethene	1	5	--	--	BDL	10	4
Vinyl Chloride	--	--	0.028	--	BDL	10	2

Notes:
- All units in µg/L
- NJ GWQS are the state ground water quality standards, which are ARARs.
- Safe Drinking Water Act (SDWA) maximum contaminant levels regulate organic and inorganic constituents in public drinking water supplies, and are presented for comparison purposes.
- PRG numerical values for carcinogens and non-carcinogens developed for estimated carcinogenic risk equals 1E-06 or HQ equals 0.1, respectively, based on exposure scenarios and factors applied in the NWS Earle human health risk assessment.
- CRQLs/CRDLs are the EPA contract required quantitation limits/detection limits for organic compounds and metlas, respectively.
- -- not a COC under this parameter.
- BDL Below detection limit.
- Arsenic was eliminated since maximum detected site concentration was less than the CRDL.

(1) No SDWA MCL for this analyte.
(2) As total trihalomethanes.

TABLE 2-17
SITE 5 PROPOSED GROUNDWATER PRGs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Proposed PRG	Basis of Selection
Aluminum	7870	Background
Cadmium	5	CRDL
Iron	7690	Background
Manganese	65	Background
Nickel	100	NJ GWQS
Thallium	10	NJ GWQS
Benzene	10	CRQL
Chloroform	10	CRQL
Trichloroethene	10	CRQL
Vinyl chloride	10	CRQL

Notes:

- all units in µg/L
- The New Jersey state ground water quality standards (GWQS) are ARARs.
- CRQLs and CRDLs are EPA contract required quantitation limits and detection limits for organic compounds and metals under the contract laboratory program's statements of work.

- Containment
- Removal and disposal

General response actions that address potential human exposure to groundwater contaminants associated with the landfill materials include:

- No action
- Institutional controls (limited action)
- Natural attenuation

Table 2-18 presents a summary of the Site 5 RAOs and corresponding general response actions.

2.7.4 Identification and Screening of Technologies and Process Options for Site 5

Table 2-18 presents a summary of potential remedial technologies and process options that apply to the Site 5 RAOs and general response actions. Screening of the remedial technologies considered their overall applicability to the media of concern (soil and landfill materials, groundwater), primary contaminants (metals, VOCs), current site conditions, and planned continued land use of the skeet and shooting range. During the screening step, process options and entire technology types were eliminated from further consideration on the basis of technical implementability.

Site conditions considered include fill materials consisting of heterogeneous construction debris possibly mixed with minor quantities of military waste materials, a cover of sandy soils over the landfilled materials and leaching of soil contaminants into underlying groundwater.

The preliminary screening of soils and landfill material remedial technologies is presented and summarized in Table 2-19, and the screening of groundwater response remedial technologies is summarized in Table 2-20. Detailed evaluations of the remedial technologies and process options for contaminated soils/landfill materials and groundwater are presented in Tables 2-21 and 2-22, respectively.

2.7.5 Site 5 Summary of Selected Remedial Technologies and Process Options

Tables 2-21 and 2-22 identify the remedial technologies that were retained after the detailed evaluation process. The technologies and process options that are not likely to be implementable or effective, or that would result in higher implementation costs were eliminated from further consideration. Site-specific considerations were also factors in the elimination of candidate technologies and process options.

TABLE 2-18
SITE 5 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Environmental Medium	Remedial Action Objectives (from site characterization)	General Response Action (for all RAOs)	Remedial Technology Type (for general response actions)	Process Options
Soils and Landfill Mat rials	Protection of Human Health Prevent human exposure to contaminated landfill soils and materials.	No Action	No Action	Not Applicable
		Limited Action	Institutional Controls	- Deed restrictions - Local ordinances
			Access Restrictions	- Fencing
			Monitoring	- Monitoring of groundwater (to assess contaminant status)
	Protection of the Environment Minimize contaminant migration into groundwater.	Containment	Surface Controls	- Grading - Revegetation
			Cap	- Soil cover - Single barrier - Double barrier
		Removal and Disposal	Excavation	- Mechanical excavation
			Disposal On base	- Consolidation (into existing landfill) - New landfill
			Disposal Off base	- RCRA Landfill

TABLE 2-18
SITE 5 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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Envir nmental Medium	Remedial Action Objectives (from site characterization)	General Response Action (for all remedial action objectives)	Remedial Technology Types (for general response actions)	Process Options
Groundwater	Protection of Human Health	No Action	No Action	- Not applicable
	Prevent human exposure to VOC and metal contaminants in groundwater.	Natural Attenuation	Natural Attenuation	- Biological processes - Chemical processes - Physical processes
		Limited Action	Limited Action Technologies - Institutional Controls - Long-Term Monitoring	- Deed restrictions - Groundwater monitoring

TABLE 2-19
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 5 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	No Action	No remedial actions taken.	Retained as baseline for comparison, in accordance with the NCP.
Limited Action	Institutional Controls	Deed Restrictions	Administrative action used to restrict future site activities on NWS Earle within potentially contaminated area. Activities such as excavation, installation of drinking water supply wells (without treatment), or residential development could be restricted or prohibited.	Potentially viable. Retained.
		Local Ordinances	Administrative actions, such as zoning by-laws and board of health regulations, used to limit property use and activities such as well installation.	Not viable. Local ordinances may not be applicable to military bases. Eliminated.
	Access Restrictions	Fencing	Security fence installed around contaminated areas to restrict access.	Potentially viable. Retained.
	Monitoring	Groundwater Monitoring	Periodic monitoring of groundwater to evaluate contaminant presence and migration from the landfill.	Potentially viable. Retained.
Containment	Surface Controls	Grading	Reshaping of topography to manage precipitation infiltration and surface runoff.	Grading of current cover material of varied thickness; may not be effective. Grading would be potentially viable if additional cover materials added. Retained.
		Revegetation	Seeding and maintaining site surface to establish vegetation to minimize erosion and to promote evapotranspiration of precipitation, thus reducing infiltration.	Potentially viable. Retained.

TABLE 2-19
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 5 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Containment (continued)	Cap	Soil (Permeable) Cover	Soil with a vegetative cover to prevent direct contact and reduce erosion and surface migration of contaminated soils.	Potentially viable if direct contact and erosion are the prime threats. Limited effectiveness for reducing infiltration. Retained.
		Single Barrier	Cap constructed with one low-permeability layer (clay or synthetic membrane) over the site to prevent direct contact, to minimize erosion, and to reduce leaching of contaminants from the landfill into groundwater. Additional layers would be required to protect the barrier.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Retained.
		Composite (Double) Barrier	Multi-media cap with two low-permeability layers (clay and/or synthetic membranes) constructed over the site to prevent direct contact and reduce leaching of landfill contaminants into groundwater. Provides greater reduction in infiltration and better protection against failure than a single-barrier cap.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Retained.
Removal and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Potentially viable for hot spot areas if encountered during remediation. However, no hot spots were identified at Site 5. Retained.
		Drum Removal	Removal of buried drums or containers using mechanical equipment such as a drum grappler, a drum cradle, a sling attached to a backhoe, or a front-end loader.	Potentially viable if drums or containers are encountered during remediation. Retained.

TABLE 2-19
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 5 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Removal and Disposal (continued)	Disposal Off Base	RCRA Landfill	Transport and disposal of excavated materials in a RCRA-permitted landfill.	Technically impracticable to excavate and dispose of entire landfill, the bulk of which is construction debris. Eliminated. Retained for hot spots and drums, if encountered.
	Disposal On Base	New RCRA-Type Landfill	Disposal of bulk untreated landfill materials in a specially constructed on-base landfill.	Technically impracticable to excavate and dispose of entire landfill, the bulk of which is construction debris. Eliminated.
		Consolidation (into existing landfill)	Relocation of landfill materials into another on-base landfill. Or relocation of small, isolated quantities of contaminated materials into an existing on-base landfill so that one closure action can accommodate both.	Technically impracticable to excavate and relocate landfill. Eliminated. Retained for consolidating small quantities of contaminated materials into existing on-base landfill.

TABLE 2-20
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
FOR SITE 5 CONTAMINATED GROUNDWATER
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	No Action	No active remediation would be conducted to address contamination.	Retained for baseline comparison purposes in accordance with NCP.
	Natural Attenuation	Natural Attenuation	Natural subsurface biological, chemical, or physical processes would attenuate dissolved organics and inorganics and limit migration of the contaminants.	Potentially applicable.
Limited Action	Institutional Controls	Deed Restrictions	Administrative action used to restrict future activities on base properties. Installation of drinking water wells without treatment would be prohibited under property deeds.	Potentially applicable.
	Long-Term Monitoring	Groundwater Monitoring	Periodic sampling and analysis of media to assess groundwater contaminant status and potential migration downgradient.	Potentially applicable.

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TABLE 2-21
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 5 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
No Action	No Action	No Action	Would not achieve remedial action objectives.	Implementable.	Capital: None O & M: Low	Retained.
Limited Action	Institutional Controls	Deed Restrictions	Effectiveness dependent on continued future enforcement to prevent use of underlying groundwater or use of landfill for development. No contaminant reduction anticipated.	Can be added to property deed (or Base Master Plan) and is implementable.	Capital: Low O & M: Low	Retained.
	Access Restrictions	Fencing	Would limit access to potentially contaminated soils and would limit usability of skeet and shooting range. No contamination reduction.	Readily implementable; numerous companies available to perform construction.	Capital: Low O & M: Low	Retained.
	Monitoring	Groundwater Monitoring	Would allow assessment of landfill contaminant status and leaching/migration in groundwater. Would enable action to be taken to reduce continuing groundwater contamination. No contaminant reduction.	Readily implementable; numerous companies with personnel and equipment to perform sampling.	Capital: Low O & M: Low	Retained.

TABLE 2-21
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 5 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Containment	Surface Controls	Grading	Would be effective in promoting precipitation runoff, thus decreasing infiltration and subsequent contaminant leaching. Would be applicable to top layer of cap system.	Implementable; numerous companies with personnel and heavy equipment to perform earth-moving and grading.	Capital: Low O&M: None	Retained.
		Revegetation	Would be effective in reducing precipitation infiltration through promotion of evapotranspiration and reduction of surface erosion.	Implementable; numerous companies with personnel and equipment to seeding and periodic maintenance.	Capital: Low O & M: Low	Retained.
	Cap	Soil (Permeable) Cover	Would prevent direct exposure to contaminated soils. Would reduce precipitation infiltration and contaminant leaching to groundwater and would reduce erosion of landfill materials to adjacent wetlands. No contaminant reduction.	Implementable using standard methods and readily available equipment.	Capital: Low O & M: Low	Retained.
		Single Barrier	Would limit infiltration and significantly reduce contaminant leaching to groundwater. Would prevent exposure to contaminated soils and surface migration of contaminated soils. No contaminant reduction.	Implementable by standard construction techniques; would require specialized, but readily available, equipment and materials to install synthetic cap.	Capital: Moderate O & M: Low	Retained.

TABLE 2-21
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 5 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Containment (continued)	Cap (continued)	Composite (Double) Barrier	Same as single barrier. Second impermeable barrier would provide greater assurance against cover failure. Level of protection offered by composite-barrier cap not required at Site 5 since groundwater contamination is low, and groundwater not used.	Implementable by standard construction; would require specialized equipment and materials to install double-barrier cap. More care to install than soil cover or single barrier.	Capital: Moderate O & M: Low	Eliminated.
Removal and Disposal	Excavation	Mechanical Excavation	Effective method for removing highly contaminated soils and hot spot materials, if encountered during remediation.	Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Retained.
		Drum Removal	Effective for drum removal, if encountered during remediation.	Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Retained.

TABLE 2-21
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 5 SOILS/LANDFILL MATERIALS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Removal and Disposal (continued)	Disposal Off Base	RCRA Landfill (for hot spot removals only)	Effectively controls release of hot spot contaminants to environment, if encountered during remedial actions. Would probably handle volume of hot spot materials encountered. Landfill materials may require treatment prior to disposal to meet land disposal requirements.	Implementable. Commercial landfill facilities are available. Implementation becomes more difficult if excavated materials require segregation or treatment prior to disposal.	Capital: Moderate O & M: None	Retained.
	Disposal On Base	Consolidation	Allows small volumes of material from other isolated locations to be consolidated and addressed with the majority of landfill materials.	Readily implementable for small or moderate soil volumes. No implementability concerns.	Capital: Low O & M: Low	Retained.

TABLE 2-22
EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 5 CONTAMINATED GROUNDWATER
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	RETAIN/ ELIMINATE
No Action	No Action	No Action	Does not achieve remedial action objectives.	Implementable	Capital: None O&M: Low	Retained.
Natural Attenuation	Natural Attenuation	Natural Attenuation	Effectiveness dependent on subsurface biological, chemical, and physical conditions. Attenuation of organics and metals is anticipated to be gradual.	Implementable. Would require monitoring to determine whether attenuation is ongoing.	Capital: None O&M: Low	Retained.
Limited Action	Institutional Controls	Deed Restrictions	Effectiveness depends on future enforcement. Does not reduce contamination.	Can be added to property deeds (or Base Master Plan) and is implementable.	Capital: Low O&M: Low	Retained.
	Long-Term Monitoring	Groundwater Monitoring	Effective method for observing contamination extent and potential migration and for assessing effectiveness of remedial action.	Readily implementable; numerous companies available with resources to perform monitoring.	Capital: Low O&M: Low	Retained.

For the contaminated soils and landfill materials options, local ordinances were eliminated from further consideration because this action may be difficult to implement and would not offer any greater protection than other institutional controls. The composite cap was eliminated since it did not offer substantially greater protectiveness than the single barrier cap and the current leaching of landfill contaminants does not appear to constitute a major problem.

All candidate technologies and process options to address contaminated groundwater were retained after the screening phase.

2.8 SITE 19 TECHNOLOGY SCREENING

The selection of viable remedial technologies and process options for assemblage into remedial alternatives for Site 19 is presented in this section.

2.8.1 Site 19 Remedial Action Objectives

The results of the RI, previous investigations, and the human health and ecological risk assessments for Site 19 were evaluated to determine the remedial action objectives that may be needed to protect human health and the environment.

Human Health Protection Considerations

Site 19 currently consists of a paved area, where equipment operators are trained to use fork lifts; the former settling pond for the ordnance maintenance area; and a barricade. Current use of this site by base personnel is limited to the paved areas of Site 19.

The Site 19 HHRA indicated that exposure to contaminated site soils (from the former settling pond) resulted in estimated RME lifetime carcinogenic risks within the acceptable risk range, and RME noncarcinogenic HIs were less than 1.0. Therefore, no further remedial actions are warranted to protect a potential future industrial worker from contaminated soils exposures. For potential exposure to contaminated groundwater, the RME risk results indicate carcinogenic risks within the acceptable risk range (10 E-04 to 10 E-6) but noncarcinogenic HIs greater than 1.0 for several target organs. Thallium and arsenic (for skin, only) posed the majority of noncarcinogenic risks. Further remedial actions may be warranted to protect a potential future industrial worker from groundwater exposure.

The Site 19 HHRA indicated that exposure to contaminated subsurface soils under the RME future residential scenario resulted in adult carcinogenic risks within the acceptable risk range and child noncarcinogenic HIs below 1.0. Because the former settling pond contaminated soils do not appear to pose health risks to a future residential receptor, further remedial actions for these soils are not warranted to protect human health.

Potential exposures to contaminated groundwater resulted in estimated RME adult ingestion carcinogenic risks of 3.3 E-04 (slightly exceeding the acceptable risk range) attributable solely to arsenic. The RME child noncarcinogenic HIs exceeded 1.0 for the groundwater ingestion (27); thallium and arsenic were the principal contributors of risk. For the CT child receptor exposure scenarios, only the ingestion of groundwater posed noncarcinogenic HIs greater than 1.0. Thallium (all target organs), arsenic (skin only), and cadmium and chromium VI (kidney) were the principal contributors of noncarcinogenic risks. Further remedial actions may be warranted to protect human health from potential exposures to contaminated groundwater that result in unacceptable risks.

Exposure risks for future residential children to lead in soils, dust, and water were characterized using the IEUBK Lead Model (v0.99). The results indicated 15.5 percent of the children exposed to similar site conditions could have blood-lead levels greater than 10 µg/dL; these results exceed the EPA protective guideline of five percent of the maximum proportion of individuals. Therefore, remedial action may be needed to protect human health from exposures to lead in environmental media at Site 19.

Exposure to contaminated sediments and surface water were evaluated for the future recreational receptor. The risk results indicated estimated carcinogenic risks below the acceptable risk range and noncarcinogenic HIs below 1.0. Therefore, no further actions are warranted to protect human health from contaminated sediments and surface water at Site 19.

A variety of metals pose potential risks to potential future adult and child receptors. While the HHRA included a future residential scenario, there are no current plans for base realignment at NWS Earle and future use of the Site 19 area for residential purposes is unknown. It is not known what changes in the future may occur that may result in different land uses. The underlying groundwater is not used as a potable water supply. Should base realignment occur in the future, resulting in different land use for Site 19, then an Environmental Baseline Survey may be warranted and measures to protect human health from exposures to contaminated soils (due to lead presence) and groundwater would be evaluated.

Ecological R ceptors Risk Considerations

The RI identified the presence of wetlands adjacent to the former paint chip and sludge disposal area for Site 19 and concluded that precipitation runoff was the principal mechanism for conveying contaminants from the settling pond (topographic depression) to the wetlands via the drainage ditch. The RI also hypothesized that precipitation infiltration would mobilize soil contaminants into groundwater, which may eventually discharge to the surface water in the wetlands.

The ERA identified aluminum, barium, beryllium, chromium, lead, vanadium, and zinc as contaminants of potential concern; these metals are present at concentrations in excess of the background range. However, the ERA concluded that most of the metals detected, based on their respective HQs, posed low potential risks for ecological receptors. The HQs for chromium, lead, and zinc were sufficiently high to indicate moderate potential risks. The RI concluded that the Site 19 soils would continue to be a source of metals contamination to the surface water and sediments in the wetlands.

Remedial action may be warranted to protect the wetlands sediments and surface water and ecological receptors.

Environmental Media Protection Considerations

Soils - A variety of metals were detected in the soil samples collected from the depression and the drainage ditch. Antimony, cadmium, chromium VI, lead, and zinc were found to exceed the New Jersey Non-Residential Soil Clean-Up Criteria (a TBC) at one location 19SB03. These metal concentrations also exceeded the background metals range. Although lead was detected at all soil sampling locations, only the 19SB03 results exceeded the state soil clean-up criteria (TBC). The RI identified the presence of low concentrations of PCE in the soil samples obtained from the topographic depression. No VOCs were detected in the underlying groundwater, which suggests that the source areas do not contain high levels of PCE.

The RI concluded that the hexavalent chromium detected in subsurface soils has the potential to migrate into and contaminate the underlying groundwater; however, groundwater chromium concentrations do not exceed the state GWQS but do exceed the background range. Other metals were detected in both the subsurface soils and in groundwater, including antimony, cadmium, and lead, that exceeded both the New Jersey Non-Residential soil clean-up criteria (a TBC) and the GWQS. Aluminum and iron (detected in all Site 19 wells) and arsenic, manganese, and thallium (detected in individual well locations) were present at concentrations exceeding the GWQS. These metals were all present in the subsurface soils.

These results indicate that the subsurface soils are probably continuing sources of metal contaminants to groundwater. Because precipitation infiltration causes leaching of contaminants to groundwater in excess of the GWQS, a remedial response action may be needed to address the continuing groundwater contamination by the Site 19 soils in the topographic depression and the drainageway.

Groundwater - Aluminum and iron exceeded the GWQS in all Site 19 well samples; only aluminum in the 19GW05 sample exceeded the background range. Antimony, arsenic, cadmium, lead, and thallium were also detected in the 19GW07 sample at concentrations that exceeded the GWQS and the background metals range. Manganese was detected in 19GW05 and 19GW06 samples at levels that exceeded the GWQS and the 19GW05 sample concentration also exceeded the background range. During the RI, no organic compounds were detected in any of the groundwater samples. Although PCE was detected in the soil samples, the data suggest that the source areas do not contain levels of PCE at sufficient concentrations to degrade groundwater quality.

The RI concluded that Site 19 soils are contributing to groundwater contamination. If source control measures are implemented, then a reduction in groundwater contaminant concentrations can be expected in the long term. Based on available information, anticipated risks, and assuming implementation of source control measures like minimizing water infiltration, no active groundwater response actions are needed at this time.

Sediments - The one Site 19 sediment sample collected at the confluence of the drainage ditch and the wetland stream contained arsenic, chromium, and lead concentrations that exceeded screening toxicity values and their respective background concentration ranges. A number of metals detected in the subsurface soils (generally near surface) from the topographic depression were also detected in the one sediment sample, which suggests that the Site 19 soils were and may still be contributors of metal contamination to sediments in the drainageway. Examination of current drainage conditions indicates that flow from the topographic depression to the wetlands was not likely to occur since most of the precipitation would probably infiltrate into underlying groundwater. However, flooding of the wetlands during precipitation events could raise the surface water level and convey contaminated sediments from the drainageway into the wetlands.

Although eight PAHs and three pesticides were detected in the sediment sample at concentrations that exceeded benchmark toxicity values, these organic contaminants were not detected in either the subsurface soils or groundwater at Site 19. These results indicate that the Site 19 soils in the topographic depression are not continuing sources of organic compound contamination to sediments.

In summary, a remedial action of the Site 19 soils and drainageway sediments because of metal contaminants is warranted to protect the adjoining wetland.

Surface Water - Copper and mercury were detected in the one surface water sample at concentrations that exceeded the fresh water chronic aquatic AWQC (TBC). Copper was also present at 19SW01 at slightly higher than background levels. The organic compounds detected at 19SW01 did not exceed any screening values.

Because surface runoff and groundwater discharge have the potential to cause contaminant migration to surface water in the adjacent wetlands in excess of the SWQC, a remedial response action may be needed to address this aspect of site contamination.

The RI indicated that surface water originating at Site 19 discharges to Mingamahone Brook, which discharges upstream of a potable water intake. Contaminants originating at Site 19 could migrate to water bodies used for drinking water.

If source control measures are implemented at Site 19, then a reduction in surface water contaminant concentrations affiliated with the soils can be expected in the long term. No active surface water response actions would be needed at this time other than the implementation for source control actions.

RAOs Selection

Based on the reasons provided above, the following remedial action objectives have been selected for Site 19:

Protection of Human Health RAO:

- Prevent potential human exposures to contaminated soils and groundwater.

Protection of the Environment RAO

- Minimize migration of soils and drainageway contaminants to groundwater and the adjacent wetlands.

2.8.2 Site 19 Pr liminary Rem diation Goals (PRGs)

The summary and basis for selecting the soils COCs are presented in Table 2-23. Soil COCs were selected if they exceeded the State Non-Residential or Residential Soil Cleanup Criteria [a TBC] and exceeded the background concentration, or if they posed risks to human health. Soil PRGs are presented in Table 2-24, and are based on State non-promulgated soil cleanup criteria, risk-based estimates, detection limits, and the maximum background metal concentrations. Proposed Site 19 soil PRGs are in Table 2-25, along with the basis for their selection. The proposed soil PRGs would be used to estimate the volume of contaminated materials to be addressed and possibly guide the remedial action.

The summary and basis for selecting groundwater COCs, based on exceedance ARARs (e.g., GWQS) and risks to human health, are presented in Table 2-26. The organics and metal containments in groundwater that would contribute to excess human health risk were selected as human health risk-based COCs. PRGs for groundwater containments used the State GWQS numerical values, risk-based groundwater concentrations that do not result in carcinogenic risks exceeding 1 E-06 or HI greater than 1.0, analytical detection limits, and maximum detected background concentrations. Tables 2-27 presents a set of candidate groundwater PRGs. A set of proposed Site 19 PRGs for groundwater are presented in Table 2-28, along with the basis for their selection. These proposed groundwater PRGs can be used to delineate the volume of contaminated groundwater that may need to be evaluated for potential remedial action, and may be used in establishing Classification Exception Areas (CEAs) as defined under the N.J.A.C. 7:9-6.

2.8.3 Site 19 General Response Actions

General response actions were selected based on the RAOs for Site 19, the types and extent of contaminants present in the soils and groundwater, and the potential migration of contaminants into the adjacent wetlands through surface runoff and groundwater discharge. The general response actions for Site 19 that address potential human exposures to contaminated soils and groundwater and potential contaminant migration into groundwater and the wetlands include

- No action
- Institutional controls (limited action)
- Containment
- Excavation and treatment
- Removal and disposal

TABLE 2-23
SITE 19 SOIL CONTAMINANTS OF CONCERN
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ Soil Cleanup Criteria	Poses Human Health Risk
Antimony	X	–
Cadmium	X	–
Chromium VI	X	–
Lead	X	X
Zinc	X	–

Notes:

- X indicates the basis for selection of the compound or element as a COC.
- The New Jersey State Non-Residential and Residential Soil Cleanup Criteria are To-Be-Considered (TBC) guidance levels.
- Lead selected as COC based on estimated blood-lead levels exceeding 10 µg/dL in 15.5 percent of children, if they were to be exposed to lead levels similar to those at Site 19.
- – Not a COC under this parameter.

TABLE 2-24
COMPARISON OF SITE 19 SOIL DATA WITH SOIL CRITERIA
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

C ntaminant of Concern	NJ Non-Residential Soil Cleanup Criteria	NJ Residential Soil Cleanup Criteria	Human Health Risk	Maximum Background Concentration	CRDL	Maximium Detected Site Concentration
Antimony	340	14	--	ND	12	32.15
Cadmium	100	1	--	0.57	1	5.9
Chromium VI	10	--	--	59.5	2	528
Lead	600	100	400 (1)	39.4	0.6	1345
Zinc	1500	1500	--	50.7	4	7760

Notes:
- -- Not a COC under this parameter
- All units in mg/kg
- NJ non-residential and residential direct contact soil cleanup criteria are to-be-considered numerical guidance values.
- Protection of human health lead value based on EPA lead guidance level.
- CRDLs are the EPA contract require detection limits for metals.

(1) Lead level is based on OSWER Directive No. 9355.4-12, Revised Interim Soil Lead Guidance Level for CERCLA Sites and RCRA Corrective Action Facilities, July 1994, suggested value.

TABLE 2-25
SITE 19 PROPOSED SOIL PRGs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Proposed PRGs	Basis of Selection
Antimony	340	NJ Non-residential Criteria
Cadmium	100	NJ Non-residential Criteria
Chromium VI	59.5	Background
Lead	600	NJ Non-residential Criteria
Zinc	1500	NJ Non-residential Criteria

Notes:

- Under current and projected use of Site 19 for continued base activities, a residential land use is unlikley. Therefore, the New Jersey State Non-residential Soil Cleanup Criteria are proposed as soils PRGs.

TABLE 2-26
SITE 19 GROUNDWATER CONTAMINANTS OF CONCERN
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Exceeds NJ GWQS	Exceeds SDWA MCLs	Poses Human Health Risk
Aluminum	X	(1)	–
Arsenic	X	–	X (2,3)
Cadmium	X	–	X (3)
Chromium VI	–	–	X (3)
Iron	X	(1)	–
Lead	X	X	X
Manganese	X	(1)	–
Thallium	X	X	X (3)

Notes:

- X indicates the basis for selection of the compound or element as a COC.
- The New Jersey state ground water quality standards (GWQS) are ARARs.
- Safe Drinking Water Act (SDWA) maximum contaminant levels regulate organic and inorganic constituents in public drinking water supplies; included for comparison purposes, only.
- – Does not exceed GWQS, SWDA MCLs, or pose a potential human health risk.

(1) No SDWA MCL for this analyte.
(2) COC contributes to excess carcinogenic risks for the future residential adult through RME ingestion, dermal, and inhalation exposures.
(3) COC contributes to HI greater than 1.0 for future adult resident future under CT exposures, or for residential child under RME and CT exposures.

TABLE 2-27
COMPARISON OF SITE 19 GROUNDWATER DATA WITH GROUNDWATER CRITERIA
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	NJ GWQS	SDWA MCLs	Human Health Risk (carcinogen)	Human Health Risk (toxicant)	Maximum Background Concentration	CRDL/CRQL	Maximium Detected Site Conc.
Aluminum	200	(1)	--	--	7870	200	9610
Arsenic	8	50	0.045	0.468	5.8	10	27.4
Cadmium	4	5	--	0.767	1.9	5	7.5
Chromium VI	100	100	--	7.13	BDL	10	43.1
Iron	300	(1)	--	--	7690	100	4880
Lead	10	15 (2)	(3)	(3)	3	3	17.2
Manganese	50	(1)	--	--	65	15	185
Thallium	10	2	--	0.12	5.1	10	28.9

Notes:

- All units in µg/L
- New Jersey state groundwater quality standards (GWQS) are ARARs.
- Safe Drinking Water Act (SDWA) maximum contaminant levels regulate organic and inorganic constituents in public drinking water supplies, and are presented for comparison purposes.
- PRG numerical values for carcinogens and non-carcinogens developed for estimated carcinogenic risk equals 1E-06 or HQ equals 0.1, respectively, based on exposure scenarios and factors applied in the NWS Earle human health risk assessment.
- CRQLs and CRDLs are the EPA contract required quantitation limits and detection limits for organic compounds and metals, respectively.
- -- not a COC under this parameter.
- BDL Below detection limit.

(1) No SDWA MCL for this analyte.
(2) Action level
(3) No risk-based PRG derived; lead is both a carcinog n and a toxicant.

TABLE 2-28
SITE 19 PROPOSED GROUNDWATER PRGs
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Contaminant of Concern	Proposed PRGs	Basis of Selection
Aluminum	7870	Background
Arsenic	10	CRDL/SDWA MCL
Cadmium	5	CRDL/SDWA MCL
Chromium VI	100	NJ GWQS
Iron	7690	Background
Lead	10	NJ GWQS
Manganese	65	Background
Thallium	10	NJ GWQS/CRDL

Notes:

- The New Jersey state groundwater quality standards (GWQS) are ARARs.
- CRDL - EPA contract required detection limit for metals under the contract laboratory program.

General response actions that address potential human exposure to groundwater contaminants associated with the landfill materials include

- No action
- Institutional controls (limited action)
- Natural attenuation

Table 2-29 presents a summary of the Site 19 RAOs and corresponding general response actions.

2.8.4 Site 19 Identification and Screening of Technologies and Process Options

Table 2-29 presents a summary potential remedial technologies and process options that apply to the Site 19 RAOs and general response actions. Screening of the remedial technologies considered their overall applicability to the media of concern (soil, sediment, and groundwater), primary contaminants (metals), current site conditions, and planned continued use of the area for training purposes. During the screening step, process options and entire technology types were eliminated from further consideration on the basis of technical implementability.

Site conditions considered include contaminated soils and paint chips and sludges, VOCs in soils, contaminated sediments in the drainageway, erosion of contaminated soils and subsequent discharge to the wetlands, and leaching of soil contaminants into underlying groundwater.

The preliminary screening of soil and sediment remedial technologies is presented and summarized in Table 2-30, and the screening of groundwater response remedial technologies is summarized in Table 2-31. Detailed evaluations of the remedial technologies and process options for contaminated soils/sediment and groundwater are presented in Tables 2-32 and 2-33, respectively.

2.8.5 Summary of Site 19 Selected Remedial Technologies and Process Options

Tables 2-32 and 2-33 identify the remedial technologies that were retained after the detailed evaluation process. The technologies and process options that are not likely to be implementable or effective or that result in higher implementation costs were eliminated.

For the contaminated soils and sediment options, fencing was eliminated since it would not be effective in protecting from exposures to mobile soils (e.g., airborne lead dusts). The composite cap was eliminated since it did not offer substantially greater protectiveness than the single barrier cap. In-situ solidification

TABLE 2-29
SITE 19 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Envir nmental Medium	Remedial Action Objective (from site characterization)	General Response Action (for all RAOs)	Remedial Technology Type (for general response actions)	Process Options
Soils and Sediments	Protection of Human Health Prevent human exposure to contaminated soils.	No Action	No Action	Not Applicable
		Limited Action	Institutional Controls	- Deed restrictions - Local ordinances
			Access Restrictions	- Fencing
			Monitoring	- Monitoring of groundwater (to assess contaminant status)
	Protection of the Environment Minimize contaminant migration into groundwater and adjacent wetlands.	Containment	Surface Controls	- Grading - Revegetation
			Containment Technologies: - Horizontal barriers - Vertical barriers	- Soil cover, single barrier, composite (double) barrier - Slurry wall, grout injection, sheet piling

TABLE 2-29
SITE 19 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY
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Environmental Medium	Remedial Action Objective (from site characterization)	General Response Action (for all RAOs)	Remedial Technology Type (for general response actions)	Process Options
Soils and Sediments (continued)	(See previous page)	Removal and Disposal	Excavation	- Mechanical excavation
			Disposal Off Base	- RCRA C or D landfill (depending on constituents)
			Disposal On Base	- Consolidation (into existing landfill) - New landfill
		Excavation, Treatment, and Disposal	Excavation	- Mechanical excavation - Discrete removal
			Treatment Technologies:	
			- Thermal treatment	- Incineration, pyrolysis, low-temperature thermal desorption, vitrification
			- Physical/chemical treatment	- Soil washing, solvent extraction, dechlorination, fixation
			- Immobilization	- Sorption, micro-encapsulation, clay pelletizing/sintering
			- Biological treatment	- Aerobic biodegradation, anaerobic biodegradation

TABLE 2-29
SITE 19 REMEDIAL ACTION OBJECTIVES, GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

Environmental Medium	Remedial Action Objective (from site characterization)	General Response Action (for all RAOs)	Remedial Technology Type (for general response actions)	Process Options
Soils and Sediments (cont.)	(See page 1)	Excavation, Treatment, and Disposal (cont.)	Disposal Technologies: - Landfill - Land disposal	 - Off-base landfill, on-base landfill - Beneficial re-use, consolidation
		In-Situ Treatment	In-Situ Treatment Technologies: - Thermal treatment - Physical/chemical treatment - Immobilization - Biological treatment	 - In-situ vitrification - Soil vapor extraction, soil flushing - In-situ fixation - In-situ biodegradation
Gr undwater	Protection of Human Health Prevent human exposure to contaminated groundwater.	No Action	No Action	- Not applicable
		Natural Attenuation	Natural Attenuation	- Biological processes - Chemical processes - Physical processes
		Limited Action	Institutional Controls	- Deed restrictions - Classification Exception Area designation
			Long-Term Monitoring	- Groundwater monitoring

TABLE 2-30
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 19 SOILS and SEDIMENTS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	No Action	No remedial actions taken.	Retained as baseline for comparison, in accordance with the NCP.
Limited Action	Institutional Controls	Deed Restrictions	Administrative action used to restrict future site activities on NWS Earle within potentially contaminated area. Activities such as excavation, installation of drinking water supply wells (without treatment), or residential development could be restricted or prohibited.	Potentially viable. Retained.
		Local Ordinances	Administrative actions, such as zoning by-laws and board of health regulations, used to limit property use and activities such as well installation.	Eliminated. Typically difficult to implement. Local ordinances may not apply to military bases.
	Access Restrictions	Fencing	Security fence installed around contaminated areas to restrict access.	Potentially viable. Retained.
	Monitoring	Groundwater Monitoring	Periodic monitoring of groundwater to evaluate contaminant presence and migration from site.	Potentially viable. Retained.
Containment	Surface Controls	Grading	Reshaping of topography to manage precipitation infiltration and surface runoff.	Grading of materials in topographic depression would not be effective in minimizing metal contaminant leaching. Eliminated.
		Revegetation	Seeding and maintaining site surface to establish vegetation to minimize erosion and to promote evapotranspiration of precipitation, thus reducing infiltration.	Revegetation of topographic depression and drainageway would not mitigate metal contaminant leaching. Eliminated.
	Horizontal Barriers (Capping)	Soil (Permeable) Cover	Soil with a vegetative cover to prevent direct contact and minimize erosion and surface migration of contaminated soils.	Potentially viable. Some effectiveness in reducing infiltration. Retained.

TABLE 2-30
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 19 SOILS and SEDIMENTS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Containment (continued)	Horizontal Barriers (Capping) (continued)	Single Barrier	Cap constructed with one low-permeability layer (clay or synthetic membrane) over site to prevent direct contact, to reduce erosion, and to reduce leaching of contaminants from landfill into groundwater. Additional layers would be required to protect the barrier.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Retained.
		Composite (double) Barrier	Multi-media cap with two low-permeability layers (clay and/or synthetic membranes) constructed over site to prevent direct contact and reduce leaching of landfill contaminants into groundwater. Provides greater reduction in infiltration and better protection against failure than a single-barrier cap.	Potentially viable to prevent direct contact and to reduce erosion and infiltration. Retained.
	Vertical Barriers	Slurry Walls	Trench filled with clay or cement slurry to form low-permeability wall to restrict horizontal migration of contaminants.	Eliminated. Would not be implementable since slurry wall needs to be keyed into low-permeability horizontal barrier or geologic unit, which is absent at this site.
		Grout Injection	Use of pressure-injected cement grout to form impermeable or semi-permeable barrier to restrict horizontal migration of contaminants.	Eliminated. Would not be implementable since wall needs to be keyed into low-permeability horizontal barrier or geologic unit, which is absent at this site.
		Sheet piles	Steel sheet piles used to form barrier to restrict horizontal migration of contaminants.	Eliminated. Would not be implementable since wall needs to be keyed into low-permeability horizontal barrier or geologic unit, which is absent at this site.

TABLE 2-30
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 19 SOILS and SEDIMENTS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Removal and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Implementable. Retained.
	Disposal Off Site	RCRA C or D Landfill	Transport and disposal of excavated materials to a RCRA-permitted landfill.	Implementable for volume of soil at Site 19. Retained.
	Disposal On Site	New RCRA-Type Landfill	Disposal of untreated hot spot materials in a specially constructed landfill on the base.	Technically impracticable to construct and maintain landfill for relatively small volume of soils. Eliminated.
		Consolidation (into existing landfill)	Relocation of untreated materials into an on-base landfill.	Potentially viable. Retained.
Excavation, Treatment, and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Potentially applicable. Retained.
	Immobilization	Solidification	Mixing of excavated contaminated materials with treatment reagents to physically and/or chemically bind and decrease the mobility of contaminants. Common treatment reagents include cement, pozzolanic materials, thermoplastics, polymers, and asphalt.	Potentially applicable. Retained.
		Clay Pelletizing/ Sintering	Encapsulation of wastes by mixing with clay, followed by sintering.	Eliminated. Not applicable to contaminants present. Typically used for volatile metals remediation.

TABLE 2-30
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 19 SOILS and SEDIMENTS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Excavation, Treatment, and Disposal (continued)	Thermal Treatment	Vitrification	Melting of wastes to entrain inorganics in a stable vitreous residual.	Eliminated. Technically impracticable for volume of soils involved.
		Incineration	Destruction of organics by oxidation at high temperatures under controlled conditions in a combustion chamber.	Eliminated. Not effective for metal-contaminated soils.
		Pyrolysis	Chemical decomposition of wastes by heating the material in absence of oxygen.	Eliminated. Not effective for metal-contaminated soils.
		Thermal Desorption	Ambient air, heat, and mechanical agitation are used to volatilize organic contaminants from soil into gas stream for further treatment.	Eliminated. Not effective for metal-contaminated soils.
	Physical Treatment	Soil Washing	Water-based process in which soils are separated into coarse and fine fractions to reduce the volume of materials requiring intensive treatment or disposal.	Eliminated. Not applicable to paint chips.
	Chemical Treatment	Solvent Extraction	Desorption of contaminants from soil particles through washing with a solvent solution.	Eliminated. Not technically practical for metal-contaminated soils.
		Dechlorination	Chemical reaction displaces chlorine atom in chlorinated organic compound to convert toxic compounds into less toxic, more water-soluble compounds.	Eliminated. Not implementable for metal-contaminated soils. VOCs in soils are not COCs.
	Biological Treatment	Aerobic Biodegradation	Degradation of organics to carbon dioxide and water in the presence of oxygen. Treatment can be conducted under easily controlled conditions in an enclosed reactor or using standard irrigation and soil mixing techniques in an above-ground cell.	Eliminated. Not implementable for metal-contaminated soils. While-applicable to site VOCs, these are not soil COCs.

TABLE 2-30
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 19 SOILS and SEDIMENTS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Excavation, Treatment, and Disposal (continued)	Biological Treatment (continued)	Anaerobic Biodegradation	Degradation of organics to methane and carbon dioxide in the absence of oxygen.	Eliminated. Not applicable to metals and not feasible for most organics. Limited application to certain complex organics.
In-Situ Treatment	Physical Treatment	In-Situ Solidification	Deep soil mixing equipment is used to apply treatment reagents to contaminated soils. Contaminants are physically and/or chemically immobilized in a cement-like mass.	Potentially implementable. Retained.
		Soil Vapor Extraction	Induced vacuum in a network of extraction wells in the unsaturated soil zone desorbs volatile organics from soil particles and removes contaminated vapor from soil pore space. Process may be enhanced using heated air, steam, or radiant heat or air sparging.	Eliminated. Not applicable for metals in soils. Would be implementable for VOCs, but these are not COCs.
	Biological Treatment	In-Situ Biodegradation	Enhancement of natural biodegradation of organic contaminants by addition of nutrients and control of the environment.	Eliminated. Metals would not be addressed. Would be implementable for VOCs, but these are not COCs.
	Chemical Treatment	Soil Flushing	In-situ process that employs a water-based extraction fluid and an injection/extraction well system to flush contaminants from soils.	Eliminated. Metals would not likely be addressed. May be implementable for site VOCs, but these are not COCs.
	Thermal Treatment	In-Situ Vitrification	An electrical network is used to melt contaminated soils in-place. Metals are immobilized within a vitreous mass; organics are destroyed by pyrolysis.	Eliminated. Not appropriate use in locations with shallow water tables.

TABLE 2-31
PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS
FOR SITE 19 CONTAMINATED GROUNDWATER
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
No Action	No Action	No Action	No active remediation would be conducted to address contamination.	Retained for baseline comparison purposes in accordance with NCP.
	Natural Attenuation	Natural Attenuation	Natural subsurface biological, chemical, or physical processes would attenuate dissolved organics and inorganics and limit migration of some of the contaminants.	Potentially applicable. Retained.
Limited Action	Institutional Controls	Deed Restrictions	Administrative action used to restrict future activities on base properties. Installation of drinking water wells without treatment would be prohibited under property deeds.	Potentially applicable. Retained.
	Long-Term Monitoring	Groundwater Monitoring	Periodic sampling and analysis of media to assess groundwater contaminant status and potential migration downgradient.	Potentially applicable. Retained.

TABLE 2-32
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 19 SOILS and SEDIMENTS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
No Action	No Action	No Action	Would not achieve remedial action objectives.	Implementable.	Capital: None O & M: Low	Retained.
Limited Action	Institutional Controls	Deed Restrictions	Effectiveness dependent on continued future enforcement to prevent use of underlying groundwater or prohibit residential development. No contaminant reduction.	Can be added to property deed (or Base Master Plan) and is implementable.	Capital: Low O & M: Low	Retained.
	Access Restrictions	Fencing	Would limit access to topographic depression but there would be no contamination reduction. Soils laden with metals can still be dispersed to environment. Would be effective in mitigating direct contact threats to humans and ecological receptors.	Readily implementable; numerous companies available to perform construction.	Capital: Low O & M: Low	Retained.
	Monitoring	Groundwater Monitoring	Would allow assessment of contaminant status and leaching/migration in groundwater. Would enable action to be taken to reduce continuing groundwater contamination. No contaminant reduction.	Readily implementable; numerous companies with personnel and equipment to perform sampling and evaluation of results.	Capital: Low O & M: Low	Retained.

TABLE 2-32
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 19 SOILS and SEDIMENTS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSION
Containment	Cap	Soil (Permeable) Cover	Would prevent direct exposure to contaminated soils. Would reduce precipitation infiltration and contaminant leaching to groundwater and would eliminate erosion of soils in depression and drainageway to adjacent wetlands. No contaminant reduction.	Implementable using standard methods and readily available equipment.	Capital: Low O & M: Low	Retained.
		Single Barrier	Would limit infiltration and reduce contaminant leaching to groundwater. Would prevent exposure to contaminated soils and eliminate erosion of soils into adjacent wetlands. No contaminant reduction.	Implementable by standard construction techniques; would require specialized, but readily available, equipment and materials to install synthetic cap.	Capital: Moderate O & M: Low	Retained.
		Composite (Double) Barrier	Same as single barrier. Second impermeable barrier would provide greater assurance against cover failure. Level of protection offered by composite-barrier cap not required at Site 19 since groundwater contamination is low and unused.	Implementable by standard construction; would require specialized equipment and materials to install double barrier cap. More care to install than soil cover or single barrier.	Capital: High O & M: Low	Eliminated.
Removal and Disposal	Excavation	Mechanical Excavation	Effective method for removing contaminated soils.	Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Retained.

TABLE 2-32
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 19 SOILS and SEDIMENTS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSIONS
Removal and Disposal (continued)	Disposal Off Site	RCRA Landfill	Effectively addresses contaminated soils and eliminates future releases to the environment. Can probably handle volume of Site 19 soil. Depending on soil constituents, RCRA facility may require treatment of soils prior to disposal to meet land disposal requirements.	Implementable. Commercial landfill facilities are available. Implementation becomes more difficult if excavated materials require segregation or treatment prior to disposal.	Capital: Moderate O & M: None	Retained.
	Disposal On Site	Consolidation	Allows small volumes of materials to be consolidated and addressed with the majority of landfill materials.	Implementable. Two NWS Earle landfills (Site 4 and 5) would be able to accept the small volume of soils that needs to be disposed, prior to closure.	Capital: Low O & M: None	Retained.
Excavation, Treatment, and Disposal	Excavation	Mechanical Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers, excavators, and front-end loaders.	Implementable. Equipment and resources are readily available from various contractors.	Capital: Low O & M: None	Retained.
	Immobilization	Solidification and Fixation	Mixing of excavated contaminated soils and paint chips with treatment reagents (cement) would be effective in physically and/or chemically binding and decrease soil contaminant mobility.	Implementable. A number of vendors are available to perform this treatment process.	Capital: Moderate O&M: None	Retained.

TABLE 2-32
DETAILED EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 19 SOILS and SEDIMENTS
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	CONCLUSIONS
In-Situ Treatment	Physical Treatment	In-Situ Solidification	Deep mixing with reagents could effectively immobilize metals in contaminated soils. However, this treatment process may be less effective than the ex-situ solidification, which can be better controlled to achieve desired results.	Vendors with equipment and personnel are available to perform in-situ treatment. Treatability study needed to assess process effectiveness.	Capital: Moderate O&M: None	Eliminated.

TABLE 2-33
EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS FOR SITE 19 CONTAMINATED GROUNDWATER
OU-1 FEASIBILITY STUDY
NAVAL WEAPON STATION EARLE, COLTS NECK, NEW JERSEY

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST	RETAIN/ ELIMINATE
No Action	No Action	No Action	Does not achieve remedial action objectives.	Implementable	Capital: None O&M: Low	Retained.
Natural Attenuation	Natural Attenuation	Natural Attenuation	Effectiveness dependent on subsurface biological, chemical, and physical conditions. Attenuation of organics and metals is anticipated to be gradual.	Implementable. Would require monitoring to determine whether attenuation is ongoing.	Capital: None O&M: Low	Retained.
Limited Action	Institutional Controls	Deed Restrictions	Effectiveness depends on future enforcement. Does not reduce contamination.	Can be added to property deeds (or Base Master Plan) and is implementable.	Capital: Low O&M: Low	Retained.
	Long-Term Monitoring	Groundwater Monitoring	Effective method for observing contaminant extent and potential migration, and for assessing effectiveness of remedial action.	Readily implementable; numerous companies available with resources to perform monitoring.	Capital: Low O&M: Low	Retained.

was eliminated because it may not be as effective as the ex-situ version and adequate mixing of treatment reagents and contaminated soils may not be as complete or effective.

The soils and sediment remediation technology types and process options remaining after detailed evaluation include

- No Action
- Institutional Controls
  - Deed restrictions
- Monitoring
- Capping
  - Soil Cover
  - Single Barrier
- Excavation
  - Mechanical Excavation
- Disposal Off site
  - RCRA D landfill
- Disposal On site
  - Consolidation
- Immobilization
  - Solidification and Fixation

All candidate technologies and process options to address contaminated groundwater were retained after the screening phase and include

- No Action
- Natural Attenuation

- Institutional Controls
  - Deed Restrictions

- Monitoring

3.1.2 Sit 4 - Remedial Alternatives Descripti ns

This section presents detailed descriptions of the source control alternatives. The key components of Alternatives 1 through 3 are identified on Table 3-1.

3.1.2.1 Site 4 - Alternative 1: No Action

The no-action alternative is developed as a baseline case, as required by the NCP. The only activities conducted under this alternative are monitoring to evaluate contaminant migration and a review of site conditions and risks every 5 years. The purpose of the alternative is to evaluate the overall human health and environmental protection provided by the site in its present state. Under this alternative, no remedial actions would be taken to protect human health or the environment.

Although extensive investigation of landfill contents has not been conducted, the RI concluded that landfill materials appear to be a continuing source of contaminants to site groundwater and surface water. Under the no-action alternative, no measures would be implemented to prevent potential human or animal exposure to landfill materials or site groundwater or to mitigate contaminant migration to the environment. Key components of Alternative 1 are identified on Table 3-1 and described below.

Existing Features - Currently, site features offer limited protection of human health and the environment. The main protective feature is a sandy soil cover that reduces the potential for human and animal contact with landfill materials. The cover is moderately vegetated with grasses and scrub pines, that serve to reduce infiltration of precipitation into landfill materials and limit surface runoff and erosion. The cover is present over the majority of the landfill; however, erosion of the cover and exposed debris are evident on the eastern side of the landfill. Where present and in good condition, the vegetation may reduce precipitation infiltration and surface runoff, but as indicated by RI sampling results, contaminant migration into groundwater and surface water is not prevented by the cover.

Because no actions would be conducted under Alternative 1 to maintain or cover the landfill, the landfill surface would continue to erode, potentially exposing more contaminated materials, increasing infiltration and attendant contaminant leaching and migration; and allowing surficial materials to be transported through precipitation and wind erosion. Under the no-action alternative, contaminants would continue to migrate.

TABLE 3-1
SITE 4 - REMEDIAL ALTERNATIVES COMPONENTS
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• Annual groundwater, surface water, and sediment monitoring • Five-year reviews
2	Limited Action	• Fencing • Institutional Controls (deed restrictions, CEA*) • Annual groundwater, surface water, and sediment monitoring • Five-year reviews
3	Capping, Institutional Controls, Natural Attenuation, and Long-Term Monitoring	• Pre-design investigations • Site preparation • Site grading • Single barrier cover system • Fencing • Institutional controls (deed restrictions, CEA*) • Natural attenuation of groundwater contaminants • Long-term operation and maintenance • Annual groundwater, surface water, and sediment monitoring • Five-year reviews

Notes:
* Classification Exception Area pursuant to the New Jersey Groundwater Quality Standards (N.J. A.C 7:9-6) would be established for groundwater that does not meet state groundwater quality standards.

Long-Term Monitoring - Under Alternative 1, the groundwater, surface water, and wetland sediment would be sampled annually to monitor the migration of contaminants from the landfill and the potential impacts to downgradient areas. The data collected would be evaluated during the 5-year review period.

For the purpose of costing, it is assumed that groundwater samples will be collected from the six existing monitoring wells and the sample will be analyzed for site-specific contaminants (metals and VOCs). Surface water and sediment would be collected from three locations within the adjacent wetlands. The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Since contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluation of analytical and hydrogeologic data, assessing whether contaminant migration has increased, and determining whether human or ecological receptors or natural resources are at risk.

3.1.2.2 Site 4 - Alternative 2: Limited Action (Institutional Controls, Access Restrictions, and Long-Term Monitoring)

Alternative 2 was developed as an option that relies on access restrictions and institutional controls to limit exposures to hazardous substances. This alternative does not employ treatment or containment to address site contamination.

Restrictions would be attached to the property title and/or the Base Master Plan (access restrictions) to limit future uses of the site that may result in disturbance of the existing soil cover or direct contact with contaminated media. A fence would be erected around the landfill to limit access to the site, to restrict human contact with contaminated landfill materials and to protect the integrity of the existing cover. Long-term, annual monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes would be left in place, site conditions and risks would be reviewed every 5 years. Key components of Alternative 2 are identified on Table 3-1 and described below.

Existing Features - Existing site features offer limited protection of human health and the environment. The main protective feature is a sandy soil cover that reduces the potential for human and animal contact with landfill materials. The cover is moderately vegetated with grasses and scrub pines, which serve to reduce infiltration of precipitation into landfill materials and limit surface runoff and erosion. The cover is

present over the majority of the landfill; however, erosion of the cover and exposed debris are evident on the eastern side of the landfill. Where present and in good condition, the vegetation may reduce precipitation infiltration and surface runoff, but as indicated by RI sampling results, contaminant migration into groundwater and surface water is not prevented by the cover.

Because no actions would be conducted to maintain or further cover the landfill, the landfill surface would continue to erode, potentially exposing more contaminated materials, increasing infiltration and attendant contaminant leaching and migration, and allowing surficial materials to be transported through precipitation and wind erosion. Contaminants will continue to migrate.

Institutional Controls - Under Alternative 2, access restrictions would be enacted to limit future use of the landfill property. Restrictions would be placed on future activities that could result in increased human exposure to contaminated landfill materials or increased erosion and contaminant migration. Restricted activities would include excavation, vehicular traffic (off-road vehicles and dirt bikes), and use of untreated groundwater for drinking water.

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Fencing - The entire landfill area would be fenced to limit human access to contaminated soils and landfill materials. An estimated 1,700 linear feet of 6-foot-high chain-link fence would be required to encircle the landfill area. The fencing would also limit animal intrusion into the landfill area thus reducing exposure of biota to contaminated materials. However, fencing would not restrict access to birds or small, burrowing animals that may be at the greatest risk from exposure to contaminants within the landfill. One gate would provide access to the site. The fencing would need to be inspected and repaired annually.

Long-term Monitoring - Under Alternative 2, the groundwater, surface water, and wetland sediment would be sampled annually to monitor the migration of contaminants from the landfill and the potential impacts to downgradient areas. The collected data would be evaluated during the 5-year review period.

For the purpose of costing, it is assumed that groundwater samples would be collected from the six existing monitoring wells and analyzed for site-specific contaminants (metals and VOCs). Surface water and sediment would be collected from three locations within the adjacent wetlands. The sampling results

would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Since contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluating analytical and hydrogeologic data, assessing whether contaminant migration has increased, and determining whether human or ecological receptors or natural resources are at risk.

3.1.2.3 Site 4 - Alternative 3: Capping, Institutional Controls, Natural Attenuation, and Long-Term Monitoring

Alternative 3 relies on containment and institutional controls to limit exposures to hazardous substances and minimize migration of contaminants to groundwater and surface water. Active treatment is not employed to address site contamination. Over time, the contaminants in groundwater will likely attenuate naturally through biological and chemical degradation (VOCs only), adsorption (metals and VOCs), and precipitation (metals). Contaminant concentrations in groundwater will also decrease as a result of reduced infiltration of precipitation through contaminated landfill materials.

A low-permeability cover system that complies with federal and state regulatory requirements would be used to prevent potential human and animal contact with contaminants in landfill materials, limit contaminant leaching to groundwater, and minimize contaminant migration via surface runoff and erosion. Access restrictions would be enacted to limit future uses of the site that may result in disturbance of the cover or direct contact with contaminated media.

Long-term, annual monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes would be left in place, site conditions and risks would be reviewed every 5 years. Key components of Alternative 3 are identified on Table 3-1 and described below.

Pre-Design Investigations and Activities - Pre-design investigations would be conducted to collect topographic, chemical, and geologic data needed for the cover system design. A topographic survey of the site would be performed to collect accurate elevation and contour data for use in the cover system design. Test pitting, sampling, and chemical analyses would be required to more fully delineate the extent of the landfill materials. Landfill gas sampling may be conducted to confirm that there is no need for a gas vent layer and methane collection system.

A geotechnical evaluation of the landfill may be necessary to evaluate the stability and settling characteristics of the landfill to determine whether actions are required to minimize future differential settling of landfill contents that could damage the cover system. However, settling concerns are likely to be minimal because the landfill has been inactive and subject to waste degradation and settling since the 1960s.

Site Preparation - The site has not been used for many years and is moderately vegetated with grasses and pine trees. Clearing and grubbing of the vegetative growth would be necessary to prepare the site for capping. Silt fences or staked hay bales would be required to minimize erosion effects while the trees and vegetation are being removed. Silt barriers would be placed at the perimeter of the level portions of the landfill and at the toe of the landfill area to prevent silt and soil movement to downslope areas and properties. Site utilities may need to be established prior to the start of remediation.

Site Grading - Grading of the landfill area would be required following removal of site vegetation. Compaction of the soils and landfill materials would be performed as needed. The appropriate slopes for the base of the cover (to facilitate drainage) would be determined as part of the cover system design.

Cover System Placement - A low-permeability cover system would be designed and installed to prevent human and animal exposures to landfill material contaminants, to reduce infiltration and resulting organics and metals leaching into groundwater, and to prevent migration of contaminants by wind and surface runoff. The cover design would conform with the state of New Jersey Municipal Waste Management Regulations (7:26.2A6) and the RCRA Criteria for Municipal Solid Waste Landfills (40 CFR 258).

For the purpose of this focused FS, a single-barrier cover system was selected as the representative capping option. Figure 3-1 presents a plan view of conceptual design of the cover. A cross section of a conceptual cover system is presented on Figure 3-2. Descriptions of the individual cover layers are summarized as follows, from bottom to top:

Subgrade - The base layer of the cover system should be a well-compacted and smooth surface of sufficient thickness to prevent puncture of the barrier layer by landfill materials. The subgrade may be a well-graded sand and gravel. A geotextile material may be used above the subgrade to separate the sand and gravel from the layers above.

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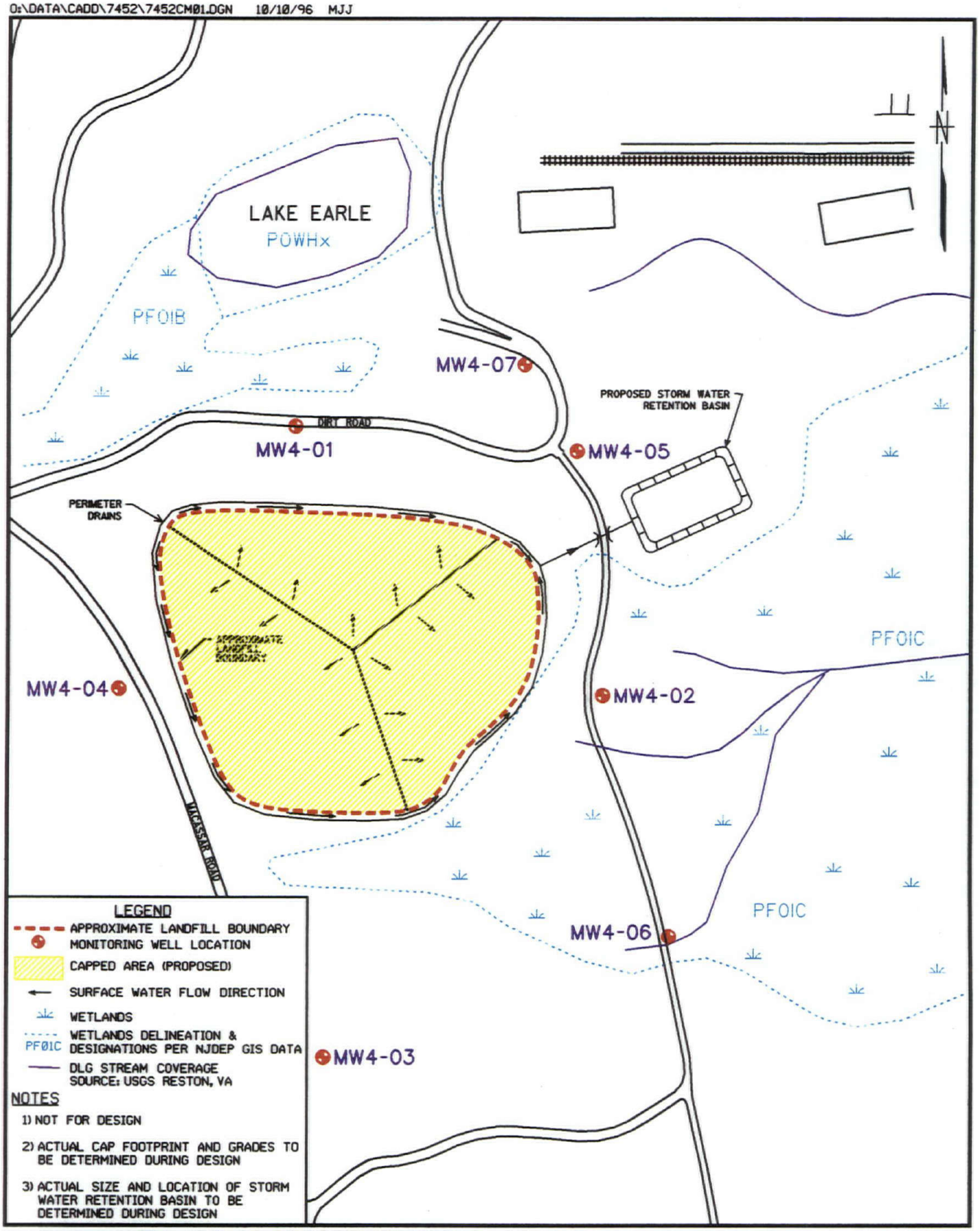


PLAN VIEW OF PROPOSED COVER SYSTEM

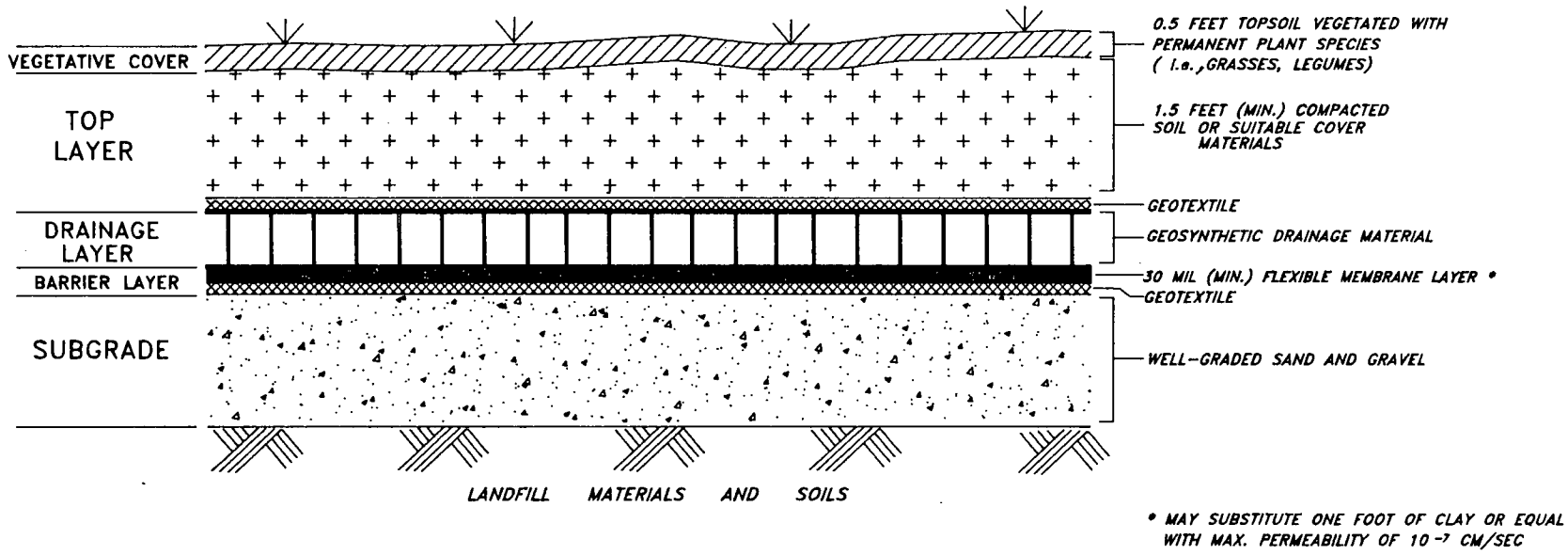
SITE 4 - ALTERNATIVE 3 FS - NWS EARLE

FIGURE 3-1

0 200 400

SCALE IN FEET

Brown & Root Environmental



CROSS-SECTIONAL VIEW

NOTE:

1. NOT TO SCALE.
2. NOT FOR DESIGN.

CONCEPTUAL COVER SYSTEM DESIGN
SITE 4 – ALTERNATIVE 3
FEASIBILITY STUDY REPORT
NWS EARLE, COLTS NECK, NEW JERSEY

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FIGURE 3-2

Gas Vent System - A gas vent system would be installed only if a pre-design investigation concludes that one is necessary. Because the landfill has been out of use and covered with permeable cover materials since the 1960s, the need for a gas venting system is not anticipated.

Barrier Layer - This layer would be designed to minimize precipitation infiltration into the landfill materials. In accordance with applicable regulations and guidance, a barrier with a maximum permeability of 1×10^{-7} cm/s, consisting of a minimum of 1 foot of compacted clay or a geomembrane at least 30 mil thick, would be used.

For this FS, a geomembrane barrier would be selected as the representative barrier layer. Geomembranes can be installed more efficiently than a compacted clay layer and are less sensitive to extreme weather conditions. The geomembrane may be a flexible membrane liner (FML) composed of low-density synthetics for tolerating subsidence-induced strains.

Drainage Layer - A drainage layer would be installed to prevent the accumulation of water above the infiltration layer that could damage the geomembrane or cause erosion of the top layer. The drainage layer would promote the removal of water to areas outside the cover. For the FS, it is assumed that a geosynthetic drainage layer would be used to channel infiltration to toe drains located at the perimeter of the cover system. Precipitation infiltration that reaches this layer would ultimately be discharged to the wetlands west of the site.

Top Layer - The objective of this layer is to protect the cover from erosion by rain or wind and from burrowing animals. A minimum of 2 feet of uniform, compacted soil would be placed over the drainage layer. The top layer would be vegetated with permanent plant species such as grasses and legumes to minimize erosion and soil loss. Trees, woody shrubs, and other deep rooted plants that might penetrate the low-permeability layer would be prevented from growing on the cover.

The final surface slope of cover system in the plateau area should have a slope of between three percent (3V:100H) and 15 percent (15V: 100H) to ensure slope stability, control erosion, and allow compaction, seeding, and revegetation of the cover materials. The final slope would also promote precipitation runoff while inhibiting erosion or infiltration. Surface run-on and runoff controls would be required to channel run-on and runoff, via drainage swales or trenches, to surface drains located on the perimeter of the cover system, for ultimate discharge to the adjacent wetlands.

The final slopes and materials to be used in the cover system would be determined during the engineering design. The capped area is expected to encompass all landfill materials.

If other NWS Earle wastes are to be consolidated at Site 4, consolidation would occur prior to cover placement.

Security Fencing - Security fencing would be installed to deter human and animal entry into the landfill area to protect the integrity of the cover. The fence is expected to be 4 feet high chain-link, with galvanized steel posts installed at 8-foot intervals. A locking gate would be installed.

Institutional Controls - After the construction of the cover, access restrictions would be used to significantly limit the future activities that could result in intrusion into and possible damage of the cover and accidental exposure to the landfill wastes. Restricted activities would include excavation, excessive vehicular traffic (off-road vehicles and dirt bikes), and use of untreated groundwater for drinking water.

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Operation and Maintenance - To ensure the proper functioning and protectiveness of the cover system, routine mowing, maintenance, and repairs of the fencing, runoff and drainage systems, gas vent system, (if needed) and the cover system would be required.

Natural Attenuation - Because Alternative 3 would significantly reduce the migration of contaminants from the landfill into site groundwater, over time, groundwater contamination would naturally attenuate by chemical, physical, and biological (organics only) mechanisms.

Long-term Monitoring - Under Alternative 3, the groundwater, surface water, and wetland sediment would be sampled annually to monitor the migration of contaminants from the landfill and assess the potential impacts to downgradient areas. The collected data would be evaluated during the 5-year review period. The frequency of monitoring and the number of analytical parameters may be decreased if the 5-year review determines that significant contaminant leaching reduction or improvement of groundwater quality has been attained.

For the purpose of costing, it is assumed that groundwater samples will be collected from the six existing monitoring wells and analyzed for site-specific contaminants. Surface water and sediment would be collected from three locations within the adjacent wetlands. The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Because contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluation of analytical and hydrogeologic data, assessing whether contaminant migration has increased and whether human or biological receptors or groundwater resources are at risk.

3.1.3 Site 4 - Alternatives Screening

In this section, alternatives are evaluated generally with regard to effectiveness, implementability, and cost to further determine the most plausible array of remedial alternatives for Site 4. The screening is presented in Table 3-2. Alternative 2 - Limited Action was eliminated because it offered limited additional benefit, when compared to Alternative 1, for the additional cost.

3.2 SITE 5 - DEVELOPMENT AND SCREENING OF ALTERNATIVES

This section presents the rationale for development of remedial action alternatives for Site 5, describes the assembled alternatives, and presents the screening of alternatives. Detailed evaluations and costing of the retained alternatives are presented in Section 4.0

3.2.1 Site 5 - Rationale for Development of Alternatives

Factors considered during formulation of the remedial alternatives to achieve the RAOs for Site 5 are discussed below:

Statutory and Guidance Considerations - Navy/Marine Corps policy (as stated in the Installation Restoration Manual) dictates that the procedures outlined in the National Oil and Hazardous Substances Contingency Plan (NCP, 40 CFR 300.430) be followed for all IR sites. In accordance with this policy, alternatives were developed in compliance with statutory requirements of the NCP and in consideration of applicable EPA directives and guidance, including

TABLE 3-2
SITE 4 - SCREENING OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	EFFECTIVENESS	IMPLEMENTABILITY	COST	COMMENTS
1	No Action: (long term monitoring, five year reviews)	Provides no additional protection of human health or the environment. Does not reduce potential for human exposure to landfill or groundwater contaminants. Does not reduce contaminant migration in the environment. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: none O&M: low	Retained as baseline alternative in accordance with NCP.
2	Limited Action (Institutional controls, access restrictions, long-term monitoring, five-year reviews)	Provides little added protection of human health through fencing and institutional controls. Groundwater use would be restricted. Does not reduce contaminant migration to the environment. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: low O&M: low	Relative to Alt. 1, provides minimal additional protectiveness for additional cost. Eliminated.
3	Capping, Institutional Controls, Natural Attenuation, and Long-Term Monitoring	Protects human health and the environment. Capping contaminated landfill materials prevents direct contact exposure and minimizes contaminant migration to the environment. Groundwater use would be restricted. Groundwater contaminants will naturally attenuate over time. No reduction of toxicity or volume of contaminants.	Readily implementable. No technical or administrative difficulties. Personnel and materials necessary to implement alternative are widely available.	Capital: moderate O&M: moderate	Retained.

- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final), (RI/FS Guidance), OSWER Directive No. 9355.3-01, EPA/540/G-89/004, October 1988.

- Presumptive Remedy for CERCLA Municipal Landfill Sites, OSWER Directive No. 9355.0-49FS, September 1993.

- Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance), OSWER Directive No. 9355.0-62FS, April 1996.

- Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, OSWER Directive No. 9355.3-11, EPA/540/P-91/001, February 1991.

The NCP and the EPA RI/FS guidance present a broad framework for the formulation, evaluation, and selection of remedial alternatives for uncontrolled hazardous waste sites. The NCP encourages development of a range of alternatives, including one or more engineering control alternatives (such as containment), one or more innovative treatment alternatives, and the baseline no-action alternative. Treatment technologies are favored to address principal threats, and engineering controls are favored to address relatively low long-term threats.

In an effort to streamline the RI/FS process dictated by the NCP and RI/FS guidance, EPA has undertaken the presumptive remedies initiative to speed up selection of remedial actions at certain categories of waste sites. Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluations of performance data on technology implementation.

EPA established containment as the presumptive remedy for municipal landfills based on the expectation that containment would generally be appropriate for municipal landfill waste because the volume and heterogeneity of the waste generally make treatment impracticable (OSWER Directive No. 9355.0-49FS). Further, EPA established that the municipal landfill presumptive remedy should also be applied to all appropriate military sites (OSWER Directive No. 9355.0-62FS). Based on the criteria presented in that directive, the Site 5 landfill is an appropriate site for the application of the presumptive remedy for CERCLA municipal landfills. As such, alternatives were developed and screened in accordance with the presumptive remedy directives noted above and the guidance Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal

Landfill Sites. The resulting alternatives development process was streamlined to focus on containment alternatives rather than treatment.

Protection of Human Health Considerations - The RAOs for protection of human health specify preventing human exposure to the contaminated landfill materials and preventing potential exposure to contaminants in site groundwater. Remedial alternatives were formulated to meet these objectives.

Protection of the Environment Considerations - The RAO for protection of the environment specifies minimizing contaminant migration to groundwater. This objective was considered in the formulation of alternatives.

3.2.2 Site 5 - Remedial Alternatives Descriptions

This section presents detailed descriptions of the source control alternatives. The key components of Alternatives 1 through 3 are identified on Table 3-3.

3.2.2.1 Site 5 - Alternative 1: No Action

The no-action alternative is developed as a baseline case, as required by the NCP. The only activities conducted under this alternative are monitoring to evaluate contaminant migration and a review of site conditions and risks every 5 years. The purpose of the alternative is to evaluate the overall human health and environmental protection provided by the Site in its present state. Under this alternative, no remedial actions would be taken to protect human health or the environment.

Although extensive investigation of landfill contents has not been conducted, the RI concluded that landfill materials appear to be a continuing source of contaminants to site groundwater and surface water. Under the no-action alternative, no measures would be implemented to prevent potential human or animal exposure to landfill materials or site groundwater or to mitigate contaminant migration to the environment. Key components of Alternative 1 are identified on Table 3-3 and described below.

Existing Features - Currently, site features offer limited protection of human health and the environment. The primary protective features are the sandy soil cover over the entire landfill that reduces the potential for human and animal contact with landfill materials and the vegetative cover that reduces infiltration of precipitation into landfill materials and limits surface runoff and erosion of the cover. Two different types of vegetative cover are present in discrete areas of the landfill: the western portion of the 13-acre landfill is moderately vegetated with scrub pines and grasses, and the eastern portion of the landfill surface is

TABLE 3-3
SITE 5 - REMEDIAL ALTERNATIVES COMPONENTS
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• Annual groundwater monitoring • Five-year reviews
2	Limited Action	• Institutional Controls (access restrictions, CEA*) • Annual groundwater monitoring • Quarterly inspection of existing cover in skeet/shooting range • Five-year reviews
3	Capping, Institutional Controls, Natural Attenuation, and Long-Term Monitoring	• Pre-design investigations • Site preparation • Site grading • Single barrier cover system • Institutional controls (access restrictions, CEA*) • Natural attenuation of groundwater contaminants • Long-term operation and maintenance • Annual groundwater monitoring • Five-year reviews

Notes:
* Classification Exception Area pursuant to the New Jersey Groundwater Quality Standards (N.J. A.C 7:9-6) would be established for groundwater that does not meet state groundwater quality standards.

sparsely covered with only low weeds and grasses. The grasses and scrub pines on the western side of the landfill are expected to be moderately effective for limiting infiltration, surface runoff, and erosion. The sparse cover on the eastern side of the landfill is likely less effective at controlling infiltration, runoff, and erosion, because the vegetation and cover materials are thin in some areas. As indicated by RI sampling results, the vegetative cover is not completely effective at preventing contaminant migration into groundwater.

Because no actions would be conducted under Alternative 1 to maintain or cover the landfill, the landfill surface could possibly erode in the future, potentially exposing contaminated materials, increasing infiltration and attendant contaminant leaching and migration, and allowing surficial materials to be transported through precipitation and wind erosion. Under the no-action alternative, contaminants would continue to migrate.

Long-Term Monitoring - Under Alternative 1, the groundwater would be sampled annually to monitor the migration of contaminants from the landfill and the potential impacts to downgradient areas. The collected data would be evaluated during the 5-year review period.

For the purpose of costing, it is assumed that groundwater samples would be collected from the eight existing monitoring wells and analyzed for site-specific contaminants (metals and VOCs). The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Since contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluation of analytical and hydrogeologic data, assessing whether contaminant migration has increased, and determining whether human or ecological receptors or natural resources are at risk.

3.2.2.2 Site 5 - Alternative 2: Limited Action (Institutional Controls, Access Restrictions, and Long-Term Monitoring)

Alternative 2 was developed as an option that relies on access restrictions and institutional controls to limit exposures to hazardous substances. This alternative does not employ treatment or containment to address site contamination.

Access restrictions would be attached to the property title and/or the Base Master Planto limit future uses of the site that may result in disturbance of the existing soil cover or direct contact with contaminated

media. A fence would be erected around the landfill to limit access to the site, to restrict human contact with contaminated landfill materials and to protect the integrity of the existing cover. Because the current and intended future use of the eastern portion of the landfill is as a skeet and shooting range, access to the site would be limited to authorized persons but would not be prohibited.

Long-term, annual monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes would be left in place, site conditions and risks would be reviewed every 5 years. Key components of Alternative 2 are identified on Table 3-3 and described below.

Existing Features - Existing site features offer limited protection of human health and the environment. The primary protective features are the sandy soil cover over the entire landfill that reduces the potential for human and animal contact with landfill materials and the vegetative cover that reduces infiltration of precipitation into landfill materials and limits surface runoff and erosion of the cover. Two different types of vegetative cover are present in discrete areas of the landfill: the western portion of the 13-acre landfill is moderately vegetated with scrub pines and grasses, and the eastern portion of the landfill is sparsely covered with only low weeds and grasses. The grasses and scrub pines on the western side of the landfill are expected to be moderately effective for limiting infiltration, surface runoff, and erosion. The sparse cover on the eastern side of the landfill is probably less effective at these functions because the vegetation and cover materials are thin in some areas. As indicated by RI sampling results, the vegetative cover is not completely effective at preventing contaminant migration into groundwater.

Because no actions would be conducted under Alternative 2 to maintain or further cover the landfill, the landfill surface could possibly erode in the future, potentially exposing contaminated materials, increasing infiltration and attendant contaminant leaching and migration, and allowing surficial materials to be transported through precipitation and wind erosion. Contaminants would continue to migrate.

Institutional Controls - Under Alternative 2, access restrictions would be enacted to restrict future use of the landfill property. Restrictions would be placed on future activities that could result in human exposure to contaminated landfill materials or erosion and subsequent contaminant migration. Restricted activities would include excavation, vehicular traffic (off-road vehicles and dirt bikes), and use of untreated groundwater for drinking water.

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice

that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Fencing - The entire landfill area would be fenced to limit human access to contaminated soils and landfill materials. An estimated 1,800 linear feet of 6-foot-high chain-link fence would be required to encircle the landfill area. The fencing would also limit animal intrusion into the landfill area, thus reducing exposure of biota to contaminated materials. However, fencing would not restrict access to birds or small, burrowing animals that may be at the greatest risk from exposure to contaminants within the landfill. One gate would provide access to the site. The fencing would need to be inspected and repaired annually.

Long-Term Monitoring - Under Alternative 2, groundwater would be sampled annually to monitor the migration of contaminants from the landfill and the potential impacts to downgradient areas. For the purpose of costing, it is assumed that groundwater samples would be collected from six of the existing monitoring wells and analyzed for site-specific contaminants (metals and VOCs). The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted. The collected data would be evaluated during the 5-year review period.

Because the current and intended future use of the eastern portion of the landfill is as a skeet shooting range, Alternative 2 would include quarterly inspection of the existing soil cover in this area to assess its integrity and evaluate whether recreational use of the site should continue.

Five-Year Reviews - Since contaminants remain on the Site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluating analytical and hydrogeologic data, assessing whether contaminant migration has increased, and determining whether human or ecological receptors or natural resources are at risk.

3.2.2.3 Site 5 - Alternative 3: Capping, Institutional Controls, Natural Attenuation, and Long-Term Monitoring

Alternative 3 relies on containment and institutional controls to limit exposures to hazardous substances and minimize migration of contaminants to groundwater. Active treatment would not be employed to address site contamination. Over time, the contaminants in groundwater would likely attenuate naturally through biological and chemical degradation (VOCs only), adsorption (metals and VOCs), and

precipitation (metals only). Contaminant concentrations in groundwater would also decrease as a result of reduced infiltration of precipitation through contaminated landfill materials.

A low-permeability cover system that complies with federal and state regulatory requirements would be constructed over the eastern, open portion of the landfill to prevent potential human and animal contact with contaminant materials, limit contaminant leaching to groundwater, and minimize contaminant migration via surface runoff and erosion. Access restrictions would be enacted to limit future uses of the site that may result in disturbance of the soil cover or direct contact with contaminated media. The cover in the western, wooded portion of the landfill is deemed adequate, and this area would not be covered further.

Long-term, annual monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes would be left in place, site conditions and risks would be reviewed every 5 years. Key components of Alternative 3 are identified on Table 3-3 and described below.

Pre-Design Investigations and Activities - Pre-design investigations would be conducted to collect topographic, chemical, and geologic data needed for the enhanced cover system design. A topographic survey of the site would be performed to collect accurate elevation and contour data for use in the enhanced cover system design. Test pitting, sampling, and chemical analyses would be required to more fully delineate the extent of the landfill materials. Landfill gas sampling may be conducted to confirm that there is no need for a gas vent layer and methane collection system.

A geotechnical evaluation of the landfill may be necessary to evaluate the stability and settling characteristics of the landfill to determine whether actions are required to minimize future differential settling of landfill contents that could damage the cover system. However, settling concerns are likely to be minimal because the landfill has been inactive and subject to waste degradation and settling since 1978.

Site Preparation - Clearing and grubbing of the vegetative growth would be necessary to prepare the portion of the site to be further capped. Silt fences or staked hay bales would be required to minimize erosion effects while the trees and vegetation are being removed. Silt barriers would be placed at the perimeter of the level portions of the landfill and at the toe of the landfill area to prevent silt and soil movement to downslope areas and properties. Site utilities may need to be established prior to the start of site remediation.

Site Grading - Grading of the landfill area to be further capped would be required following removal of site vegetation and consolidation of materials removed from the wooded portion of the landfill. Compaction of the soils and landfill materials would be performed as needed. The appropriate slopes for the base of the cover (to facilitate drainage) would be determined as part of the cover system design.

Cover System Placement - A low-permeability cover system would be designed and installed over the eastern, open portion of the landfill to prevent human and animal exposures to landfill material contaminants, to reduce infiltration and resulting organics and metals leaching into groundwater, and to prevent migration of contaminants by wind and surface runoff. The cover design would conform with the Municipal Waste Management Regulations (7:26.2A6) and the RCRA Criteria for Municipal Solid Waste Landfills (40 CFR 258).

For the purpose of this focused FS, a single-barrier cover system was selected as the representative capping option. The cover system would be installed over the eastern portion of the Site 5 landfill. The western, wooded portion of the landfill would remain uncapped. Figure 3-3 presents a plan view of conceptual design of the cover. A cross section of a conceptual cover system is presented on Figure 3-4. Descriptions of the individual cover layers are summarized as follows, from bottom to top:

Subgrade - The base layer of the cover system should be a well-compacted and smooth surface of sufficient thickness to prevent puncture of the barrier layer by landfill materials. The subgrade may be a well-graded sand and gravel. A geotextile material may be used above the subgrade to separate the sand and gravel from the layers above.

Gas Vent System - A gas vent system would be installed only if a pre-design investigation concludes that one is necessary. Because the landfill has been out of use and covered with permeable cover materials since the 1970s, the need for a gas venting system is not anticipated.

Barrier Layer - This layer would be designed to minimize precipitation infiltration into the landfill materials. In accordance with applicable regulations and guidance, a barrier with a maximum permeability of 1×10^{-7} cm/s, consisting of a minimum of 1 foot of compacted clay or a geomembrane at least 30 mil thick, would be used.

For this FS, a geomembrane barrier will be selected as the representative barrier layer. Geomembranes can be installed more efficiently than a compacted clay layer and are less

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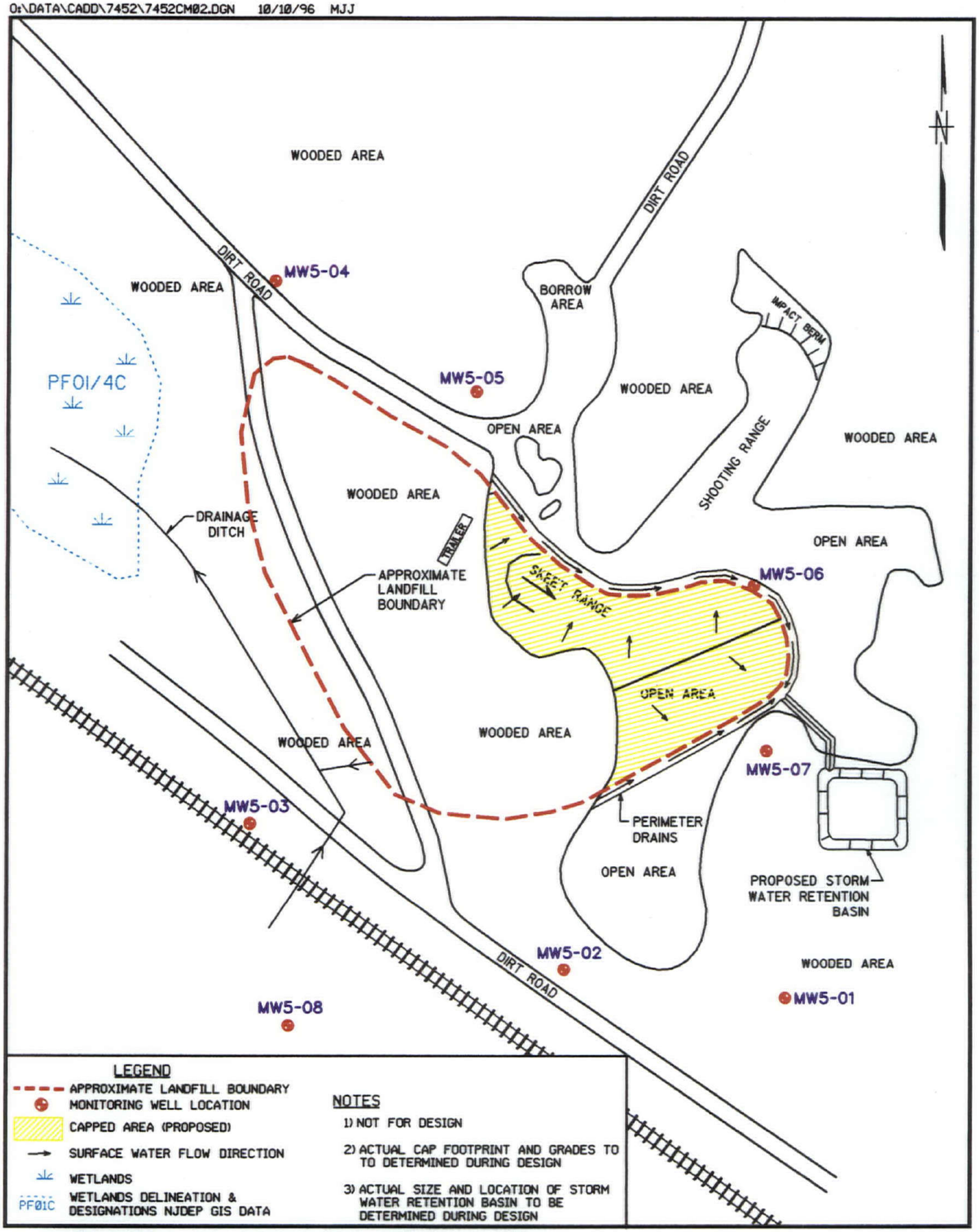

PLAN VIEW OF PROPOSED COVER SYSTEM

SITE 5 - ALTERNATIVE 3 FS - NWS EARLE

FIGURE 3-3

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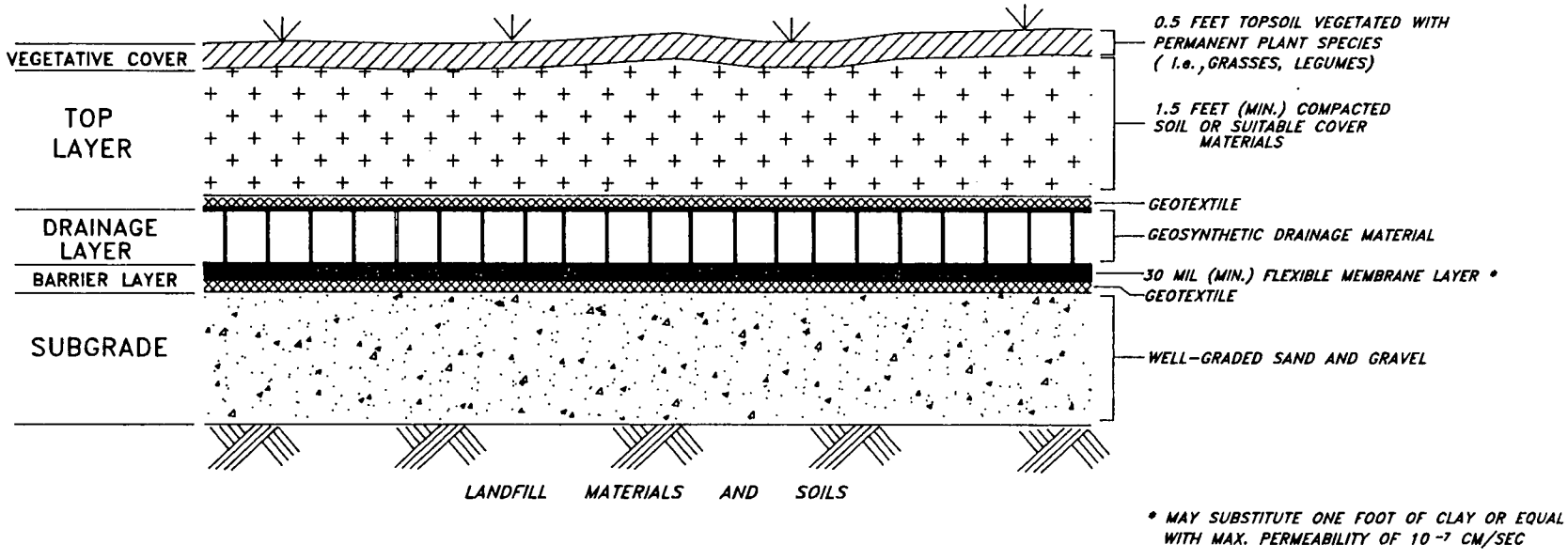

CROSS-SECTIONAL VIEW

NOTE:

1. NOT TO SCALE.
2. NOT FOR DESIGN.

CONCEPTUAL COVER SYSTEM DESIGN
SITE 5 – ALTERNATIVE 3
FEASIBILITY STUDY REPORT
NWS EARLE, COLTS NECK, NEW JERSEY

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FIGURE 3-4

sensitive to extreme weather conditions. The geomembrane may be a flexible membrane liner (FML) composed of low-density synthetics for tolerating subsidence-induced strains.

Drainage Layer - A drainage layer would be installed to prevent the accumulation of water above the infiltration layer that could damage the geomembrane or cause erosion of the top layer. The drainage layer would promote the removal of water to areas outside the cover. For the focused FS, it is assumed that a geosynthetic drainage layer would be used to channel infiltration to toe drains located at the perimeter of the cover system. Precipitation infiltration that reaches the drainage layer would ultimately be discharged via drains to the wetlands east of the site.

Top Layer - The objective of this layer is to protect the cover from erosion by rain or wind and from burrowing animals. A minimum of 2 feet of uniform, compacted soil would be placed over the drainage layer. The top layer would be vegetated with permanent plant species such as grasses and legumes to minimize erosion and soil loss. Trees, woody shrubs, and other deep rooted plants that might penetrate the low-permeability layer would be prevented from growing on the cover.

The final surface slope of cover system in the plateau area should have a slope of between 3 percent (3V:100H) and 15 percent (15V: 100H) to ensure slope stability, control erosion, and allow compaction, seeding, and revegetation of the cover materials. The final slope would also promote precipitation runoff while inhibiting erosion or infiltration. Surface run-on and runoff controls would be required to channel run-on and runoff, via drainage swales or trenches, to surface drains located on the perimeter of the cover system, for ultimate discharge to the adjacent wetlands.

The final slopes and materials to be used in the cover system would be determined during the remedial design.

If wastes are to be consolidated at Site 5, consolidation would occur prior to cover placement.

Institutional Controls - After construction of the enhanced cover, access restrictions would be used to limit the future activities that could result in intrusion into and possible damage of the cover and accidental exposure to the landfill wastes. Restricted activities would include excavation, excessive vehicular traffic (off-road vehicles and dirt bikes), and use of untreated groundwater for drinking water.

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Operation and Maintenance - To ensure the proper functioning and protectiveness of the cover system, routine mowing, maintenance, and repairs of the fencing, runoff and drainage systems, gas vent system, and the cover system will be required.

Natural Attenuation - Because Alternative 3 would reduce the migration of contaminants from the landfill into site groundwater, over time groundwater contamination will naturally attenuate by chemical, physical, and biological (organics only) mechanisms.

Long-term Monitoring - Under Alternative 3, the groundwater would be sampled annually to monitor the migration of contaminants from the landfill and assess the potential impacts to downgradient areas. The collected data would be evaluated during the 5-year review period. The frequency of monitoring and the number of analytical parameters would be decreased if the 5-year review determines that significant contaminant leaching reduction or improvement of groundwater quality has been attained.

For the purpose of costing, it is assumed that groundwater samples would be collected from six of the existing monitoring wells and analyzed for site-specific contaminants. The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Because contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluation of analytical and hydrogeologic data, assessing whether contaminant migration has increased, and whether human or biological receptors or groundwater resources are at risk.

3.2.3 Site 5 - Alternatives Screening

In this section, alternatives are evaluated generally with regard to effectiveness, implementability, and cost to determine the most plausible array of remedial alternatives for Site 5. The screening is presented in Table 3-4. Alternative 2 - Limited Action was eliminated because it offered limited additional benefit, when compared to Alternative 1, for the additional cost.

TABLE 3-4
SITE 5 - SCREENING OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	EFFECTIVENESS	IMPLEMENTABILITY	COST	COMMENTS
1	No Action: (long term monitoring, five year reviews)	Provides no additional protection of human health or the environment. Does not reduce potential for human exposure to contaminants in the landfill or groundwater. Does not reduce contaminant migration in the environment. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: none O&M: low	Retained as baseline alternative in accordance with NCP.
2	Limited Action (Institutional controls, access restrictions, long-term monitoring, five-year reviews)	Provides little added protection of human health through fencing and institutional controls. Groundwater use would be restricted. Does not reduce contaminant migration to the environment. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: low O&M: low	Relative to Alt. 1, provides minimal additional protectiveness for additional cost. Eliminated.
3	Capping, Institutional Controls, Natural Attenuation, and Long-Term Monitoring	Protects human health and the environment . Capping contaminated landfill materials beneath the skeet and shooting range reduces potential for direct contact exposure and reduces contaminant migration to the environment. Groundwater use would be restricted. Groundwater contaminants will naturally attenuate over time. No reduction of toxicity or volume of contaminants.	Readily implementable. No technical or administrative difficulties. Personnel and materials necessary to implement this alternative are widely available.	Capital: moderate O&M: moderate	Retained.

3.3.2 Site 19 - Remedial Alternatives Descriptions

This section presents detailed descriptions of the source control alternatives. The key components of Alternatives 1 through 5 are identified on Table 3-5.

3.3.2.1 Site 19 - Alternative 1: No Action

The no-action alternative is developed as a baseline case, as required by the NCP. The only activities conducted under this alternative are monitoring to evaluate contaminant migration and a review of site conditions and risks every 5 years.

The purpose of the alternative is to evaluate the overall human health and environmental protection provided by the Site in its present state. Under this alternative, no remedial actions would be taken to protect human health or the environment. No measures would be implemented to prevent potential human exposure to site groundwater or mitigate contaminant migration to the environment. Key components of Alternative 1 are identified on Table 3-5 and described below.

Existing Features - Currently, site features offer limited protection of human health and the environment. Much of the site is currently covered with gravel or pavement; however, the contaminant source area (the topographic depression where paint chips and sludge were disposed) is not covered, allowing infiltration and leaching of contaminants from soils into groundwater. Additionally, the overflow pipe that connects the topographic depression with the drainage ditch is intact; under extreme storm conditions, the pipe may allow surface water flow from the topographic depression to discharge to the wetlands.

Because no actions would be conducted under Alternative 1 to remove or cover contaminated soils in the topographic depression or the drainage ditch, migration of contaminants to groundwater and surface water would continue and ecological receptors could be adversely affected by site contaminants.

Long-term Monitoring - Under Alternative 1, groundwater, surface water, and sediments would be sampled annually to monitor the migration of contaminants from Site 19 and the potential impacts to the adjacent wetlands. The collected data would be evaluated during the 5-year review period.

For the purpose of costing, it is assumed that groundwater samples would be collected from the six existing monitoring wells, and surface water and sediment would be collected from three locations within the adjacent wetlands. All samples would be analyzed for site-specific contaminants (metals and

organics). The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Since contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluation of analytical and hydrogeologic data, assessing whether contaminant migration has increased, and determining whether human or biological receptors or natural resources are at risk.

3.3.2.2 Site 19 - Alternative 2: Limited Action (Institutional Controls, Access Restrictions, and Long-Term Monitoring)

Alternative 2 was developed as an option that relies on access restrictions and institutional controls to limit exposures to hazardous substances. This alternative does not employ treatment or containment to address site contamination.

Access restrictions would be attached to the property title and/or the Base Master Plan to limit future uses of the site that may result in increased migration of contaminants or direct contact with contaminated media. A fence would be erected around the contaminant source area soils to prevent access and intrusive activities that could result in further contaminant migration to groundwater and the adjacent wetlands. Long-term, annual monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes are left in place, site conditions and risks would be reviewed every five years. Key components of Alternative 2 are identified on Table 3-5 and described below.

Existing Features - Currently, site features offer limited protection of human health and the environment. Much of the site is currently covered with gravel or pavement; however, the contaminant source area (the topographic depression where paint chips and sludge were disposed) is not covered, allowing infiltration and leaching of contaminants from soils into groundwater. Additionally, the overflow pipe that connects the topographic depression with the drainage ditch is intact; under extreme storm conditions, the pipe may allow surface water flow from the topographic depression to discharge to the wetlands.

Because no actions would be conducted under Alternative 2 to remove or cover contaminated soils in the topographic depression or the drainage ditch, migration of contaminants to groundwater and surface water would continue unabated and ecological receptors may be adversely affected by site contaminants.

TABLE 3-5
SITE 19 - REMEDIAL ALTERNATIVES COMPONENTS
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	KEY COMPONENTS OF ALTERNATIVE
1	No Action	• Annual groundwater, surface water, and sediment monitoring • Five-year reviews
2	Limited Action	• Fencing • Institutional Controls (access restrictions, CEA*) • Annual groundwater, surface water, and sediment monitoring • Five-year reviews
3	Soils Consolidation, Capping, Natural Attenuation, and Long-Term Monitoring	• Pre-design investigations • Site preparation • Excavation of drainage ditch soils/consolidation in the topographic depression • Single barrier cover system • Institutional controls (access restrictions, CEA*) • Natural attenuation of groundwater contaminants • Long-term operation and maintenance • Annual groundwater monitoring • Five-year reviews
4	Excavation, On-Site Solidification, On-Site Disposal, Natural Attenuation, and Long-Term Monitoring	• Site preparation • Excavation/consolidation • On-site solidification • On-site disposal • Institutional controls (access restrictions, CEA*) • Natural attenuation of groundwater contaminants • Annual groundwater monitoring • Five-year reviews
5	Excavation and Disposal	• Excavation • A. Off-Base Disposal (RCRA landfill) • B. On-Base Disposal (Site 4 or 5 landfill) • Institutional controls (access restrictions, CEA*) • Natural attenuation of groundwater contaminants • Annual groundwater monitoring • Five-year reviews

Notes:
* Classification Exception Area pursuant to the New Jersey Groundwater Quality Standards (N.J. A.C 7:9-6) would be established for groundwater that does not meet state groundwater quality standards.

Institutional Controls - Under Alternative 2, access restrictions would be enacted to restrict the future use of the site. Restrictions would be placed on future activities such as excavation that could result in increased human exposure to contaminated subsurface materials or increased erosion and subsequent contaminant migration. Future use of untreated site groundwater for drinking water would be prohibited to prevent ingestion, inhalation, and dermal exposure to site contaminants.

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Fencing - The topographic depression would be fenced to limit human access to source area contaminants. An estimated 190 linear feet of 6-foot-high, chain-link fence would be required to encircle the area; one gate would be provided to allow authorized access to the area. The fencing would be inspected and repaired annually.

Long-term Monitoring - Under Alternative 2, groundwater, surface water, and sediments would be sampled annually to monitor the migration of contaminants from the site and the potential impacts to the adjacent wetlands. The data collected would be evaluated during the 5-year review period.

For the purpose of costing, it is assumed that groundwater samples would be collected from the six existing monitoring wells, and surface water and sediment would be collected from three locations within the adjacent wetlands. All samples would be analyzed for site-specific contaminants (metals and organics). The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Since contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluating analytical and hydrogeologic data, assessing whether contaminant migration has increased, and determining whether human or biological receptors or natural resources are at risk.

3.3.2.3 Site 19 - Alternative 3: Soils Consolidation, Capping, Natural Attenuation, and Long-Term Monitoring

Alternative 3 relies on containment and institutional controls to limit exposure to hazardous substances and minimize migration of contaminants to groundwater and the adjacent wetlands. Active treatment is not employed to address site contamination. Contaminants in site groundwater would naturally attenuate over time through dispersion as leaching of contaminants from source soils is reduced.

Contaminated sediments from the drainage ditch would be excavated and consolidated into the topographic depression and the depression would be capped to prevent erosion and minimize migration of contaminants. Access restrictions would be attached to the property title to limit future uses of the site that may result in damage to the cover and increased migration of contaminants. Access restrictions would also prohibit the use of untreated groundwater for drinking water.

Long-term, annual monitoring would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes would be left in place, site conditions and risks would be reviewed every 5 years. Key components of Alternative 3 are identified on Table 3-5 and described below.

Pre-Design Investigations and Activities - Pre-design investigations would be conducted to collect topographic and chemical data needed for the remedial design. A topographic survey of the site would be performed to collect accurate elevation, location, and contour data for use in the cover system design. Soil and sediment sampling and analyses may be necessary to more fully delineate the extent of contaminated materials requiring consolidation under the cap.

Site Preparation - Demolition and removal of the barricade and limited removal of the existing pavement cover would be required to prepare the topographic depression area for capping. The below-ground overflow pipe that connects the topographic depression to the drainage ditch would be permanently sealed at both ends to prevent contaminant migration through the pipe. Site utilities may need to be established prior to the start of site remediation.

Excavation/Consolidation - Contaminated soil and sediment from the drainage ditch would be excavated and placed into the topographic depression. Excavation/consolidation would remove a source of wetland contaminants, minimize ecological exposure to contaminated soils, and facilitate containment of drainage ditch sediment.

Cover System Placement - Following consolidation of contaminated sediments from the drainage ditch, a low-permeability cover system would be installed over the topographic depression area to prevent direct contact with contaminated soils, minimize infiltration and contaminant leaching into groundwater, and prevent surface migration of contaminants into the adjacent wetlands. The cover design would conform with the State of New Jersey Municipal Waste Management Regulations (7:26.2A6) and the RCRA Criteria for Municipal Solid Waste Landfills (40 CFR 258).

For the purpose of this focused FS, a single-barrier cover system was selected as the representative capping option. Figure 3-5 presents a plan view of conceptual design of the cover. A cross section of a conceptual cover system is presented on Figure 3-6. Descriptions of the individual cover layers are summarized as follows from bottom to top:

Subgrade - The base layer of the cover system should be a well-compacted and smooth surface of sufficient thickness to prevent puncture of the barrier. The subgrade may be a well-graded sand and gravel.

Barrier Layer - This layer would be designed to minimize precipitation infiltration into the consolidated sediments. In accordance with applicable regulations and guidance, a barrier with a maximum permeability of 1×10^{-7} cm/s, consisting of a minimum of 1 foot of compacted clay or a geomembrane at least 30 mil thick, would be used.

For this FS, a geomembrane barrier will be selected as the representative barrier layer. Geomembranes can be installed more efficiently than a compacted clay layer and are less sensitive to extreme weather conditions. The geomembrane may be a flexible membrane liner (FML) composed of low-density synthetics for tolerating subsidence-induced strains.

Drainage Layer - A drainage layer would be installed to prevent the accumulation of water above the infiltration layer that could damage the geomembrane or cause erosion of the top layer. The drainage layer would promote the removal of water to areas outside the cover. For the focused FS, it is assumed that a geosynthetic drainage layer would be used to channel infiltration to toe drains located at the perimeter of the cover system. Precipitation infiltration that reaches this layer would ultimately be discharged to the wetlands west of the site.

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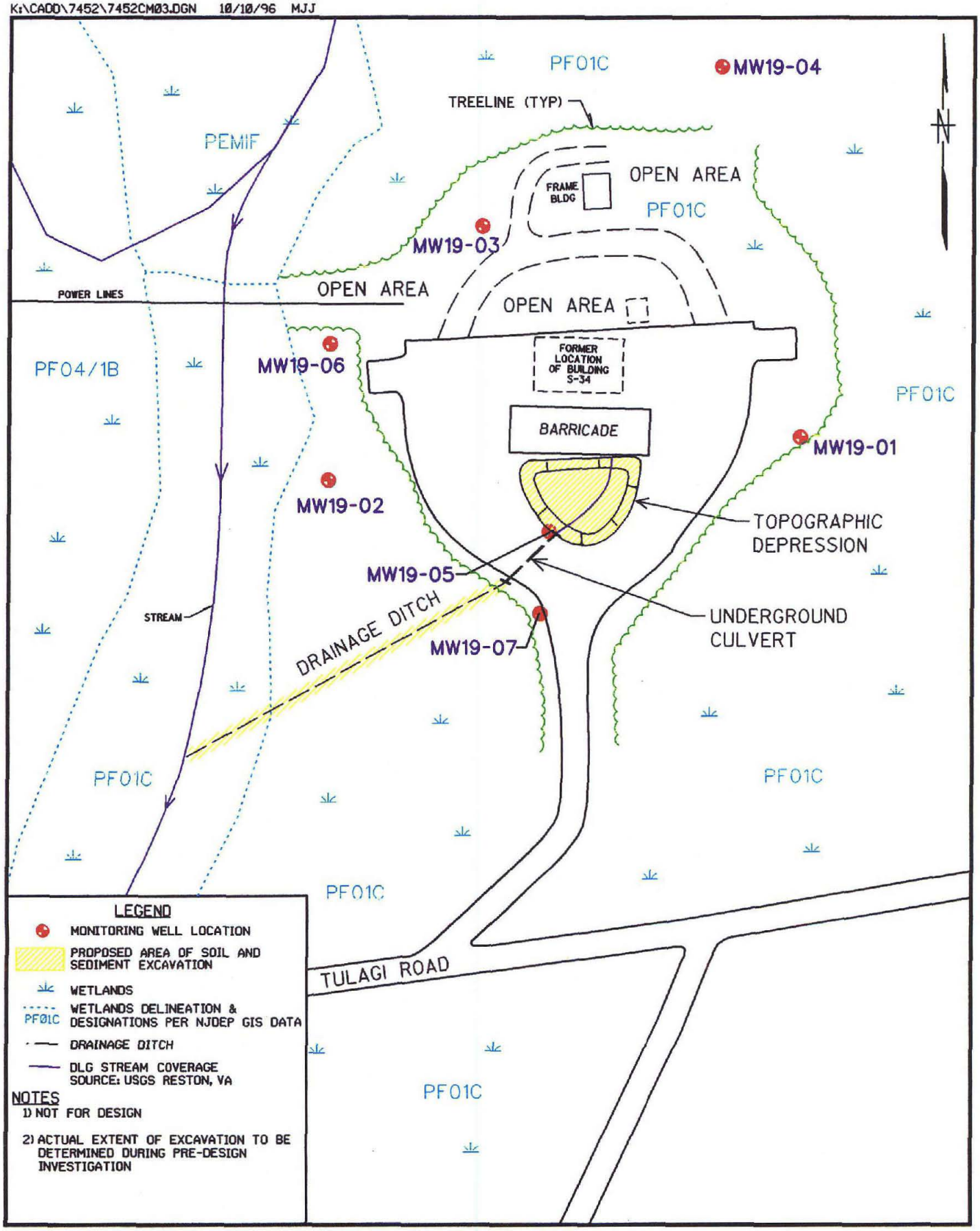


PROPOSED AERIAL EXTENT OF EXCAVATION

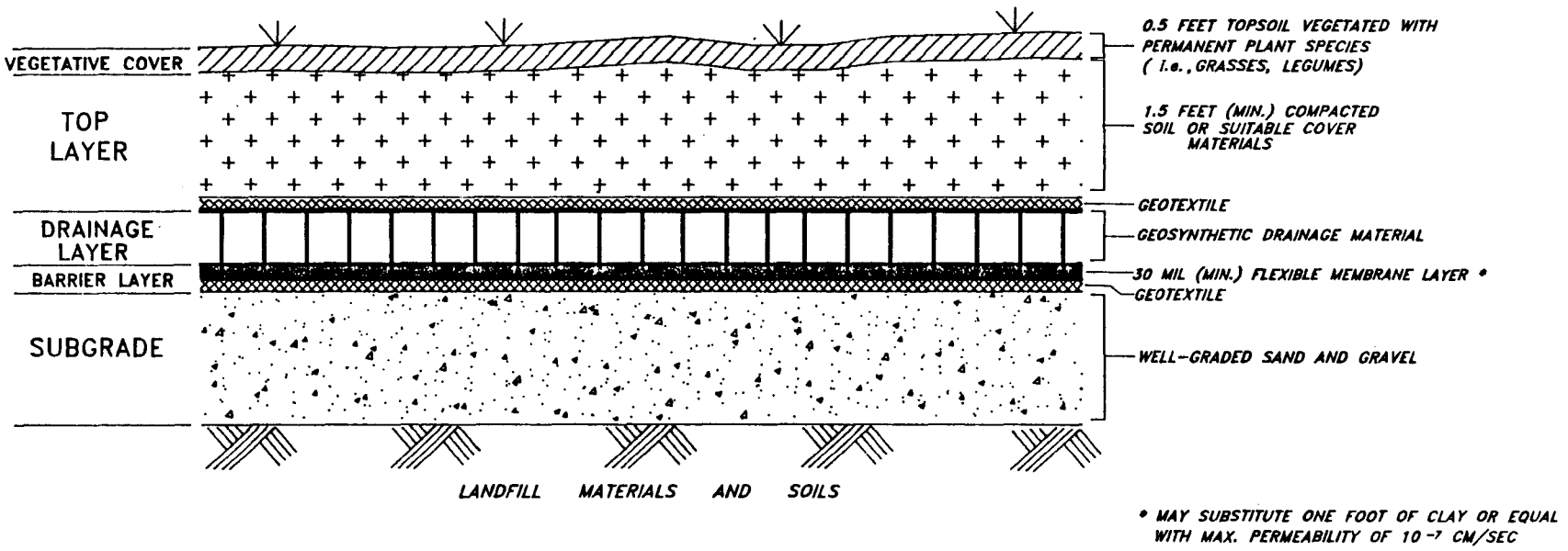
SITE 19 - ALTERNATIVES 4 & 5 FS - NWS EARLE

FIGURE 3-5

0 100 200

SCALE IN FEET

Brown & Root Environmental



CROSS-SECTIONAL VIEW

NOTE:

1. NOT TO SCALE.
2. NOT FOR DESIGN.

CONCEPTUAL COVER SYSTEM DESIGN
SITE 19
FEASIBILITY STUDY REPORT
NWS EARLE, COLTS NECK, NEW JERSEY

Brown & Root Environmental
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FIGURE 3-6

Top Layer - The objective of this layer is to protect the cover from erosion by rain or wind and from burrowing animals. A minimum of 2 feet of uniform, compacted soil, covered with pavement or a vegetative cover, would be placed over the drainage layer.

The final surface slope of cover system in the plateau area should have a slope of between 3 percent (3V:100H) and 15 percent (15V: 100H) to ensure slope stability and control erosion. The final slope would also promote precipitation runoff while inhibiting erosion or infiltration. The final slopes and materials to be used in the cover system would be determined during the remedial design.

Institutional Controls - After the cover has been constructed, access restrictions would be used to limit the future activities that could result in intrusion into and possible damage of the cover and accidental exposure to the contaminated soil and sediment. Restricted activities would include excavation and use of untreated groundwater for drinking water

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards would not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Operation and Maintenance - To ensure the proper functioning and protectiveness of the cover system, routine maintenance of the cover system would be required.

Natural Attenuation - Because Alternative 3 would reduce the migration of contaminants from soils and sediments into site groundwater over time, groundwater contamination would naturally attenuate by chemical, physical, and biological (organics only) mechanisms.

Long-term Monitoring - Under Alternative 3, the groundwater would be sampled annually to monitor the migration of contaminants from the site and assess the potential impacts to downgradient areas. The collected data collected would be evaluated during the 5-year review period. The frequency of monitoring and the number of analytical parameters may be decreased if the 5-year review determines that significant contaminant leaching reduction or improvement of groundwater quality has been attained.

For the purpose of costing, it is assumed that groundwater samples would be collected from the six existing monitoring wells and analyzed for site-specific contaminants. The sampling results would be

evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Because contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluation of analytical and hydrogeologic data, assessing whether contaminant migration has increased and whether human or biological receptors or groundwater resources are at risk.

3.3.2.4 Site 19 Alternative 4 - Excavation, On-Site Solidification, On-Site Disposal, Natural Attenuation, and Long-Term Monitoring

Alternative 4 employs soil treatment to limit exposure to hazardous substances and minimize migration of contaminants to groundwater and the adjacent wetlands. Contaminants in site groundwater would naturally attenuate over time through dispersion after leaching of contaminants from site soils and sediments is abated.

Under this alternative, the contaminated sediments and soils from the drainage ditch and the topographic depression would be excavated and solidified using cement or cement-asphalt mixtures. Treated soils would be placed in the topographic depression and the depression would be closed with an asphalt cover, forming a contained, treated-soil cell. Access restrictions would be enacted to limit future uses of the site that may result in intrusion into the treated-soil cell. Access restrictions would also prohibit the use of untreated groundwater for drinking water.

Long-term, annual monitoring of groundwater would be conducted to assess contaminant status and potential threats to human health and the environment. Since wastes would be left on site, site conditions and risks would be reviewed every five years. Key components of Alternative 4 are identified on Table 3-5 and described below.

Site Preparation - Demolition and removal of the barricade and limited removal of the existing pavement cover would be required to access the contaminated soils in the topographic depression and prepare the area for treated waste placement/capping. The below-ground overflow pipe that connects the topographic depression to the drainage ditch would be permanently sealed at both ends to prevent contaminant migration through the pipe. Site utilities may need to be established prior to the start of site remediation.

Excavation/Consolidation - Contaminated soil and sediment from the topographic depression and the drainage ditch would be excavated and transported to a temporary staging area for the on-site solidification facility.

On-Site Solidification - Excavated soils would be treated by solidification to immobilize metals in a stable cement matrix. Treatment would be conducted on site using a modular, transportable treatment unit. Treated soils would be cured prior to being redeposited on site in the topographic depression. Treatability studies would be required to determine the optimum reagent mixture and treatment conditions to minimize metals leaching and to ensure long-term stability of the treated matrix.

On-Site Disposal - Treated, cured soils would be redeposited on site in the topographic depression. The depression would then be backfilled with clean subgrade materials to the level of the surrounding pavement. The cell would be covered with a layer of pavement to minimize leaching and disturbance of the treated soils.

Institutional Controls - Access restrictions would be enacted to restrict the future use of the site that could result in disturbance of the treated soils. Future use of untreated site groundwater for drinking water would be prohibited to prevent ingestion, inhalation, and dermal exposure to site contaminants.

Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Natural Attenuation - Because Alternative 4 will reduce contaminant mobility in site soils and sediments and reduce further contaminant migration into site groundwater, over time groundwater contamination would naturally attenuate by chemical, physical, and biological (organics only) mechanisms.

Long-term Monitoring - Under Alternative 4, the groundwater would be sampled annually to monitor the migration of contaminants from the site and assess the potential impacts to downgradient areas. The collected data would be evaluated during the 5-year review period. The frequency of monitoring and the number of analytical parameters may be decreased if the 5-year review determines that significant contaminant leaching reduction or improvement of groundwater quality has been attained.

For the purpose of costing, it is assumed that groundwater samples would be collected from the six existing monitoring wells and analyzed for site-specific contaminants. The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Because contaminants remain on the site, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluation of analytical and hydrogeologic data, assessing whether contaminant migration has increased and whether human or ecological receptors or groundwater resources are at risk.

3.3.2.5 Site 19 - Alternative 5: Excavation and Disposal

This alternative would constitute a clean closure of this site. All contaminated soils and sediments in excess of selected clean-up goals would be excavated and sent off of Site 19 for disposal. Site 19 soils would no longer pose threats to groundwater or the adjacent wetlands. Once the source of contamination is removed, contaminants in site groundwater would naturally attenuate over time through dispersion.

Long-term monitoring of groundwater and the 5-year review of site conditions would be necessary to verify the natural attention of the groundwater. Key components of Alternative 5 are identified on Table 3-5 and described below.

Excavation - Contaminated soil and sediment from the topographic depression and the drainage ditch would be excavated using common construction equipment, such as bulldozers or loaders. If necessary, soils would be dewatered by natural drainage within the overall excavation area. The below-ground overflow pipe that connects the topographic depression to the drainage ditch would be removed to prevent contaminant migration through the pipe.

Off-Site Disposal - Two off-site disposal options are under consideration:

A. Off-Base Disposal: Under this option, excavated soils would be transported off base to an appropriate hazardous or industrial-waste-type landfill. TCLP testing of soils would be necessary to determine the appropriate disposal facility. If necessary, off-site treatment of the soils would be conducted to immobilize metals prior to disposal.

B. Disposal in On-Base Landfill: If capping is the selected remedial alternative for Site 4, the excavated soils from Site 19 could be consolidated on the Site 4 landfill prior to capping. Although this option would not result in the soils leaving the base, it would allow clean closure of Site 19 without significantly altering the remedial action at Site 4.

Institutional Controls - Access restrictions would be enacted to restrict the future use of untreated site groundwater for drinking water to prevent ingestion, inhalation, and dermal exposure to site contaminants. Because site groundwater does not meet New Jersey groundwater quality standards, a classification exception area (CEA) pursuant to N.J.A.C 7:9-6 would be established to provide the state official notice that the constituent standards will not be met for a specified duration and to ensure that use of groundwater in the affected area is suspended until standards are achieved.

Natural Attenuation - Because Alternative 5 would remove the source of contamination and prevent any further migration of contaminants into site groundwater, over time groundwater contamination will naturally attenuate by chemical, physical, and biological (organics only) mechanisms.

Long-Term Monitoring - Because contaminated groundwater is not actively remediated under Alternative 5, the groundwater would be sampled annually to monitor the migration of contaminants from the site and assess the potential impacts to downgradient areas. The collected data would be evaluated during the 5-year review period. The frequency of monitoring and the number of analytical parameters may be decreased if the 5-year review determines that improvement of groundwater quality has been attained.

For the purpose of costing, it is assumed that groundwater samples would be collected from the six existing monitoring wells and analyzed for site-specific contaminants. The sampling results would be evaluated to assess whether there have been changes in contaminant status and to determine whether additional response actions are warranted.

Five-Year Reviews - Because groundwater contaminants remain at concentrations exceeding state groundwater quality standards, a review of site conditions and risks would be conducted every 5 years, as required by CERCLA. The reviews would consist of evaluation of analytical and hydrogeologic data, assessing whether human or biological receptors or groundwater resources are at risk.

3.3.3 Site 19 - Alternatives Screening

In this section, alternatives are evaluated generally with regard to effectiveness, implementability, and cost to further focus the FS on the most plausible array of remedial alternatives for Site 19. The screening is presented in Table 3-6. Based on the screening, Alternatives 2 - Limited Action and Alternative 3 - Soils consolidation and capping were eliminated.

TABLE 3-6
SITE 19 - SCREENING OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	EFFECTIVENESS	IMPLEMENTABILITY	COST	COMMENTS
1	No Action: (long term monitoring, five year reviews)	Provides no additional protection of human health or the environment. Does not reduce potential for human exposure to contaminants in soils, sediment, or groundwater. Does not reduce contaminant migration in the environment. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: none O&M: low	Retained as baseline alternative in accordance with NCP.
2	Limited Action (Institutional controls, access restrictions, long-term monitoring, five-year reviews)	Provides little added protection of human health through fencing and institutional controls. Groundwater use would be restricted. Does not reduce contaminant migration to the environment. No reduction in toxicity, mobility, or volume of contaminants.	Readily implementable. No technical or administrative difficulties.	Capital: low O&M: low	Relative to Alt. 1, provides minimal additional protectiveness for additional cost. Eliminated.
3	Soils Consolidation, Capping, Institutional Controls, Natural Attenuation, and Long-Term Monitoring	Protects human health and the environment by containing contaminated soils and sediments within the topographic depression, preventing direct contact and reducing contaminant migration to the environment. Groundwater use would be restricted. No reduction of toxicity or volume of contaminants. Groundwater contaminants will naturally attenuate over time.	Readily implementable. No technical or administrative difficulties. Personnel and materials necessary to implement alternative are widely available.	Capital: moderate O&M: moderate	Provides the same degree of protection as Alt. 5, but because it doesn't result in clean closure of Site 19, it requires long-term operation , maintenance, and monitoring. Also likely to be more expensive than Alt. 5. Eliminated.

TABLE 3-6
SITE 19 - SCREENING OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

	ALTERNATIVE	EFFECTIVENESS	IMPLEMENTABILITY	COST	COMMENTS
4	Excavation, On-Site Solidification, On-Site Disposal, Natural Attenuation, and Long-Term Monitoring	Protects human health and the environment by immobilizing soil contaminants, preventing direct contact, and minimizing contaminant migration to the environment. Groundwater use would be restricted. Groundwater contaminants will naturally attenuate over time.	Readily implementable. Specialized treatment equipment is required, but is available from several vendors. No technical or administrative difficulties. Personnel and materials necessary to implement alternative are widely available.	Capital: moderate O&M: moderate	Retained as representative treatment alternative.
5 A	Excavation and Off-Base Disposal	Protects human health and the environment by excavating contaminated soils and sediments and transporting them off-base for disposal in a RCRA landfill. Groundwater use would be restricted. Groundwater contaminants will naturally attenuate over time. No reduction of toxicity or volume of contaminants.	Readily implementable. Adequate landfill capacity exists for disposal of the small volume of contaminated materials from Site 19.	Capital: low O&M: low	Alternative would result in clean closure of Site 19 and would expedite its reuse. Retained.
5 B	Excavation and On-Base Disposal	Protects human health and the environment by excavating contaminated soils and sediments and transporting them off-site for consolidation in an existing on-base landfill that is being capped under a separate remedial action. Groundwater use would be restricted. Groundwater contaminants will naturally attenuate over time. No reduction of toxicity or volume of contaminants.	Readily implementable if capping is the selected alternative at the Site 4 landfill. The small volume of contaminated materials from Site 19 would be used to assist in achieving the proper grades for the final cap. The small volume of soils from Site 19 would not be expected to significantly alter the cost or design of the proposed landfill cap.	Capital: low O&M: low	Alternative would result in clean closure of Site 19 and would expedite its reuse. Retained.

4.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

This section contains the detailed evaluation of the remedial alternatives that were retained after the screening of alternatives in Section 3.0. In accordance with the EPA RI/FS guidance, each alternative is evaluated with respect to seven criteria: overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost. Site 4 alternatives are evaluated in Section 4.1; Site 5 alternatives are evaluated in Section 4.2; and Site 19 alternatives are evaluated in Section 4.3.

4.1 INDIVIDUAL ANALYSIS OF SITE 4 ALTERNATIVES

Detailed evaluations of the two Site 4 remedial alternatives retained for further evaluation are presented in this section. Detailed cost estimates and assumptions for each alternative are presented in Appendix A.

4.1.1 Site 4 - Alternative 1: No-Action

The No-Action Alternative was developed as a baseline case, as required by the NCP. The only activities conducted under this alternative are annual monitoring to evaluate contaminant migration and a review of site conditions and risks every five years.

Overall Protection of Human Health and the Environment

The No-Action Alternative would not provide protection of human health or the environment. Contaminants within the landfill materials would not be remediated or isolated and would continue to pose risk and adversely impact the environment.

Because precipitation would continue to infiltrate the landfill, the contaminants remaining in the landfill mass would continue to leach into the groundwater, causing continued exceedence of State GWQS and potentially affecting downgradient portions of the aquifer. Under a future residential land use scenario, exposure to contaminated groundwater beneath the site would pose potential carcinogenic and non-carcinogenic risks exceeding the EPA's target risk range (carcinogenic risk>1 E-04, and HI >1.0). Alternative 1 does not include implementation of institutional controls to restrict use of contaminated groundwater in the event of future change in land or groundwater use.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to humans and animals. Presently, most of the surface is covered with soil and vegetation, but exposed debris are evident on the eastern side of the landfill. Over time as the landfill surface erodes, more contaminated subsurface

materials may be exposed and become available for direct contact, resulting in increased human health and ecological risks. Additionally, increased migration of contaminated soils to the adjacent surface water and wetlands may result from surface runoff and wind erosion.

Long-term monitoring of groundwater, surface water, and sediment would make it possible to evaluate site conditions and risks. However, because only infrequent (annual) monitoring is proposed, impacts on downgradient receptors may not be identified early enough to provide any additional protection of human health or the environment.

Compliance with ARARs

Alternative 1 would not comply with federal and state municipal landfill post-closure requirements [40 CFR 258.61 and N.J.A.C. 7:26-2A.9] for routine maintenance and repair of the existing cover, but it would comply with long-term monitoring requirements through the annual monitoring and evaluation of groundwater, surface water, and sediment monitoring requirements.

Because groundwater beneath Site 4 exceeds groundwater quality criteria (GWQC) specified in the New Jersey GWQS [N.J.A.C. 7:9-6] and no actions would be taken to reduce contaminant concentrations or establish a CEA, Alternative 1 would not comply with these standards.

Long-Term Effectiveness and Permanence

Since no remedial actions would occur under Alternative 1, the current and future threats to human health and the environment would remain.

The Site 4 human health risk assessment concluded that, under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a potential carcinogenic risk of 1.4 E-04 and an HI of 3.3 for non-carcinogenic exposures. These risk estimates slightly exceed EPA's target risk range. Because no actions would be taken to reduce contaminant leaching to groundwater and no institutional controls would be implemented to prohibit use of untreated contaminated groundwater, the risk to potential future residential users of the groundwater would remain. The groundwater underlying Site 4 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on the base (within approximately one mile upgradient of the site). If site land and groundwater usage changes in the future, potential residential users of groundwater would not be protected.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that landfilled materials may pose health risks to humans and ecological receptors. Because this alternative includes no controls to prevent deterioration of the landfill surface, over time surface soils would likely erode, exposing landfill materials and potentially increasing the human health and ecological risks posed by direct contact with landfill materials. Erosion of the landfill surface would also result in increased migration of contaminants to the adjacent surface water and wetlands through wind and surface runoff.

Under ambient conditions, natural attenuation and degradation of some of the contaminants in landfill materials and site groundwater may occur; however, the process is likely to take many years. Five-year reviews would be required to assess whether threats or risks are increasing or abating with time in light of future land use or changes in the conditions at the site.

No controls would be used to manage the landfill mass under the No-Action Alternative; therefore, the evaluation of the adequacy and reliability of controls is not applicable.

Reduction of Toxicity, Mobility, or Volume Through Treatment

The No-Action Alternative would not reduce the toxicity, mobility, or volume of contamination through treatment, since no treatment is used to address the contaminated landfill materials.

Short-Term Effectiveness

Since no response actions would occur, implementation of the No-Action Alternative would not pose additional short-term risks to Base personnel or the local community. Short-term risks to workers conducting long-term monitoring would be mitigated by use of appropriate procedures and personal protective equipment (PPE). Current risks would remain unabated. None of the RAOs would be achieved.

Implementability

Since no response activities would occur, the No-Action Alternative is readily implementable. The technical feasibility criteria, including constructibility, operability, and reliability, are not relevant to this alternative. Monitoring to assess contaminant status would pose no implementability concerns. Additional actions can be easily implemented in the future, if warranted.

Permits would not be required under Alternative 1. Coordination with other agencies may be required as part of the long-term monitoring and five-year review processes.

Regulatory personnel and environmental specialists are readily available to perform the environmental monitoring and five-year reviews effectively.

Cost

No capital costs are associated with the No Action Alternative. The average annual O&M cost for long-term monitoring is $16,200 and five-year reviews are $15,500 per event. Over a 30-year period, the net present worth cost is $234,000 (at a 7 percent discount rate).

4.1.2 Site 4 - Alternative 3: Capping, Institutional Controls, Natural Attenuation, and Long-Term Monitoring

Alternative 3 relies on containment and institutional controls to achieve RAOs. A low permeability enhanced cover system would be used to prevent potential human and animal contact with contaminants in the landfill materials, limit contaminant leaching to groundwater, and minimize contaminant migration via surface runoff and erosion. The perimeter of the landfill would be fenced to limit access to the covered area. Access restrictions would be emplaced to limit future uses of the site that may result in disturbance of the soil cover or direct contact with contaminated media, and to prohibit the use of untreated groundwater as drinking water. Over time, as a result of reduced leaching of contaminants from the landfill, groundwater contamination is expected to naturally attenuate by chemical, physical, and biological (organics only) mechanisms. Long-term monitoring and five-year reviews would be required to assess contaminant status and potential threats to human health and the environment. The key components of Alternative 3 are identified on Table 3-1.

Overall Protection of Human Health and the Environment

Alternative 3 would provide overall protection of human health and the environment by preventing direct exposure to contaminated landfill materials, reducing contaminant migration from the landfill into the environment, and instituting restrictions on use of site groundwater.

Although the potential health risks from direct exposure to landfill contaminants were not quantified in the RI, it is conservatively assumed that direct exposure landfilled materials may pose health risks to humans and animals. These risks would be reduced by installation of an enhanced cover system over the landfill. Because the enhanced cover would effectively eliminate the direct exposure pathway, the direct contact risks would be eliminated, provided that the cover was properly maintained. The cover system would also prevent contaminant migration to the environment by surface runoff and wind erosion.

Alternative 3 would also reduce the risks posed by future use of site groundwater. The human health risk assessment concluded that site groundwater poses carcinogenic and non-carcinogenic risks exceeding EPA's target risk range under a future residential exposure scenario. Capping the landfill with a low permeability cover system would significantly reduce infiltration of precipitation into the landfill, thereby reducing contaminant leaching from the landfill materials to the underlying groundwater and facilitating natural attenuation of groundwater contamination. Reducing leaching of contaminants from the landfill into the underlying groundwater will eventually result in a decrease of groundwater contaminant concentrations to acceptable levels (GWQSs), reducing the long-term risk posed by future use of site groundwater. Implementing access restrictions and establishing the site as a groundwater CEA would provide interim protection by prohibiting use of the aquifer until GWQSs are achieved.

Fencing and access restrictions would provide additional long-term protection by limiting access to the capped area and restricting activities that could damage or intrude into the cover system and contaminated media.

The long-term monitoring program would allow the responsible agency to monitor the quality of groundwater leaving the site, assess potential impacts to downgradient receptors, and determine whether additional remedial actions are necessary.

Use of engineering controls to minimize generation of fugitive dusts and vapors, and proper use of PPE by site workers would effectively minimize short-term risks to the local community and workers posed by implementation of this alternative.

Compliance with ARARs

Implementation of Alternative 3 would comply with all ARARs identified in Tables 2-1 through 2-6. Because Alternative 3 does not include active treatment of groundwater, initially, the groundwater beneath Site 4 would not meet the constituent concentrations specified in the New Jersey GWQS [N.J.A.C. 7:9-6]. However, capping the landfill as proposed under Alternative 3 would reduce migration of contaminants into groundwater, facilitating natural attenuation of contaminants and ultimately resulting in attainment of GWQS. Alternative 3 includes a provision to seek a temporary exemption (CEA) from these requirements until the GWQS are achieved through natural attenuation. The CEA would be established to provide the state official notice that the constituent standards would not be met for a specified duration and to ensure that consumption of the untreated groundwater is prohibited.

The single barrier cover system and long-term monitoring and maintenance plan proposed under Alternative 3 would comply with federal and state municipal landfill closure and post-closure regulations [40 CFR 258.60 & 258.61and N.J.A.C. 7:26-2A.9].

The potential effects of the proposed remediation on wetlands, floodplains, water bodies, and other sensitive receptors would be identified during the design of Alternative 3 and all necessary measures would be taken to comply with the location-specific federal and state ARARs identified in Tables 2-3 and 2-4. It is expected that Alternative 3 would easily comply with these ARARs.

Brief descriptions of the cited requirements are provided in Section 2.2 of this report.

Long-Term Effectiveness and Permanence

The risk assessment concluded that under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a potential carcinogenic risk of 1.4 E-04 and an HI of 3.3 for non-carcinogenic exposures. These risk estimates slightly exceed EPA's target risk range. Capping the landfill, maintaining the cap, and implementing institutional controls to prohibit use of untreated contaminated groundwater would reduce these risks and provide long term protection of human health.

Capping the landfill with a low permeability cover system would significantly reduce infiltration of precipitation into the landfill, thereby reducing contaminant leaching from the landfill materials to the underlying groundwater and facilitating natural attenuation of groundwater contamination. Containing the source of groundwater contamination will ultimately result in reduced risk as groundwater contaminant concentrations decrease to acceptable levels (GWQSs) through physical, chemical, and biological (VOCs only) mechanisms.

The groundwater underlying Site 4 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on the Base (within approximately one mile upgradient of the site), indicating that future use of groundwater is conceivable. If site land and groundwater usage changes in the future, potential residential users of groundwater would be protected by institutional controls (access restrictions and CEA) until GWQSs are achieved.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to human and ecological receptors. Alternatives would reduce the human health risk posed by direct exposure to

contaminated landfill materials. Because contaminated soils and landfill materials would remain in place beneath the cover, long-term routine maintenance of the cover system and perimeter fencing would be required to ensure the long-term protectiveness of the cover. With proper maintenance, the cover system would effectively provide long-term protection.

The annual monitoring of groundwater, surface water, and sediment would allow the responsible agency to monitor the quality of groundwater beneath and leaving the Site, assess potential impacts to the adjacent wetlands and downgradient receptors, and determine whether additional remedial actions are necessary. The monitoring program, in combination with the cover system, should be effective in minimizing the risks to downgradient receptors and the environment.

Five-year reviews would be required to assess whether the cover system is effective in preventing direct exposures and reducing contaminant leaching, and whether groundwater is naturally attenuating. These reviews would be based in large part on analytical data collected during annual monitoring events. Review of the effectiveness of access restrictions and the CEA in preventing damage to the cover system and exposure to site contaminants would also be required.

No difficulties or uncertainties are anticipated in performing the long-term maintenance or monitoring. All materials used in construction of the enhanced cover system and fencing are readily available and can be replaced. In the event of damage to the cap system, repairs would likely be performed without many difficulties. Groundwater monitoring wells may require replacement if sedimentation or vandalism occur; the wells would be readily replaceable.

Because maintenance of the enhanced cover system would be continual, catastrophic failure is unlikely. In the event of failure or damage of the cover, existing access restrictions, institutional controls, and monitoring would provide adequate short-term protection of human health until the cover system was repaired.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 3 would not reduce the toxicity, mobility, or volume of contamination through treatment since no treatment is used to address the contaminated landfill materials or groundwater. However, mobility of contaminants in the landfill materials would be reduced by the cover system.

Short-Term Effectiveness

Implementation of Alternative 3 is not expected to pose any significant risks to Base personnel or the local community. Increased truck and heavy equipment vehicular traffic would occur as the result of site

preparation and the import and placement of capping materials. Coordination and scheduling of truck and heavy equipment traffic on public roads would be required to manage increased vehicular activity.

During site preparation and placement of the cap system, risks posed to Base personnel by fugitive dust (bearing adsorbed contaminants) would be minimized by appropriate engineering control measures such as dust suppressants. Workers who implement Alternative 3 would be adequately safeguarded by using appropriate PPE to prevent exposure to contaminated landfill materials, contaminant-laden dusts, and airborne VOCs. OSHA standards would be followed and proper PPE would be used during all remedial activities.

No permanent adverse impacts to the environment are anticipated to result from construction of the enhanced cap system. Erosion control measures such as hay bales and silt fences would be would be used to prevent damage to the environment from sediment runoff during cap construction.

The cap system placement would require approximately 18 months to implement, including pre-design and design activities. Upon completion of the cap, Alternative 3 would achieve the RAO for protection of human health by preventing exposure to contaminated soils and the RAO for reducing migration of contaminants to groundwater. Implementing access restrictions and establishing the groundwater CEA may take a year or longer.

Implementability

Alternative 3 is implementable. No anticipated difficulties or uncertainties exist in constructing the enhanced cover system since common construction techniques are required and cover materials are available from several vendors. Long-term monitoring (sampling and analyses) only requires readily available resources. Access restrictions should not be difficult to implement and enforce, since the site is part of an active Navy base and coordination with other agencies and property owners is not necessary.

Since long-term monitoring is included under Alternative 3, contaminant presence and migration can be assessed. Monitoring of groundwater, surface water, and sediment would be effective for detecting changes in media quality that may indicate cap failure, and for identifying potential impacts to downgradient receptors.

Permits would not be required under Alternative 3 since all activities would be conducted on the site; however, the substantive requirements of all ARARs would be met as described previously.

The criterion of availability of treatment technologies, TSD facilities, and capacity is not applicable.

There is ample availability of companies with the trained personnel, equipment, and materials to perform site preparation, construct the cover system, install fencing, and perform maintenance and long-term monitoring. Regulatory personnel and environmental specialists are readily available to perform five-year reviews.

Cost

The capital costs for Alternative 3 total $1,983,000. The average annual O&M costs are $29,600, and five-year reviews cost $15,500 per event. Over a 30-year period, the net present worth cost is $2,400,000 (at a 7 percent discount rate).

4.1.3 Comparative Analysis of Site 4 Alternatives

As part of the detailed analysis, comparisons of the remedial alternatives are made to identify differences between the alternatives and how site contaminant threats are addressed. The two alternatives are compared with respect to each of the evaluation criteria and differences are identified. Table 4-1 presents summaries of the evaluations for each alternative.

Overall Protection of Human Health and the Environment

Only Alternative 3 would be protective of human health and the environment. Because no actions are conducted, Alternative 1 would not reduce human health or ecological risk and would not reduce contaminant migration to the environment. Because no actions would be taken under Alternative 1 to contain contaminants or prevent deterioration of the landfill surface, health risks and adverse impacts to the environment are expected to remain the same or increase over time.

Alternative 3 is protective of human health and the environment. The enhanced cover system would reduce human health and ecological risks posed by contact with landfilled materials and would reduce leaching of contaminants to groundwater, thereby reducing contaminant migration into the environment and facilitating natural attenuation of groundwater contamination. Routine maintenance of the landfill cover system would ensure its long-term protectiveness. Institutional controls would provide assurance that untreated contaminated groundwater is not used as a potable water source in the future.

TABLE 4-1
SITE 4 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 3: CAPPING, INSTITUTIONAL CONTROLS, NATURAL ATTENUATION, AND LONG-TERM MONITORING
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Prevent Human Exposure to Contaminated Soils and Landfilled Materials	No action taken to prevent human exposure to contaminated soils and landfilled materials. Existing risks would remain. Continued deterioration of the landfill surface would expose more contaminated soils and landfilled materials and result in increased direct exposure risks.	Enhanced cover system would prevent direct contact with contaminated soils and landfilled materials. Current direct contact risks were not quantified, but it is conservatively assumed that landfilled materials may pose excess health risks. Any excess risks would be reduced to acceptable levels by installing and maintaining the cap.
Prevent Human Exposure to VOC and Metal Contaminants in Groundwater	No action taken to prevent human exposure to contaminated groundwater. Carcinogenic and non-carcinogenic risks exceeding EPA's target risk range would remain. No actions taken to reduce contaminant leaching to groundwater. No institutional controls implemented to prohibit use of untreated groundwater for drinking water.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. The cover system would reduce leaching of contaminants to groundwater, facilitating natural attenuation of contaminants. In time, contaminant concentrations would reach levels that would not pose excess risk.
Minimize Contaminant Migration	No actions taken to reduce contaminant leaching to groundwater. Contaminants would continue to leach into groundwater and migrate downgradient, potentially affecting downgradient receptors.	The cover system would reduce leaching of contaminants to groundwater and would reduce migration of contaminants to the environment by surface water and wind erosion.
COMPLIANCE WITH ARARs		
Chemical-Specific ARARs	Would not comply with state groundwater quality standards.	Groundwater contaminant concentrations would initially exceed state GWQC; over time GWQC would be achieved by natural attenuation. A classification exception area (CEA) would be established to provide the state official notification that standards would not be met for a specified duration.

TABLE 4-1
SITE 4 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2

Location-Specific ARARs	Not Applicable.	Would comply with federal and state ARARs for wetlands, floodplains, and other sensitive receptors.
Action-Specific ARARs	Would not comply with federal or state ARARs for post-closure maintenance of municipal landfills.	Would comply with federal and state ARARs for closure and post-closure of municipal landfills.
LONG-TERM EFFECTIVENESS AND PERMANENCE		
Magnitude of Residual Risk	Existing risks would remain: approximately 1.4×10^{-4} excess cancer risk (ECR) and HI = 3.3 non-carcinogenic risks from exposure to site groundwater. Increased risk anticipated over time as landfill surface deteriorates.	Implementation and enforcement of institutional controls would reduce risks from exposure to site groundwater to less than 1×10^{-6} ECR and HI less than 1.0. Over time, natural attenuation would result in permanently reduced risks. Installation and maintenance of the cap would reduce direct exposure risks to less than 1×10^{-6} ECR and HI less than 1.0.
Adequacy and Reliability of Controls	No new controls implemented. Existing site features provide limited controls.	If properly maintained, the cap system would be reliable for preventing exposure and reducing contaminant migration to the environment. If implemented and enforced, institutional controls could prevent damage to the cap, intrusion into contaminated materials, and use of contaminated groundwater.
Need for 5-Year Review	Review would be required since soil and groundwater contaminants would be left in place.	Same as Alternative 1.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT		
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, since no treatment would be employed.	Groundwater contamination eventually eliminated by natural attenuation.
SHORT-TERM EFFECTIVENESS		
Community Protection	No risk to community anticipated.	No significant risk to community anticipated. Engineering controls would be used during implementation to mitigate risks.
Worker Protection	No risk to workers anticipated if proper PPE is used during long-term monitoring.	No significant risk to workers anticipated if proper PPE is used during remediation and long-term monitoring.

TABLE 4-1
SITE 4 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 3

Environmental Impacts	No adverse impacts to the environment anticipated.	No significant impacts to the environment anticipated. Engineering controls would be used during implementation to mitigate risks.
Time Until Action is Complete	Not applicable.	1.5 years enhanced cap is in place. Natural attenuation will likely take longer.
IMPLEMENTABILITY		
Ability to Construct and Operate	No construction or operation involved.	No difficulties anticipated. Capping is a readily implementable technology.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	If additional actions are warranted, the cover system may need to be opened to access contaminated materials within.
Ability to Monitor Effectiveness	Monitoring would provide assessment of potential exposures, contaminant presence, migration, or changes in site conditions.	Same as Alternative 1.
Ability to Obtain Approvals and Coordinate with Other Agencies	Coordination for 5-year reviews may be required and would be obtainable.	Coordination for 5-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	Same as Alternative 1.
Availability of Equipment, Specialists, and Materials	Personnel and equipment available for implementation of long-term monitoring and 5- year reviews.	Ample availability of equipment and personnel to construct cap and perform long-term maintenance, monitoring, and 5-year reviews.
Availability of Technology	Not required.	Common construction techniques and materials required for cap construction.
COST		
Capital Cost	$0	$1,983,000
First-Year Annual O&M Cost	$16,200	$29,600
Present Worth Cost	$234,000	$2,400,000

Compliance with ARARs

Because Alternative 1 does not include any remedial actions, it would not comply with state and federal ARARs pertaining to post-closure of municipal landfills [40 CFR 258.60 & 258.61and N.J.A.C. 7:26-2A.9]. Alternative 3 would comply with these requirements since an enhanced cover system would be installed and a long-term maintenance and repair program would be implemented.

Both alternatives would comply with federal and state long-term monitoring requirements through the annual monitoring and evaluation of groundwater, surface water, and sediments.

Alternative 1 would not comply with state ARARs for attainment of groundwater quality standards [N.J.A.C. 7:9-6], Alternative 3 would comply by seeking a temporary exemption (CEA) from these requirements until the GWQS are achieved through natural attenuation.

Long-Term Effectiveness and Permanence

Alternative 3 is the only alternative that offers substantial long-term protection of human health and the environment. Under Alternative 1, risks would remain the same or increase over time as the landfill surface erodes because no additional actions would be taken to contain wastes and limit deterioration of the landfill surface. Potential future users of site groundwater may be at risk under Alternative 1 because it lacks institutional controls that would prohibit use of untreated contaminated groundwater.

Alternative 3 would reduce human and ecological risks due to direct exposure to landfilled materials by eliminating the potential for exposure. Long-term risks due to ingestion of site groundwater would be mitigated by reducing contaminant leaching into groundwater and natural attenuation of groundwater contaminants, and by implementing institutional controls to prohibit use of untreated, contaminated groundwater.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Because neither of the alternatives includes treatment, neither would reduce the toxicity, mobility, or volume through treatment. Alternative 3 would reduce the mobility of landfill contaminants by reducing precipitation infiltration.

Short-Term Effectiveness

The short-term effectiveness of the two alternatives would be similar since the use of appropriate engineering controls and PPE is expected to minimize adverse impacts to Base residents and personnel, the local community, and workers during implementation.

Long-term monitoring, which would provide little opportunity for short-term impact, is the only on-site action proposed under Alternative 1. Alternative 3 would present a greater opportunity for short-term impact due to site preparation, grading, and constructing the enhanced cover system.

Impacts to the environment are not anticipated under Alternative 1 since minimal activities would be conducted. Impacts to the environment would be minimized under Alternative 3 by use of erosion and storm water control measures during enhanced cap construction.

Alternative 1 would not achieve any of the RAOs. Alternative 3 would achieve all RAOs within approximately 1.5 years.

Implementability

Alternative 1 is the most easily implemented since the only activities proposed are long-term monitoring and five-year reviews. Alternative 3 would be more difficult to implement since it involves the construction of an enhanced cover system over several acres of land; however, no difficulties are anticipated, since common construction techniques are required and cover materials are available from several vendors.

If additional actions are warranted, they could be easily implemented under Alternative 1. Additional actions could be implemented under Alternative 3; however, opening the cover system to access contaminated materials may be required.

Cost

The costs associated with each alternative are provided in Table 4-1. Alternative 1, No Action, would cost less to implement than Alternative 3.

4.2 INDIVIDUAL ANALYSIS OF SITE 5 ALTERNATIVES

Detailed evaluations of the two Site 5 remedial alternatives retained for further evaluation are presented in this section. Detailed cost estimates and assumptions for each alternative are presented in Appendix A.

4.2.1 Site 5 - Alternative 1: No-Action

The No-Action Alternative was developed as a baseline case, as required by the NCP. The only activities conducted under this alternative are annual monitoring to evaluate contaminant migration and a review of site conditions and risks every five years.

Overall Protection of Human Health and the Environment

The No-Action Alternative would not provide protection of human health or the environment. Contaminants within the landfill materials would not be remediated or isolated and would continue to pose risk and adversely impact the environment.

Because precipitation would continue to infiltrate the landfill, the contaminants remaining in the landfill mass would continue to leach into the groundwater, causing continued exceedence of State GWQS and potentially affecting downgradient portions of the aquifer. Under a future residential land use scenario, exposure to contaminated groundwater beneath the site would pose potential carcinogenic and non-carcinogenic risks exceeding the EPA's target risk range (carcinogenic risk>1 E-04, and HI >1.0). Alternative 1 does not include implementation of institutional controls to restrict use of contaminated groundwater in the event of future change in land or groundwater use.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that direct contaminated landfill materials may pose health risks to humans and animals. Currently, the western 4 acres of the landfill is a wooded area, moderately vegetated with scrub pines and grasses; the soil cover over this portion of the landfill is estimated to be 1.5 to 3 feet thick (based on site inspection/hand augers samples collected by B & R Environmental in September 1996). The eastern one acre of the landfill surface is sparsely covered with low weeds and grasses; cover materials are reported to be thin in some areas. Because Alternative 1 does not include measures to prevent deterioration of the landfill surface, over time surface soils would erode, particularly in the sparsely vegetated areas, exposing contaminated subsurface materials and potentially increasing the human health and ecological risks posed by direct contact with landfilled materials.

Long-term monitoring of groundwater would make it possible to evaluate site conditions and risks. However, because only infrequent (annual) monitoring is proposed, impacts on downgradient receptors may not be identified early enough to provide any additional protection of human health or the environment.

Compliance with ARARs

Alternative 1 would not comply with federal and state municipal landfill post-closure requirements [40 CFR 258.61 and N.J.A.C. 7:26-2A.9] for routine maintenance and repair of the existing cover, but it would comply with long-term monitoring requirements through the annual monitoring and evaluation of groundwater.

Because groundwater beneath Site 5 exceeds groundwater quality criteria (GWQC) specified in the New Jersey GWQS [N.J.A.C. 7:9-6] and no actions would be taken to reduce contaminant concentrations or establish a CEA, Alternative 1 would not comply with these standards.

Long-Term Effectiveness and Permanence

Since no remedial actions would occur under Alternative 1, the current and future threats to human health and the environment would remain.

The Site 5 human health risk assessment concluded that, under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a potential carcinogenic risk of 1.3 E-04 and an HI of 5.2 for non-carcinogenic exposures. These risk estimates slightly exceed EPA's target risk range. Because no actions would be taken to reduce contaminant leaching to groundwater and no institutional controls would be implemented to prohibit use of untreated contaminated groundwater, the risk to potential future residential users of the groundwater would remain. The groundwater underlying Site 5 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on the Base. If site land and groundwater usage changes in the future, potential residential users of groundwater would not be protected.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that landfilled materials may pose health risks to humans and ecological receptors. Because this alternative includes no controls to prevent deterioration of the landfill surface, over time surface soils could erode, exposing landfilled materials and potentially increasing the human health and ecological risks posed by direct contact with landfilled materials. Surface erosion would be expected to be greatest in the eastern portion of the landfill. This area is sparsely vegetated with low weeds and grasses, and the cover materials are reported to be thin in some areas. The western portion of the site is a wooded area, moderately vegetated with scrub pines and grasses. The cover is reported to be 1.5 to 3 feet thick in this area. The pine trees and grass cover appear to be effectively limiting erosion of the landfill surface there.

Under ambient conditions, natural attenuation and degradation of some of the contaminants in landfill materials and site groundwater may occur; however, the process is likely to take many years. Five-year reviews would be required to assess whether threats or risks are increasing or abating with time in light of future land use or changes in the conditions at the site.

No controls would be used to manage the landfill mass under the No-Action Alternative; therefore, the evaluation of the adequacy and reliability of controls is not applicable.

Reduction of Toxicity, Mobility, or Volume Through Treatment

The No-Action Alternative would not reduce the toxicity, mobility, or volume of contamination through treatment, since no treatment is used to address the contaminated landfill materials.

Short-Term Effectiveness

Since no response actions would occur, implementation of the No-Action Alternative would not pose additional short-term risks to Base personnel or the local community. Short-term risks to workers conducting long-term monitoring would be mitigated by use of appropriate procedures and PPE. Current risks would remain unabated. None of the RAOs would be achieved.

Implementability

Since no response activities would occur, the No-Action Alternative is readily implementable. The technical feasibility criteria, including constructibility, operability, and reliability, are not relevant to this alternative. Monitoring to assess contaminant status would pose no implementability concerns. Additional actions can be easily implemented in the future, if warranted.

Permits would not be required under Alternative 1. Coordination with other agencies may be required as part of the long-term monitoring and five-year review processes.

Regulatory personnel and environmental specialists are readily available to perform the environmental monitoring and five-year reviews effectively.

Cost

No capital costs are associated with the No-Action Alternative. The average annual O&M cost for long-term monitoring is $10,400 and five-year reviews are $15,500 per event. Over a 30-year period, the net present worth cost is $163,000 (at a 7 percent discount rate).

4.2.2 Site 5 - Alternative 3: Capping, Institutional Controls, Natural Attenuation, and Long-Term Monitoring

Alternative 3 relies on containment and institutional controls to achieve RAOs. A low permeability enhanced cover system would be installed over the eastern, open portion of the landfill to prevent potential human and animal contact with contaminants in the landfilled materials, reduce contaminant leaching to groundwater, and minimize contaminant migration via surface runoff and erosion. The existing soil and vegetative cover over the western portion of the landfill would be left intact to prevent direct exposure to landfill materials and limit contaminant migration in this area. Access restrictions would be emplaced to limit future uses of the site that may result in disturbance of the cover or direct contact with contaminated media, and to prohibit the use of untreated groundwater as drinking water.

Over time, as a result of reduced leaching of contaminants from the landfill, groundwater contamination is expected to naturally attenuate by chemical, physical, and biological (organics only) mechanisms. Routine inspection and maintenance of the entire landfill surface would be conducted to ensure the integrity of the existing and new cover systems. Long-term monitoring and five-year reviews would be required to assess contaminant status and potential threats to human health and the environment. The key components of Alternative 3 are identified on Table 3-3.

Overall Protection of Human Health and the Environment

Alternative 3 would provide overall protection of human health and the environment by preventing direct exposure to contaminated landfill materials, reducing contaminant migration from the landfill into the environment, and instituting restrictions on use of site groundwater.

Although the potential health risks from direct exposure to landfill contaminants were not quantified in the RI, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to humans and animals. Direct exposure risks would be reduced by installation of an enhanced cover system over the eastern side of the landfill and long-term inspection and maintenance of the entire landfill surface. Because the properly maintained cover system would effectively eliminate the direct exposure pathway, the direct

contact risks would be eliminated by implementation of Alternative 3. The enhanced cover system would also prevent further erosion of the landfill surface and reduce contaminant migration to the environment by surface runoff and wind erosion.

Alternative 3 would also reduce the risks posed by future use of site groundwater. The human health risk assessment concluded that site groundwater poses carcinogenic and non-carcinogenic risks exceeding EPA's target risk range under a future residential exposure scenario. Capping the eastern portion of the landfill with a low permeability cover system would reduce infiltration of precipitation into the landfill, thereby reducing contaminant leaching from the landfill materials to the underlying groundwater and facilitating natural attenuation of groundwater contamination. By encouraging evapotranspiration of precipitation, the vegetative cover over the western portion of the landfill is expected to be moderately effective for limiting infiltration and leaching of contaminants to groundwater. Reducing leaching of contaminants from the landfill into the underlying groundwater will eventually result in a decrease of groundwater contaminant concentrations to acceptable levels (GWQSs), reducing the long-term risk posed by future use of site groundwater. Implementing access restrictions and establishing the site as a groundwater CEA would provide interim protection by prohibiting use of the aquifer until GWQSs are achieved.

Access restrictions would also provide additional long-term protection by limiting access to the capped area and restricting activities that could damage or intrude into the cover system and contaminated media.

The long-term monitoring program would allow the responsible agency to monitor the quality of groundwater leaving the site, assess potential impacts to downgradient receptors, and determine whether additional remedial actions are necessary.

Use of engineering controls to minimize generation of fugitive dusts and vapors, and proper use of PPE by site workers would effectively minimize short-term risks to the local community and workers posed by implementation of this alternative.

Compliance with ARARs

Implementation of Alternative 3 would comply with all ARARs identified in Tables 2-1 through 2-6.

Because Alternative 3 does not include active treatment of groundwater, initially, the groundwater beneath Site 5 would not meet the constituent concentrations specified in the New Jersey GWQS [N.J.A.C. 7:9-6]. However, capping the landfill as proposed under Alternative 3 would reduce migration of contaminants into groundwater, facilitating natural attenuation of contaminants and ultimately resulting in attainment of constituent standards. Alternative 3 includes a provision to seek a temporary exemption (CEA) from these

requirements until the GWQS are achieved through natural attenuation. The CEA would be established to provide the state official notice that the constituent standards would not be met for a specified duration and to ensure that consumption of the untreated groundwater is prohibited.

The single barrier cover system and long-term monitoring and maintenance plan proposed under Alternative 3 would comply with federal and state municipal landfill closure and post-closure regulations [40 CFR 258.60 & 258.61and N.J.A.C. 7:26-2A.9].

The potential effects of the proposed remediation on wetlands, floodplains, water bodies, and other sensitive receptors would be identified during the design of Alternative 3 and all necessary measures would be taken to comply with the location-specific federal and state ARARs identified in Tables 2-3 and 2-4. It is expected that Alternative 3 would easily comply with these ARARs.

Brief descriptions of the cited requirements are provided in Section 2.2 of this report.

Long-Term Effectiveness and Permanence

The risk assessment concluded that under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in a potential carcinogenic risk of 1.3 E-04 and an HI of 5.2 for non-carcinogenic exposures. These risk estimates slightly exceed EPA's target risk range. Capping the eastern portion of the landfill, maintaining the enhanced cover system, and implementing institutional controls to prohibit use of untreated contaminated groundwater would reduce these risks and provide long term protection of human health.

Capping the eastern portion of the landfill with a low permeability cover system would reduce infiltration of precipitation into the landfill, thereby reducing contaminant leaching from the landfill materials to the underlying groundwater and facilitating natural attenuation of groundwater contamination. By encouraging evapotranspiration of precipitation, the vegetative cover over the western portion of the landfill is expected to be moderately effective for limiting infiltration and leaching of contaminants to groundwater. Reducing leaching of contaminants from the landfill into the underlying groundwater would eventually result in reduced risk as groundwater contaminant concentrations decrease to acceptable levels (GWQSs) through physical, chemical, and biological (VOCs only) mechanisms.

The groundwater underlying Site 5 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on the Base, indicating that future use of groundwater is conceivable. If site land and groundwater usage

changes in the future, potential residential users of groundwater would be protected by institutional controls (access restrictions and CEA) until GWQSs are achieved.

The potential health risks from direct exposure to landfill contaminants were not quantified in the RI; however, it is conservatively assumed that direct exposure to landfilled materials may pose health risks to human and ecological receptors. The existing risks are expected to be greatest in the eastern portion of the landfill which is has sparse vegetation and thin cover in some areas. The western portion of the landfill, which is covered by an approximately 1.5 to 3 feet thick soil layer, vegetated with pine trees and grasses, is expected to be sufficient to prevent direct contact exposure.

Capping the eastern portion of the Site 5 landfill would reduce the human health risk posed by direct exposure to contaminated landfill materials. Because contaminated soils and landfill materials would remain in place beneath the cover, long-term routine maintenance of the existing and new cover systems would be required to ensure their long-term protectiveness. With proper maintenance, the cover system would effectively provide long-term protection of human health and the environment.

The annual monitoring of groundwater would allow the responsible agency to monitor the quality of groundwater beneath and leaving the site and determine whether additional remedial actions are necessary. The monitoring program, in combination with the cover system, should be effective in minimizing the risks to downgradient receptors and the environment.

Five-year reviews would be required to assess whether the cover system is effective in preventing direct exposures and reducing contaminant leaching and whether groundwater is naturally attenuating. These reviews would be based in large part on analytical data collected during annual monitoring events. Review of the effectiveness of access restrictions and the CEA in preventing damage to the cover system and exposure to site contaminants would also be required.

No difficulties or uncertainties are anticipated in performing the long-term maintenance or monitoring. All materials used in construction of the enhanced cover system are readily available and can be replaced. In the event of damage to the cap system, repairs would likely be performed without many difficulties. Groundwater monitoring wells may require replacement if sedimentation or vandalism occur; the wells would be readily replaceable.

Because maintenance of the enhanced cover system would be continual, catastrophic failure is unlikely. In the event of failure or damage of the cover, institutional controls and monitoring would provide adequate short-term protection of human health until the cover system was repaired.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 3 would not reduce the toxicity, mobility, or volume of contamination through treatment since no treatment is used to address the contaminated landfill materials or groundwater. However, mobility of contaminants in the landfill materials would be further reduced by placement of the low permeability cover system over the eastern portion of the landfill.

Short-Term Effectiveness

Implementation of Alternative 3 is not expected to pose any significant risks to Base personnel or the local community. Increased truck and heavy equipment vehicular traffic would occur as the result of site preparation and the import and placement of capping materials. Coordination and scheduling of truck and heavy equipment traffic on public roads would be required to manage increased vehicular activity.

During site preparation and placement of the cap system, risks posed to Base personnel by fugitive dust (bearing adsorbed contaminants) would be minimized by appropriate engineering control measures such as dust suppressants. Workers who implement Alternative 3 would be adequately safeguarded by using appropriate PPE to prevent exposure to contaminated landfill materials, contaminant-laden dusts, and airborne VOCs. OSHA standards would be followed and proper PPE would be used during all remedial activities.

No permanent adverse impacts to the environment are anticipated to result from construction of the enhanced cap system. Erosion control measures such as hay bales and silt fences would be would be used to prevent damage to the environment from sediment runoff during cap construction.

The cap system placement would require approximately 18 months to implement, including pre-design and design activities. Upon completion of the cap, Alternative 3 would achieve the RAO for protection of human health by preventing exposure to contaminated soils and the RAO for reducing migration of contaminants to groundwater. Implementing access restrictions and establishing the groundwater CEA may take a year or longer.

Implementability

Alternative 3 is implementable. No anticipated difficulties or uncertainties exist in constructing the enhanced cover system since common construction techniques are required and cover materials are available from several vendors. Long-term monitoring (sampling and analyses) only requires readily available resources.

Access restrictions should not be difficult to implement and enforce, since the site is part of an active Navy base and coordination with other agencies and property owners is not necessary.

Since long-term monitoring is included under Alternative 3, contaminant presence and migration can be assessed. Monitoring of groundwater would be effective for detecting changes in media quality that may indicate cap failure, and for identifying potential impacts to downgradient receptors.

Permits would not be required under Alternative 3 since all activities would be conducted on the site; however, the substantive requirements of all ARARs would be met as described previously.

The criterion of availability of treatment technologies, TSD facilities, and capacity is not applicable.

There is ample availability of companies with the trained personnel, equipment, and materials to perform site preparation, construct the cover system, and perform maintenance and long-term monitoring. Regulatory personnel and environmental specialists are readily available to perform five-year reviews.

Cost

The capital costs for Alternative 3 total $588,000. The average annual O&M costs are $18,600, and five-year reviews cost $15,500 per event. Over a 30-year period, the net present worth cost is $852,000 (at a 7 percent discount rate).

4.2.3 Comparative Analysis of Site 5 Alternatives

As part of the detailed analysis, comparisons of the remedial alternatives are made to identify differences between the alternatives and how site contaminant threats are addressed. The two alternatives are compared with respect to each of the evaluation criteria and differences are identified. Table 4-2 presents summaries of the evaluations for each alternative.

Overall Protection of Human Health and the Environment

Only Alternative 3 would be protective of human health and the environment. Because no actions are conducted, Alternative 1 would not reduce human health or ecological risk and would not reduce contaminant migration to the environment. Health risks and adverse impacts to the environment are expected to remain the same or increase over time.

TABLE 4-2
SITE 5 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 3: CAPPING, INSTITUTIONAL CONTROLS, NATURAL ATTENUATION, AND LONG-TERM MONITORING
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Prevent Human Exposure to Contaminated Landfill Soils and Materials	No action taken to prevent human exposure to landfilled materials. Existing risks would remain. Continued deterioration of the landfill surface, particularly the eastern portion, would expose more landfilled materials and result in increased direct exposure risks.	New cover system over eastern 1 acre of landfill and would prevent direct contact with contaminated materials. Existing soil/vegetative cover over western portion of landfill would limit direct contact with contaminated materials. Current direct contact risks were not quantified, but it is conservatively assumed that landfilled materials may pose excess health risk. Excess risks would be reduced by installing the new cap and maintaining the new and existing caps.
Prevent Human Exposure to VOC and Metal Contaminants in Groundwater	No action taken to prevent human exposure to contaminated groundwater. Carcinogenic and non-carcinogenic risks exceeding EPA's target risk range would remain. No actions taken to reduce contaminant leaching to groundwater. No institutional controls implemented to prohibit use of untreated groundwater for drinking water.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. The enhanced cover system would reduce leaching of contaminants to groundwater, facilitating natural attenuation of contaminants. In time, contaminant concentrations would reach levels that would not pose excess risk.
Minimize Contaminant Migration to Groundwater	No actions taken to reduce contaminant leaching to groundwater. Contaminants would continue to leach into groundwater and migrate downgradient, potentially affecting downgradient receptors.	The enhanced cover system would reduce leaching of contaminants to groundwater and would reduce migration of contaminants to the environment by surface water and wind erosion.

TABLE 4-2
SITE 5 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2

COMPLIANCE WITH ARARs		
Chemical-Specific ARARs	Would not comply with state groundwater quality standards.	Groundwater contaminant concentrations would initially exceed state GWQC; over time GWQC would be achieved by natural attenuation. A classification exception area (CEA) would be established to provide the state official notification that standards would not be met for a specified duration.
Location-Specific ARARs	Not Applicable.	Would comply with federal and state ARARs for wetlands, floodplains, and other sensitive receptors.
Action-Specific ARARs	Would not comply with federal or state ARARs for post-closure maintenance of municipal landfills.	Would comply with federal and state ARARs for closure and post-closure of municipal landfills.
LONG-TERM EFFECTIVENESS AND PERMANENCE		
Magnitude of Residual Risk	Existing risks would remain: approximately 1.3×10^{-4} ECR and HI = 5.2 non-carcinogenic risks from exposure to site groundwater. Increased risk anticipated over time as landfill surface deteriorates, especially on eastern portion of landfill.	Implementation and enforcement of institutional controls would reduce risks from exposure to site groundwater to less than 1×10^{-6} and HI less than 1.0. Over time, natural attenuation would result in permanently reduced risks. Installation of the new cap, maintenance of the new and existing caps, and implementation of access restrictions to prevent intrusion into contaminated materials would reduce direct exposure risks.
Adequacy and Reliability of Controls	No new controls implemented. Existing site features provide limited controls.	If properly maintained, the cap system would be reliable for preventing exposure and reducing contaminant migration to the environment. If implemented and enforced, institutional controls could prevent damage to the cap, intrusion into contaminated materials, and use of contaminated groundwater.

TABLE 4-2
SITE 5 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 3

Need for 5-Year Review	Review would be required since soil and groundwater contaminants would be left in place.	Same as Alternative 1.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT		
Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, since no treatment would be employed.	Groundwater contamination eventually eliminated by natural attenuation.
SHORT-TERM EFFECTIVENESS		
Community Protection	No risk to community anticipated.	No significant risk to community anticipated. Engineering controls would be used during implementation to mitigate risks.
Worker Protection	No risk to workers anticipated if proper PPE is used during long-term monitoring.	No significant risk to workers anticipated if proper PPE is used during cap construction and long-term monitoring.
Environmental Impacts	No adverse impacts to the environment anticipated.	No significant impacts to the environment anticipated. Engineering controls would be used during implementation to mitigate risks.
Time Until Action is Complete	Not applicable.	14 months until enhanced cap is in place. Natural attenuation will likely take longer.
IMPLEMENTABILITY		
Ability to Construct and Operate	No construction or operation involved.	No difficulties anticipated. Capping is a readily implementable technology.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	If additional actions are warranted in the eastern portion of the landfill, the single barrier cover system may need to be opened to access contaminated materials within. Additional actions would be easily implemented in the western portion of the landfill.
Ability to Monitor Effectiveness	Monitoring would provide assessment of potential exposures, contaminant presence, migration, or changes in site conditions.	Same as Alternative 1.

TABLE 4-2
SITE 5 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 4

Ability to Obtain Approvals and Coordinate with Other Agencies	Coordination for 5-year reviews may be required and would be obtainable.	Coordination for 5-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	Same as Alternative 1.
Availability of Equipment, Specialists, and Materials	Personnel and equipment available for implementation of long-term monitoring and 5- year reviews.	Ample availability of equipment and personnel to construct cap and perform long-term maintenance, monitoring, and 5-year reviews.
Availability of Technology	Not required.	Common construction techniques and materials required for cap construction.
COST		
Capital Cost	$0	$588,000
First-Year Annual O&M Cost	$10,400	$18,600
Present Worth Cost	$163,000	$852,000

Alternative 3 is protective of human health and the environment. The enhanced cover system would reduce human health and ecological risks posed by contact with landfilled materials and would reduce leaching of contaminants to groundwater, thereby reducing contaminant migration into the environment and facilitating natural attenuation of groundwater contamination. Routine maintenance of the landfill cover system would ensure its long-term protectiveness. Institutional controls would provide assurance that untreated contaminated groundwater is not used as a potable water source in the future.

Compliance with ARARs

Because Alternative 1 does not include any remedial actions, it would not comply with state and federal ARARs pertaining to post-closure of municipal landfills [40 CFR 258.60 & 258.61and N.J.A.C. 7:26-2A.9].

Alternative 3 would comply with these requirements since an enhanced cover system would be installed and a long-term maintenance and repair program would be implemented.

Both alternatives would comply with federal and state long-term monitoring requirements through the annual monitoring and evaluation of groundwater.

Alternative 1 would not comply with state ARARs for attainment of groundwater quality standards [N.J.A.C. 7:9-6]. However, Alternative 3 would comply by seeking a temporary exemption (CEA) from these requirements until the GWQS are achieved through natural attenuation.

Long-Term Effectiveness and Permanence

Alternative 3 is the only alternative that offers long-term protection of human health and the environment. Because no additional actions would be taken under Alternative 1 to contain wastes and limit deterioration of the landfill surface, risks would increase over time as the landfill surface erodes. Potential future users of site groundwater may be at risk under Alternative 1 because it lacks institutional controls that would prohibit use of untreated contaminated groundwater.

Alternative 3 would reduce human and ecological risks due to direct exposure to landfilled materials by eliminating the potential for exposure. Long-term risks due to ingestion of site groundwater would be reduced by reducing contaminant leaching into groundwater and natural attenuation of groundwater contaminants, and by implementing institutional controls to prohibit use of untreated, contaminated groundwater.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Because neither of the alternatives includes treatment, neither would reduce the toxicity, mobility, or volume through treatment. Alternative 3 would reduce the mobility of landfill contaminants by reducing precipitation infiltration into the eastern portion of the landfill.

Short-Term Effectiveness

The short-term effectiveness of the two alternatives would be similar since the use of appropriate engineering controls and PPE is expected to minimize adverse impacts to Base residents and personnel, the local community, and workers during implementation. Long-term monitoring, which would provide little opportunity for short-term impact, is the only on-site action proposed under Alternative 1. Alternative 3 would present a greater opportunity for short-term impact due to site preparation, grading, and constructing the cover system.

Impacts to the environment are not anticipated under Alternatives 1 since minimal activities would be implemented. Impacts to the environment would be minimized by implementing erosion and storm water control measures during cap construction under Alternative 3.

Alternative 1 would not achieve any of the RAOs. Alternative 3 would achieve all RAOs within approximately 1.5 years.

Implementability

Each of the alternatives would be implementable. Alternative 1 is the most easily implemented since the only activities proposed are long-term monitoring and five-year reviews. Alternative 3 would be more difficult to implement since it involves the construction of a cover system over several acres of land; however, no difficulties are anticipated, as covers are a commonly applied technology involving conventional construction methods and cover materials are available from several vendors.

If additional actions are warranted, they could be easily implemented under Alternative 1. Under Alternative 3, additional actions could be easily implemented, however, opening the cover system to access contaminated materials may be required.

Cost

The costs associated with each alternative are provided in Table 4-2. Alternative 1, No-Action, would cost less to implement than Alternative 3.

4.3 INDIVIDUAL ANALYSIS OF SITE 19 ALTERNATIVES

Detailed evaluations of the three Site 19 remedial alternatives retained for further evaluation are presented in this section. Detailed cost estimates and assumptions for each alternative are presented in Appendix A.

4.3.1 Site 19 - Alternative 1: No-Action

The No Action-Alternative for Site 19 was developed as a baseline case, as required by the NCP. The only activities conducted under this alternative are annual monitoring to evaluate contaminant migration and a review of site conditions and risks every five years.

Overall Protection of Human Health and the Environment

The No-Action Alternative would not provide protection of human health or the environment. No response actions would be taken to contain or treat contaminated soil, sediment, or groundwater and no measures would be implemented to prevent future use of site groundwater. Contaminated soils and groundwater would continue to pose a potential health risk and adversely impact the environment.

The potential human health risks from ingestion, inhalation, and contact with contaminated groundwater would not be reduced under Alternative 1 because it would involve no active treatment of groundwater, no implementation of institutional controls to restrict use of contaminated groundwater, and no source control measures to reduce contaminant leaching to groundwater. The risks to future residential and industrial receptors of site groundwater would exceed EPA's target levels for carcinogens (residential only), non-carcinogens, and lead (residential child).

Site contaminants would also continue to pose a threat to the wetlands adjacent to the site. Because contaminated soils in the topographic depression would remain uncovered and the overflow pipe that connects the topographic depression with the drainage ditch would remain intact, migration of contaminants from the topographic depression into the wetlands via surface water flow may occur under extreme storm conditions.

Leaving the contaminated soil and sediments in place would also pose potential lead poisoning risk to children exposed to site soils, dust, and groundwater under a future residential scenario. Additionally, the ecological risk assessment indicated that contaminated wetland sediments may pose moderate risk to ecological receptors as a result of chromium, zinc, and lead exposure.

Long-term monitoring of groundwater, surface water, and sediment would make it possible to evaluate site conditions and risks. However, because only infrequent monitoring (annual) is proposed, impacts on downgradient receptors may not be identified early enough to provide any additional protection of human health or the environment.

Compliance with ARARs

Because groundwater beneath Site 19 exceeds groundwater quality criteria (GWQC) specified in the New Jersey GWQS [N.J.A.C. 7:9-6] and no actions would be taken to reduce contaminant concentrations or establish a CEA, Alternative 1 would not comply with this standard.

Long-Term Effectiveness and Permanence

Since no remedial actions would occur under Alternative 1, the current and future threats to human health and the environment would remain.

The risk assessment concluded that under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in potential carcinogenic risk of 3.3 E-04 and potential non-carcinogenic risk (HI) of greater than 3.0 for four target organs. These calculated risk values all exceed EPA's target risk range. Exposure to contaminated groundwater under a future industrial land use scenario also resulted in exceedence of EPA's target risk range for non-carcinogenic hazards. Because Alternative 1 would not include any remedial response actions or institutional controls to reduce contaminant concentrations in groundwater or prohibit use of untreated contaminated groundwater, the risk to potential future users of the groundwater would remain unchanged.

The groundwater underlying Site 19 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on the Base (within approximately one mile upgradient of the site). If site land and groundwater usage patterns change in the future, potential residential and industrial users of groundwater would not be protected.

Potential health risks from exposure to lead in site soils, dust, and groundwater were identified using the IEUBK Lead model. The results indicated that 15.5 percent of the children exposed to similar site conditions could have blood-lead levels greater than the EPA guideline of 10 μg/dl; these results exceed the EPA protective guideline of 5 percent of the maximum proportion of individuals. These risks would remain unchanged.

The ecological risk assessment concluded that chromium, zinc, and lead in contaminated wetland sediments may pose moderate risk to ecological receptors. These risks would not be mitigated under the No-Action Alternative because the sediments would remain in place. Because no measures would be taken to prevent surface water outflow from the topographic depression into the drainage ditch, risks to ecological receptors may increase over time as a result of continued migration of contaminated sediments from the depression into the drainage ditch and wetlands.

Under ambient conditions, natural attenuation of the contaminants in site soils, sediment, and groundwater may occur through physical and chemical mechanisms; however, the process is likely to take many years.

Five-year reviews would be required to assess whether human health and ecological risks are increasing or abating with time in light of future land use or changes in the conditions at the site.

No controls would be used to manage site contaminants under the No Action Alternative; therefore, the evaluation of the adequacy and reliability of controls is not applicable.

Reduction of Toxicity, Mobility, or Volume Through Treatment

The No-Action Alternative would not reduce the toxicity, mobility, or volume of contamination through treatment, since no treatment is used to address the contaminated media.

Short-Term Effectiveness

Since no response actions would occur, implementation of the No-Action Alternative would not pose additional short-term risks to Base personnel or the local community. Current risks would remain unabated. None of the RAOs would be achieved. Short-term risks to workers conducting long-term monitoring would be mitigated by use of appropriate procedures and PPE.

Implementability

Since no response activities would occur, the No-Action Alternative is readily implementable. The technical feasibility criteria, including constructibility, operability, and reliability, are not relevant to this alternative. Monitoring to assess contaminant status would pose no implementability concerns. Additional actions can be easily implemented in the future, if warranted.

Permits would not be required under Alternative 1. Coordination with other agencies may be required as part of the long-term monitoring and five-year review processes.

Regulatory personnel and environmental specialists are readily available to perform the environmental monitoring and five-year reviews effectively.

Cost

No capital costs are associated with the No Action Alternative. The average annual O&M cost for long-term monitoring is $16,200 and five-year reviews are $15,500 per event. Over a 30-year period, the net present worth cost is $234,000 (at a 7 percent discount rate).

4.3.2 Site 19 - Alternative 4: Excavation, On-Site Solidification, On-Site Disposal, Natural Attenuation, and Long-term Monitoring

Alternative 4 employs soil treatment to limit exposure to hazardous substances and minimize migration of contaminants to groundwater and the adjacent wetlands. Contaminated sediments and soils from the drainage ditch and topographic depression would be excavated and treated by solidification to immobilize metals. Treated soils would be redeposited in the topographic depression and the depression would be backfilled to grade and closed with an asphalt cover to form a treated-soil containment cell. Contaminants in site groundwater would naturally attenuate over time through precipitation, absorption, dilution, and dispersion after leaching of contaminants from site soils and sediments is abated. Institutional controls would be enacted to limit future uses of the site that may result in intrusion into the treated-soil cell and prohibit the use of untreated groundwater for drinking water. Long-term, annual monitoring of groundwater would be conducted to assess contaminant status and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years since wastes are left on site. Key components of Alternative 4 are identified on Table 3-5.

Overall Protection of Human Health and the Environment

Alternative 4 would provide overall protection of human health and the environment by preventing direct exposure to contaminated soil and sediments, minimizing contaminant migration from site soils into groundwater and the adjacent wetlands, and instituting restrictions on the use of site groundwater.

The potential human health and ecological risks resulting from direct exposure to contaminants in site soils and sediments would be reduced to acceptable levels through excavation, treatment, and on-site containment of all contaminated soils and sediments. Treating and containing site soils and sediments will minimize the potential for direct human or ecological exposure and will thereby minimize excess risks. Treatment and containment of soils and sediments will also provide long term protection of the environment by reducing migration of contaminants to groundwater and the wetlands adjacent to the site.

The potential human health risks from ingestion, inhalation, and contact with contaminated groundwater would be reduced to acceptable levels under Alternative 4 through natural attenuation of groundwater contamination and implementation of institutional controls. Immobilization of contaminants in site soils and sediments will significantly reduce additional leaching of contaminants to the underlying groundwater. Eliminating the source of groundwater contamination will eventually result in a permanent reduction in human health risk as groundwater contaminant concentrations decrease to acceptable levels (GWQSs) through precipitation, absorption, dilution, and dispersion. The groundwater underlying Site 19 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells

and domestic wells are situated elsewhere on the Base (within approximately 1 mile upgradient of the site). If site land and groundwater usage changes in the future, implementation of institutional controls (access restrictions and CEA) to prohibit use of untreated site groundwater for drinking water will provide protection of human health in the interim, until GWQS are achieved.

Solidification and on-site containment of soils is expected to provide permanent protection from direct contact exposures. Access restrictions would provide additional assurance of long-term protection by restricting activities that could intrude into the treated soils. Solidification is potentially permanent in preventing metals leaching; however, long-term periodic monitoring of groundwater would be required to monitor its effectiveness.

The long-term monitoring program would allow the responsible agency to monitor the quality of groundwater leaving the site, evaluate the long-term effectiveness and reliability of solidification, and natural attenuation, assess potential impacts to downgradient receptors, and determine whether additional remedial actions are necessary to protect human health or the environment.

Use of engineering controls to minimize generation of fugitive dusts and migration of suspended contaminants in surface water, and proper use of PPE by site workers would effectively minimize short-term risks to the local community and workers posed by implementation of this alternative.

Compliance with ARARs

Implementation of Alternative 4 would comply with all ARARs identified in Tables 2-1 through 2-6.

Because Alternative 4 does not include active treatment of groundwater, initially, the groundwater beneath Site 19 would not meet the constituent concentrations specified in the New Jersey GWQS [N.J.A.C. 7:9-6]. However, solidification treatment of the contaminated soils and sediments would immobilize the metals, preventing further migration of contaminants into groundwater and facilitating natural attenuation of contaminants. Ultimately, natural attenuation would result in attainment of groundwater quality criteria (GWQC). Alternative 4 includes a provision to seek a temporary exemption (CEA) from these requirements until the GWQC are achieved through natural attenuation. The CEA would be established to provide the state official notice that the constituent standards would not be met for a specified duration and to ensure that consumption of the untreated groundwater is prohibited.

The potential effects of the proposed remediation on wetlands, floodplains, water bodies, and other sensitive receptors would be identified during the design of Alternative 4 and all necessary measures would be taken

to comply with the federal and state location-specific ARARs identified in Tables 2-3 and 2-4. For example, to comply with federal and state wetlands protection rules [40 CFR 6, App. A & N.J.A.C. 7:7A] use of engineering controls would be required during excavation of drainage ditch sediments to minimize harm to the adjacent wetlands. The on-site treatment facility would be sited outside the 100-year floodplain in accordance with federal and state hazardous waste facility siting criteria [40 CFR 264.18(a) and N.J.A.C. 7:26-13]. It is expected that Alternative 4 would easily comply with all identified location-specific ARARs.

If excavated soils and sediments are determined to be hazardous wastes, the on-site treatment facility proposed under Alternative 4 would be constructed and operated in accordance with federal and state hazardous waste facility regulations [40 CFR 265 Subparts B, C, D, E; 40 CFR 264 Subpart X; and N.J.A.C. 7:26-9]. These regulations identify general facility requirements, groundwater monitoring, preparedness and prevention, contingency and emergency procedures, and recordkeeping requirements. Treatment would also be conducted in compliance with state treatment regulations [N.J.A.C. 7:26-11.7] which detail operating requirements, waste analyses and monitoring of treatment conditions, and handling and compatibility of wastes in chemical, physical, and biological treatment processes.

Alternative 4 would be implemented in compliance with RCRA Land Disposal Restrictions [40 CFR 268]. Only treated wastes that meet the LDR requirements would be disposed on-site.

Brief descriptions of the cited requirements are provided in Section 2.2 of this report.

Long-Term Effectiveness and Permanence

Alternative 4 would provide long term protection of human health and the environment and would result in permanent reduction in all identified health risks.

The risk assessment concluded that under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in potential carcinogenic risk of 3.3 E-04 and potential non-carcinogenic risk (HI) of greater than 3.0 for four target organs. These calculated risk values all exceed EPA's target risk range. Exposure to contaminated groundwater under a future industrial land use scenario also resulted in exceedence of EPA's target risk range for non-carcinogenic hazards. These risks would be reduced under Alternative 4 through natural attenuation of groundwater contamination and implementation of institutional controls. Solidification treatment of source area soils and sediments will immobilize the metals and prevent additional leaching of metals to the underlying groundwater. Eliminating the groundwater contaminant source will eventually result in a permanent reduction in human health risk as groundwater contaminant concentrations decrease to acceptable levels (GWQSs) through precipitation, absorption, dilution, and dispersion. The groundwater underlying Site 19 is not currently used as a potable

water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on the Base (within approximately one mile upgradient of the site). If site land and groundwater usage changes in the future, implementation of institutional controls (access restrictions and CEA designation) to prohibit use of untreated site groundwater for drinking water will provide protection of human health in the interim, until GWQS are achieved.

Potential health risks from exposure to lead in site soils, dust, and groundwater were identified using the IEUBK lead model. The results indicated that 15.5 percent of the children exposed to similar site conditions could have blood-lead levels greater than 10 μg/dl these results exceed the EPA protective guideline of 5 percent of the maximum proportion of individuals. Treatment and on-site containment of contaminated soil and sediment and imposition of institutional controls that prohibit use of untreated groundwater would eliminate the potential for direct exposure to lead contaminated media and effectively eliminate excess health risk posed by lead-contaminated soil, sediment, and groundwater.

The ecological risk assessment concluded that chromium, zinc, and lead in contaminated wetland sediments may pose moderate risk to ecological receptors. These risks would be mitigated under Alternative 4 through removal and treatment of contaminated drainage ditch sediments and immobilization of contaminants in source area soils to prevent redeposition of contaminants via surface water outflow.

Solidification is a reliable technology for long-term immobilization of metals in soils and sediments. Combined with backfilling and containment, solidification is expected to provide permanent protection from direct contact exposures. Access restrictions would provide additional assurance of long-term protection by restricting activities that could intrude into the treated soils. Solidification is a potentially permanent method for immobilization of metals; however, long-term periodic monitoring of groundwater would be required to evaluate its effectiveness.

The long-term monitoring program would allow the responsible agency to monitor the quality of groundwater leaving the Site, evaluate the long-term effectiveness and reliability of solidification and natural attenuation, assess potential impacts to downgradient receptors, and determine whether additional remedial actions are necessary to protect human health or the environment.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Implementation of Alternative 4 would reduce the mobility of contaminants in soil and sediments through treatment by solidification. Metals in site soils and sediments would be effectively immobilized through treatment. No reduction in toxicity or volume of soil and sediment contamination would be achieved.

Alternative 4 would reduce the toxicity mobility, and volume of groundwater contaminants via natural attenuation.

Short-Term Effectiveness

Implementation of Alternative 4 is not expected to pose any significant risks to the Base personnel, the local community, site workers, or the environment.

During site preparation, excavation, and treatment of contaminated soils and sediments, short-term risks posed to Base personnel, site workers, and the environment would be mitigated through use of engineering controls and appropriate PPE. Adverse impacts to Base personnel by fugitive dust (bearing adsorbed contaminants) would be minimized by appropriate engineering control measures such as dust suppressants. Workers who implement Alternative 4 would be adequately safeguarded by using appropriate PPE to prevent exposure to contaminated soils/sediments and airborne VOCs. OSHA standards would be followed and proper PPE would be used during all remedial activities.

Erosion control measures such as hay bales and silt fences would be would be used to prevent damage to the environment from sediment suspension and migration during excavation of drainage ditch sediments. No permanent adverse impacts to the human health or the environment are anticipated to result from implementation of Alternative 4.

Alternative 4 soil and sediment remediation would require approximately 8 months to implement, including pre-design and design activities. Upon completion of soil and sediment treatment, Alternative 4 would achieve the RAO for protection of human health by preventing exposure to contaminated soils and the RAO for minimizing migration of contaminants to groundwater and the adjacent wetlands. The RAO for protection of human health by preventing exposure to contaminated groundwater will be achieved in the short item access restrictions are implemented and the groundwater CEA is established; these activities may take up to a year, and in the long term by natural attention of groundwater containments.

Implementability

Alternative 4 is implementable. There are no anticipated difficulties or uncertainties in excavating or treating contaminated soil and sediment, or disposing and covering treated materials. Common construction techniques are required for excavation and on-site disposal. Precautions may be required to minimize damage to the wetlands during excavation of drainage ditch sediments.

Solidification is a well demonstrated technology employing relatively common equipment and materials. Several vendors are available that could provide the necessary equipment, materials, and services necessary to treat the volume of materials at Site 19.

Long-term monitoring (sampling and analyses) only requires readily available resources. Access restrictions should not be difficult to implement and enforce, since the site is part of an active Navy base and coordination with other agencies and property owners is not necessary.

Contaminant migration and exposure pathways can be adequately assessed during implementation of Alternative 4 by monitoring groundwater quality. Long-term monitoring of groundwater would be effective for detecting changes in media quality that may indicate failure of the solidification treatment (leaching of contaminants from the treated soils) and for identifying potential impacts to downgradient receptors.

Permits would not be required under Alternative 4 since all activities would be conducted on the site; however, the substantive requirements of all ARARs would be met as described previously.

There is ample availability of companies with the trained personnel, equipment, and materials to perform site preparation, excavation, treatment, disposal, and long-term monitoring. Regulatory personnel and environmental specialists are readily available to perform five-year reviews.

Cost

The capital costs for Alternative 4 total $491,000. The average annual O&M costs are $21,600, and five-year reviews cost $15,500 per event. Over a 30-year period, the net present worth cost is $793,000 (at a 7 percent discount rate).

4.3.3 Site 19 - Alternative 5: Excavation and Disposal

This alternative would constitute closure of Site 19. All contaminated soils and sediments in excess of selected clean-up goals would be excavated and sent off site for disposal. Contaminants in site groundwater would naturally attenuate over time through precipitation, absorption, dilution, and dispersion after contaminated soils and sediments are removed. Institutional controls would be temporarily enacted to prohibit the use of untreated groundwater for drinking water until GWQS are met. Long-term, annual monitoring of groundwater would be conducted to assess contaminant status and potential threats to human health and the environment. Site conditions and risks would be reviewed every five years since wastes are left in place. Key components of Alternative 5 are identified on Table 3-5, the two disposal options are described below.

A. Off-Base Disposal: Under this option, excavated soils would be transported off-base to an appropriate hazardous or industrial waste-type landfill. TCLP testing of soils would be necessary to determine the appropriate disposal facility. If necessary, off-site treatment of the soils will be conducted to immobilize metals prior to disposal.

B. Disposal in On-Base Landfill: If Capping is the selected remedial alternative for the Site 4 landfill, the excavated soils from Site 19 could be consolidated in their existing landfills prior to capping. While this option would not result in the soils leaving the Base, it would allow clean closure of Site 19 without significantly altering the remedial action at Site 4.

Overall Protection of Human Health and the Environment

Alternatives 5A and 5B

Alternatives 5A and 5B would provide overall protection of human health and the environment by eliminating the potential for direct exposure to contaminated soil and sediments, preventing contaminant migration from site soils into groundwater and the adjacent wetlands, and instituting restrictions on use of site groundwater.

The potential human health and ecological risks resulting from direct exposure to contaminants in site soils and sediments would be reduced to acceptable levels through excavation and off site disposal of all contaminated soils and sediments. Removal of site soils and sediments will eliminate the potential for direct human or ecological exposure, thereby eliminating excess risks, and will also provide long term protection of the environment by stopping migration of contaminants to groundwater and the wetlands adjacent to the site.

The potential human health risks from ingestion, inhalation, and contact with contaminated groundwater would be reduced to acceptable levels under Alternatives 5A and 5B through natural attenuation of groundwater contamination and implementation of institutional controls. Removal of contaminated site soils and sediments will prevent additional leaching of contaminants to the underlying groundwater. Eliminating the source of groundwater contamination will eventually result in a permanent reduction in human health risk as groundwater contaminant concentrations decrease to acceptable levels (GWQSs) through precipitation, absorption, dilution and dispersion. The groundwater underlying Site 19 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on the Base (within approximately 1 mile upgradient of the site). If site land and groundwater usage changes in the future, implementation of institutional controls (access restrictions and CEA designation) to prohibit use of untreated site groundwater for drinking water will provide protection of human health in the interim, until GWQS are achieved.

Removal of contaminated soils and sediments will provide permanent protection from direct contact exposures and will permanently prevent leaching of contaminants to the groundwater underlying Site 19.

Long-term groundwater monitoring will allow the responsible agency to assess the progress of natural attenuation of groundwater contamination and evaluate potential impacts to downgradient receptors, and determine whether additional remedial actions are necessary to protect human health or the environment.

Use of engineering controls to minimize generation of fugitive dusts and migration of suspended contaminants in surface water, and proper use of PPE by site workers would effectively minimize short-term risks to the local community and workers posed by implementation of this alternative.

Compliance with ARARs

Alternatives 5A and 5B

Implementation of Alternatives 5A and 5B would comply with all ARARs identified in Tables 2-1 through 2-6.

Because active treatment of groundwater would not be conducted, initially, the groundwater beneath Site 19 would not meet the constituent concentrations specified in the New Jersey GWQS [N.J.A.C. 7:9-6]. However, excavation and removal of the contaminated soils and sediments in the topographic depression and drainage ditch would prevent further migration of contaminants into groundwater and facilitate natural attenuation of contaminants. Ultimately, natural attenuation would result in attainment of groundwater quality criteria (GWQC). Alternatives 5A and 5B include a provision to seek a temporary exemption (CEA) from these requirements until the GWQC are achieved through natural attenuation. The CEA would be established to provide the state official notice that the constituent standards would not be met for a specified duration and to ensure that consumption of the untreated groundwater is prohibited.

The potential effects of the proposed remediation on wetlands, floodplains, water bodies, and other sensitive receptors would be identified during the design of Alternatives 5A and 5B and all necessary measures would be taken to comply with the federal and state location-specific ARARs identified in Tables 2-3 and 2-4. For example, to comply with federal and state wetlands protection rules [40 CFR 6, App. A and N.J.A.C. 7:7A] use of engineering controls would be required during excavation of drainage ditch sediments to minimize harm to the adjacent wetlands. It is expected that Alternatives 5A and 5B would easily comply with all identified location-specific ARARs.

If excavated soils and sediments are determined to be hazardous wastes, their handling, management, and off-site transport would be conducted in accordance with RCRA hazardous waste generator and transporter requirements [40 CFR parts 262 and 263] and New Jersey labeling, records, and transportation requirements [N.J.A.C. 7:26-7].

Under Alternative 5A, if it is determined that soils and sediments are subject to RCRA Land Disposal Restrictions [40 CFR 268], soils would be treated off-site prior to disposal, in accordance with these regulations. Any wastes determined to be subject to LDRs would be disposed off-site at a RCRA Subtitle C facility.

Under Alternative 5B, only wastes that pass the RCRA characteristics tests (40 CFR 261) would be disposed at the existing on-base landfill. Any other wastes subject would be disposed off-site at a RCRA Subtitle C facility.

Brief descriptions of the cited requirements are provided in Section 2.2 of this report.

Long-Term Effectiveness and Permanence

Alternatives 5A and 5B

Alternatives 5A and 5B would provide long term protection of human health and the environment and would result in permanent reduction in all identified health risks.

The risk assessment concluded that under a future residential land use scenario, exposure to contaminated groundwater beneath the site would result in potential carcinogenic risk of 3.3 E-04 and potential non-carcinogenic risk (HI) of greater than 3.0 for four target organs. These calculated risk values all exceed EPA's target risk range. Exposure to contaminated groundwater under a future industrial land use scenario also resulted in exceedence of EPA's target risk range for non-carcinogenic hazards. These risks would be reduced under Alternatives 5A and 5B through natural attenuation of groundwater contamination and implementation of institutional controls. Removal of source area soils and sediments will prevent additional leaching of metals to the underlying groundwater. Eliminating the groundwater contaminant source will eventually result in a permanent reduction in human health risk as groundwater contaminant concentrations decrease to acceptable levels (GWQSs) through precipitation, absorption, dilution, and dispersion. The groundwater underlying Site 19 is not currently used as a potable water supply and there are no existing plans for its use; however, public non-community wells and domestic wells are situated elsewhere on the base (within approximately one mile upgradient of the site). If site land and groundwater usage changes in the future, implementation of institutional controls (access

restrictions and CEA designation) to prohibit use of untreated site groundwater for drinking water will provide protection of human health in the interim, until GWQS are achieved.

Potential health risks from exposure to lead in site soils, dust, and groundwater were identified using the IEUBK lead model. The results indicated that 15.5 percent of the children exposed to similar site conditions could have blood-lead levels greater than 10 μg/dl these results exceed the EPA protective guideline of 5 percent of the maximum proportion of individuals. Removal of contaminated soil and sediment and imposition of institutional controls that prohibit use of untreated groundwater would eliminate the potential for direct exposure to lead contaminated media and effectively eliminate excess health risk posed by lead-contaminated soil, sediment, and groundwater.

The ecological risk assessment concluded that chromium, zinc, and lead in contaminated wetland sediments may pose moderate risk to ecological receptors. These risks would be mitigated under Alternatives 5A and 5B through removal of contaminated drainage ditch sediments and removal of source area soils to prevent redeposition of contaminants via surface water outflow.

Long-term groundwater monitoring will allow the responsible agency to assess the progress of natural attenuation of groundwater contamination, evaluate potential impacts to downgradient receptors, and determine whether additional remedial actions are necessary to protect human health or the environment.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternatives 5A and 5B

Alternatives 5A and 5B would not reduce the toxicity, mobility, or volume of soil/sediment contaminants through treatment since no treatment would be conducted. The mobility of contaminants in the environment would be reduced only by placement of contaminated soil and sediment in a controlled landfill. Groundwater contaminants toxicity, mobility, and volume would be reduced by natural attenuation.

Short-Term Effectiveness

Alternative 5A

Implementation of Alternative 5A is not expected to pose any significant risks to the Base personnel, the local community, workers, or the environment.

During excavation of contaminated soils and sediments, short-term risks posed to Base personnel, site workers, and the environment would be mitigated through use of engineering controls and appropriate PPE. Adverse impacts to base personnel by fugitive dust (bearing adsorbed contaminants) would be minimized by

appropriate engineering control measures such as dust suppressants. Workers who implement Alternative 5A would be adequately safeguarded by using appropriate PPE to prevent exposure to contaminated soils/sediments, contaminant-laden dusts, and airborne VOCs. OSHA standards would be followed and proper PPE would be used during all remedial activities.

Erosion control measures such as hay bales and silt fences would be would be used to prevent damage to the environment from sediment suspension and migration during excavation of drainage ditch sediments. No permanent adverse impacts to the human health or the environment are anticipated to result from implementation of Alternative 5A.

Somewhat increased truck and heavy equipment vehicular traffic would occur for a short time as the result of excavation and off-base transport of contaminated soils/sediments. Coordination, routing, and scheduling of truck and heavy equipment traffic on public roads would be required to manage increased vehicular activity. Equipment such as covered trucks would be used (excavation and disposal of soil and sediments) to minimize spills and migration of contaminants during transport.

Alternative 5A, would require approximately 2.5 months to implement, including TCLP analysis of soils to determine the appropriate disposal facility. Upon completion of soil and sediment removal, Alternative 5A would achieve the RAO for protection of human health by preventing exposure to contaminated soils and the RAO for minimizing migration of contaminants to groundwater and the adjacent wetlands. The RAO for protection of human health by preventing exposure to contaminated groundwater will be achieved in the short-term when access restrictions are implemented and the groundwater CEA is established (these activities may take up to a year); and in the long term by natural attenuation of groundwater containments.

Alternative 5B

The short-term effectiveness of Alternative 5B would be nearly identical to that of Alternative 5A. The only differences would be in transportation impacts and time to achieve RAOs.

Because Alternative 5B would involve disposal of contaminated soils and sediments on-base at Site 4, any impacts to the local community resulting from transportation of contaminated materials off-base would be eliminated. Any short-term impacts or inconvenience to local residents resulting from additional truck traffic on local roads would be minimal.

Somewhat increased truck and heavy equipment vehicular traffic on-base would occur for a short time as the result of excavation and on-base transport of contaminated materials to Site 4. The transportation impacts to

the Base personnel and residents would be minimized by coordination, routing, and scheduling of truck traffic and use of equipment such as covered trucks to minimize spills and migration of contaminants during transport.

Alternative 5B may take somewhat longer to implement than Alternative 5A due to additional start-up time required for design of the landfill cap for Site 4 and preparation of the landfill for capping. These activities would require approximately 11 months to complete. Once excavation of Site 19 soils and sediments commences, it would require less than one month to complete. Upon completion of soil and sediment removal, Alternative 5B would achieve the RAO for protection of human health by preventing exposure to contaminated soils and the RAO for minimizing migration of contaminants to groundwater and the adjacent wetlands. The RAO for protection of human health by preventing exposure to contaminated groundwater will be achieved in the short term when access restrictions are implemented and the groundwater CEA is established (these activities may take up to a year); and in the long term by natural attenuation of groundwater containments.

Implementability

Alternative 5A

Alternative 5A is implementable. There are no anticipated difficulties or uncertainties in excavating or disposing of contaminated soil and sediment. Common construction techniques and equipment are required for excavation and off-base transport. Precautions may be required to minimize damage to the wetlands during excavation of drainage ditch sediments.

Sufficient commercial landfill capacity is available to handle the small volume (approximately 260 cubic yards) of contaminated materials that would require off-base disposal.

Long-term monitoring (sampling and analyses) only requires readily available resources. Access restrictions should not be difficult to implement and enforce, since the site is part of an active Navy base and coordination with other agencies and property owners is not necessary.

Contaminant migration and exposure pathways can be adequately assessed during implementation of Alternative 5A by monitoring groundwater quality. Long-term monitoring of groundwater would be effective for monitoring the progress of natural attenuation and identifying potential impacts to downgradient receptors.

Permits (manifests) would be required and obtainable for off-base transportation and disposal of contaminated materials.

There is ample availability of companies with the trained personnel, equipment, and materials to perform excavation, disposal, and long-term monitoring. Regulatory personnel and environmental specialists are readily available to perform five-year reviews.

Alternative 5B

The implement ability of Alternative 5B would be nearly identical to that of Alternative 5A. The only differences would be that no off-base disposal capacity and no permits for off-base transportation or disposal would be required.

Sufficient area exists at the Site 4, landfill to accommodate the small volume of materials from Site 19 (approximately 260 cubic yards) without significantly altering the cap design or material requirements. The 260 cy of soils would cover 1 acre of land with a thickness of approximately 2 inches. The material from Site 19 could be used as subgrade in areas where the elevation needs to be raised to achieve the proper base grades.

Cost

Alternative 5A

The capital costs for Alternative 5A total $375,000. The average annual O&M costs are $21,600, and five-year reviews cost $15,500 per event. Over a 30-year period, the net present worth cost is $677,000 (at a 7 percent discount rate).

Alternative 5B

The capital costs for Alternative 5B total $153,000. The average annual O&M costs are $21,600, and five-year reviews cost $15,500 per event. Over a 30-year period, the net present worth cost is $455,000 (at a 7 percent discount rate).

4.3.4 Comparative Analysis of Site 19 Alternatives

As part of the detailed analysis, comparisons of the remedial alternatives are made to identify differences between the alternatives and how site contaminant threats are addressed. The two alternatives are compared with respect to each of the evaluation criteria and differences are identified. Table 4-3 presents summaries of the evaluations for each alternative.

TABLE 4-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY

CRITERION:	ALTERNATIVE 1: NO ACTION	ALTERNATIVE 4: EXCAVATION, ON-SITE SOLIDIFICATION, ON-SITE DISPOSAL, NATURAL ATTENUATION, AND LONG-TERM MONITORING	ALTERNATIVE 5*: EXCAVATION, OFF-SITE DISPOSAL, NATURAL ATTENUATION, AND LONG-TERM MONITORING
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT			
Prevent Human Exposure to Contaminated Soils.	No action taken to prevent human exposure to contaminated soils and sediments.	Excavation, treatment, and on-site disposal would prevent direct contact with contaminated materials.	Excavation and off-site disposal would prevent direct contact with contaminated materials.
Prevent Human Exposure to Contaminated Groundwater	No action taken to prevent human exposure to contaminated groundwater. Carcinogenic and non-carcinogenic risks exceeding EPA's target risk range would remain. No actions taken to reduce contaminant leaching to groundwater. No institutional controls implemented to prohibit use of untreated groundwater for drinking water.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. Excavation and solidification of soils would reduce leaching of contaminants to groundwater, facilitating natural attenuation of contaminants. In time, contaminant concentrations would reach levels that would not pose excess risk.	Institutional controls would minimize potential exposure to site groundwater by prohibiting its use. Excavation and off-site disposal of soils would reduce leaching of contaminants to groundwater, facilitating natural attenuation of contaminants. In time, contaminant concentrations would reach levels that would not pose excess risk.
Minimize Contaminant Migration to Groundwater and Adjacent Wetlands	No actions taken to reduce contaminant migration to groundwater or wetlands. Contaminants would continue to leach into groundwater and migrate into wetlands via surface runoff.	Excavation and solidification of contaminated soils would reduce leaching of contaminants to groundwater and would reduce migration of contaminants to the environment by surface water and wind erosion.	Excavation and removal of contaminated soils would reduce leaching of contaminants to groundwater and would reduce migration of contaminants to the environment by surface water and wind erosion.

TABLE 4-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 2

COMPLIANCE WITH ARARs			
Chemical-Specific ARARs	Would not comply with state groundwater quality standards.	Groundwater contaminant concentrations would initially exceed state GWQC; over time GWQC would be achieved by natural attenuation. A classification exception area (CEA) would be established to provide the state official notification that standards would not be met for a specified duration. Alternative 4 would be implemented in compliance with RCRA Land Disposal Restrictions.	Same as Alternative 4.
Location-Specific ARARs	Not Applicable.	Would comply with federal and state ARARs for wetlands, floodplains, and other sensitive receptors.	Same as Alternative 4.
Action-Specific ARARs	Not Applicable.	If soils and sediments are determined to be hazardous, Alternative 4 would comply with federal and state ARARs for siting and operation of hazardous waste treatment facilities.	If soils and sediments are determined to be hazardous, Alternative 5 would comply with federal and state ARARs for transport/disposal of hazardous waste.

TABLE 4-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 3

LONG-TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk	Existing risks would remain: Approximately 3.3 x 10^{-4} ECR and HI = 3.0 non-carcinogenic risks from exposure to site groundwater; Risks exceeding EPA's protective guideline for exposure to lead in soil, dust, and groundwater (estimated 15.5 percent children exposed may have blood lead levels >10μg/l vs guideline of maximum 5 percent).	Implementation and enforcement of institutional controls would reduce risks from exposure to site groundwater to less than 1 x 10^{-6} and HI less than 1.0. Over time, natural attenuation would result in permanently reduced risks. Excavation, treatment, and on-site containment of contaminated soils and sediments would reduce direct exposure risks to acceptable levels for lead exposure.	Implementation and enforcement of institutional controls would reduce risks from exposure to site groundwater to less than 1 x 10^{-6} and HI less than 1.0. Over time, natural attenuation would result in permanently reduced risks. Excavation and off-site disposal of contaminated soils and sediments would reduce direct exposure risks to acceptable levels for lead exposure.
Adequacy and Reliability of Controls	No new controls implemented.	Solidification is a widely demonstrated, reliable technology for immobilization of metals in soils and sediments. Combined with on-site containment, solidification is expected to provide permanent protection from direct contact exposures and long-term reduction in contaminant leaching to groundwater.	Because contaminated soils and sediments would be removed, no controls would be necessary for preventing exposure and reducing contaminant migration to the environment. If implemented and enforced, institutional controls could prevent use of contaminated groundwater.
Need for 5-Year Review	Review would be required since soil and groundwater contaminants would be left in place.	Same as Alternative 1.	Review would be required since groundwater contaminants would remain, in excess of GWQC.
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT			
Treatment Process Used	None.	Solidification/Natural Attenuation	Natural Attenuation
Amount Treated or Destroyed	None.	260 cubic yards of soil/sediment. All of contaminated groundwater.	All of contaminated groundwater.

TABLE 4-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 4

Reduction of Toxicity, Mobility, or Volume Through Treatment	No reduction, since no treatment would be employed.	Mobility of metals in soils and sediments reduced through treatment by solidification. Contaminated groundwater treated through natural attenuation.	Contaminated groundwater treated through natural attenuation.
Irreversible Treatment	Not Applicable	Solidification treatment is expected to provide effective long-term immobilization of contaminants. Since contaminants are immobilized, rather than destroyed, treatment may not be irreversible. Contaminatd groundwater irreversibly addressed by natural attenuation.	Contaminatd groundwater irreversibly addressed by natural attenuation.
Statutory Preference for Treatment	No	Yes	Yes
SHORT-TERM EFFECTIVENESS			
Community Protection	No risk to community anticipated.	No significant risk to community anticipated. Engineering controls would be used during implementation to mitigate risks.	Same as Alternative 4.
Worker Protection	No risk to workers anticipated if proper PPE is used during long-term monitoring.	No significant risk to workers anticipated if proper PPE is used during remediation and long-term monitoring.	Same as Alternative 4.
Environmental Impacts	No adverse impacts to the environment anticipated.	No significant impacts to the environment anticipated. Engineering controls would be used during implementation to mitigate risks.	Same as Alternative 4.

TABLE 4-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 5

Time Until Action is Complete	Not applicable.	8 months until RAOs for exposure to contaminated soils and sediments achieved. 1 year until RAOs for exposure to site groundwater are achieved.	Alternative 5A: 2.5 months until RAOs for exposure to contaminated soils and sediments achieved. Alternative 5A: 11months until RAOs for exposure to contaminated soils and sediments achieved (including time to prepare Site 4 landfill for acceptance of excavated soils). Both 5A and 5B: 1 year until RAOs for exposure to site groundwater are achieved.
IMPLEMENTABILITY			
Ability to Construct and Operate	No construction or operation involved.	No construction or operational difficulties anticipated. Common construction techniques used for excavation and on-site disposal. Precautions would be taken to minimize damage to wetlands during excavation. Solidification is a well demonstrated technology employing common equipment and materials.	No construction or operational difficulties anticipated. Common construction techniques and equipment used for excavation and off-site disposal. Precautions would be taken to minimize damage to wetlands during excavation.
Ease of Doing More Action if Needed	Additional actions would be easily implemented if required.	If additional actions are warranted, the solidified materials could be excavated and removed.	Same as Alternative 1.
Ability to Monitor Effectiveness	Monitoring would provide assessment of potential exposures, contaminant presence, migration, or changes in site conditions.	Same as Alternative 1.	Same as Alternative 1.

TABLE 4-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 6

Ability to Obtain Approvals and Coordinate with Other Agencies	Coordination for 5-year reviews may be required and would be obtainable.	Coordination for 5-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable.	Coordination for 5-year reviews may be required and would be obtainable. Coordination with the state would be required to establish a CEA and would be obtainable. Alt. 5A: manifests would be required for off-site transportation and disposal of contaminated materials.
Availability of Treatment, Storage Capacities, and Disposal Services	None required.	No off-site TSD capacity or services required. Ample availability of companies to provide equipment and services for solidification treatment.	Alt. 5A: Sufficient commercial landfill capacity available for materials requiring disposal. Alt. 5B: Sufficient area available for disposal of materials at the Site 4 landfill.
Availability of Equipment, Specialists, and Materials	Personnel and equipment available for implementation of long-term monitoring and 5- year reviews.	Ample availability of companies with trained personnel, equipment, and materials to perform excavation, treatment, disposal, long-term monitoring, and 5-year reviews.	Ample availability of companies with trained personnel, equipment, and materials to perform excavation, off-site disposal, long-term monitoring, and 5-year reviews.
Availability of Technology	Not required.	Solidification is a well demonstraded technology employing relative common and available equipment and materials. Several vendors are available that could provide the necessary equipment and materials.	Common construction techniques and materials required for excavation and off-site disposal

TABLE 4-3
SITE 19 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
OU-1 FEASIBILITY STUDY
NWS EARLE, COLTS NECK, NEW JERSEY
PAGE 7

COST			
Capital Cost	$0	$491,000	Alt. 5A: $375,000 Alt. 5B: $153,000
First-Year Annual O&M Cost	$16,200	$21,600	Alt. 5A: $21,600 Alt. 5B: $21,600
Present Worth Cost	$234,000	$793,000	Alt. 5A: $677,000 Alt. 5B: $455,000

Notes:
* Evaluation presented pertains to Alternative 5A (off-base disposal) and Alternative 5B (on-base disposal) unless otherwise noted.

Overall Protection of Human Health and the Environment

Alternatives 4 and 5 would be protective of human health and the environment. Because no actions are conducted, Alternative 1 would not reduce human health or ecological risk and would not reduce contaminant migration to the environment. Health risks and adverse impacts to the environment are expected to increase over time as the landfill surface deteriorates.

Alternatives 4 and 5 are similarly protective of human health and the environment. Both alternatives eliminate the potential for direct contact with contaminated materials. By reducing or preventing leaching of contaminants from site soils and sediments, both alternatives minimize contaminant migration into the environment and facilitate natural attenuation of groundwater contamination.

By excavating and transporting contaminated materials off-site, Alternative 5A results in permanent protection of health and the environment at Site 19. However, because the soils and sediments are not treated, the potential long-term risks and long-term monitoring considerations are transferred to another location: to an off-base landfill under Alternative 5A and to an on-base landfill under Alternative 5B.

In contrast, Alternative 4 incorporates treatment that immobilizes contaminants. The solidification technology has been widely demonstrated and would be expected to provide long-term protection, but monitoring would be required to ensure the continued effectiveness and permanence of this Alternative.

Both Alternatives 4 and 5 include institutional controls that would provide assurance that untreated contaminated groundwater is not used as a potable water source in the future; Alternative 1 would not include any institutional controls to protect future users of site groundwater.

Compliance with ARARs

Alternative 1 would not comply with state ARARs for attainment of groundwater quality criteria [N.J.A.C. 7:9-6], or include a provision to seek a temporary exemption.

Implementation of Alternatives 4 and 5 would comply with all ARARs identified in Tables 2-1 through 2-6. Alternatives 4 and 5 would eventually meet GWQC through natural attenuation and both include a provision to seek a temporary exemption (CEA) from these requirements until the GWQC are achieved through natural attenuation.

Compliance with location-specific ARARs would be the same under Alternatives 4 and 5. The potential effects on wetlands, floodplains, water bodies, and other sensitive receptors would be identified during the design of each alternative and all necessary measures would be taken to comply with the federal and state location-specific ARARs identified in Tables 2-3 and 2-4.

Alternative 4 would be constructed and operated in accordance with federal and state hazardous waste facility regulations [40 CFR 265 Subparts B, C, D, E; 40 CFR 264 Subpart X; and N.J.A.C. 7:26-9] if excavated soils and sediments are determined to be hazardous wastes.

Alternative 5 would be conducted in accordance with RCRA hazardous waste generator and transporter requirements [40 CFR parts 262 and 263] and New Jersey labeling, records, and transportation requirements [N.J.A.C. 7:26-7] if excavated soils and sediments are determined to be hazardous wastes.

Both Alternative 4 and Alternative 5 would be implemented in compliance with RCRA Land Disposal Restrictions [40 CFR 268].

Long-Term Effectiveness and Permanence

Only Alternatives 4 and 5 offer long-term protection of human health and the environment. Since no remedial actions would occur under Alternative 1 to treat, contain, or remove contaminated soils and sediments, the current and future threats to human health and the environment from direct exposure to these media would remain and contaminant migration to groundwater would continue unabated. Because no institutional controls would be implemented to prohibit use of untreated contaminated groundwater, the risk to potential future users of the groundwater would remain unchanged.

Alternatives 4 and 5 would both reduce human and ecological risks due to direct exposure to site contaminants by eliminating the potential for exposure. Alternative 4 would achieve long-term protection by immobilizing contaminants and disposing treated soils in an on-site containment cell. Monitoring would ensure the long-term effectiveness and permanence of treatment. Alternative 5 would achieve long-term protection by excavating and disposing of soils off-site. The action would permanently reduce risks as Site 19, but contaminant mobility in the environment would not be reduced. The requirement for long-term monitoring would be transferred to the disposal location.

Long-term risks due to ingestion of site groundwater would be reduced under Alternatives 4 and 5 by reducing contaminant leaching into groundwater and natural attenuation of groundwater contaminants, and by implementing institutional controls to prohibit use of untreated, contaminated groundwater. Alternative 1 would not include any measures to reduce these risks.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Only Alternative 4 would reduce the mobility of soil/sediment contaminants through treatment. Because neither Alternative 1 or Alternative 5 includes soil/sediment treatment, neither would reduce the toxicity, mobility, or volume through treatment.

Natural attenuation would reduce the toxicity, mobility and volume of contaminated groundwater over time under all three alternatives, athough GWQS would be met much faster under Alternatives 4 and 5.

Short-Term Effectiveness

The short-term effectiveness of the three alternatives would be similar since the use of appropriate engineering controls and PPE is expected to minimize adverse impacts to Base residents and personnel, the local community, and workers during implementation.

Long-term monitoring, the only on-site action proposed under Alternative 1, would provide little opportunity for short-term impact to the local community or the environment.

Alternatives 4 and 5 would present a greater opportunity for short-term impacts to human health and the environment due to excavation and handling of contaminated soils and sediments. Alternative 5A would present the greatest opportunity for short-term impact, as it is the only alternative that includes off-Base transport of contaminated soils/sediments. In all cases, short-term /risks posed to Base personnel, site workers, and the environment under either alternative would be mitigated through use of engineering controls and appropriate PPE. No permanent adverse impacts to the human health or the environment are anticipated to result from implementation of Alternatives 4 or 5.

Implementability

Each of the alternatives would be implementable. Alternative 1 is the most easily implemented since the only activities proposed are long-term monitoring and five-year reviews.

Alternative 5A and 5B would be the next easiest to implement because it involves only excavation and off-site transport and disposal. There is ample availability of companies with the trained personnel, equipment, and materials to perform excavation, disposal, and long-term monitoring. Sufficient commercial landfill capacity is available to handle the small volume of contaminated materials (approximately 260 cubic yards) that would require off-base disposal under Alternative 5A. Under Alternative 5B, sufficient area exists at the Site 4

landfill to accommodate the small volume of materials from Site 19 without altering the cap design or material requirements.

Alternative 4 would be somewhat more difficult to implement because it would require mobilization and operation of an on-site treatment system. However, solidification is a well demonstrated technology employing relatively common equipment and materials and several vendors are available that could provide the necessary equipment, materials, and services.

If additional actions are warranted, they could be easily implemented under Alternatives 1 and 5. Under Alternative 4, additional actions could be implemented; however, excavation and removal of the solidified materials may be required.

Cost

The costs associated with each alternative are provided in Table 4-3. Alternative 1, No Action, would cost the least to implement and Alternative 4 would cost the most to implement. Alternative 5A costs more to implement than Alternative 5B.

APPENDIX A

COSTS

NWS Earle Site FS
Site 4 - Alternative 1 - No Action
Colts Neck New Jersey
Present Worth Analysis
[C:\CLEAN\CTO279\DFFS\COST\PW4ALT1.WK4] 09 OCT 96

PRESENT WORTH ANALYSIS

YEAR	PRESENT WORTH FACTOR	CAPITAL COSTS ($ 000s)	O & M COSTS ($ 000s)	5-YEAR COSTS ($ 000s)	PRESENT WORTH ($ 000s)
0	1.000	0			0.00
1	0.935		16.20		15.14
2	0.873		16.20		14.15
3	0.816		16.20		13.22
4	0.763		16.20		12.36
5	0.713		16.20	15.5	22.60
6	0.666		16.20		10.79
7	0.623		16.20		10.09
8	0.582		16.20		9.43
9	0.544		16.20		8.81
10	0.508		16.20	15.5	16.11
11	0.475		16.20		7.70
12	0.444		16.20		7.19
13	0.415		16.20		6.72
14	0.388		16.20		6.28
15	0.362		16.20	15.5	11.49
16	0.339		16.20		5.49
17	0.317		16.20		5.13
18	0.296		16.20		4.79
19	0.277		16.20		4.48
20	0.258		16.20	15.5	8.19
21	0.242		16.20		3.91
22	0.226		16.20		3.66
23	0.211		16.20		3.42
24	0.197		16.20		3.19
25	0.184		16.20	15.5	5.84
26	0.172		16.20		2.79
27	0.161		16.20		2.61
28	0.150		16.20		2.44
29	0.141		16.20		2.28
30	0.131		16.20	15.5	4.16
		TOTAL PRESENT WORTH =			$234,473

Discount rate of 7% per OSWER Directive No. 9355.3-20, June 25, 1993

NWS Earle Site FS
Site 4 - Alternative 1 - No Action
Colts Neck New Jersey
O & M Analysis
[C:\CLEAN\CTO279\DFFS\COST\OM4ALT1.WK4] 09 OCT 96

Annual Costs

ITEM	ANNUAL O & M ITEMS ($)	5-YEAR ITEMS ($)	NOTES
1. Ground, surface water, & sediment monitoring	$12,200		collect 9 GW (6 + 3 QC), 6 SW (3 + 3QC), and 6 SED (3 + 3QC) samples annually, plus travel, living & shipping
2. Reporting	$4,000		50 LOE hours for annual reports plus other direct costs
3. 5-year Site reviews		$15,550	Reviews performed for years 5, 10, 15, 20, 25, and 30

Brown & Root Environmental		Calculation Sheet	
Client: Navy CLEAN	File No.	**By:** LC	**Page** 1 of 1
Subject: Site 4, Alt. 1 - Assumptions and Cost Basis, NWS Earle FS, CTO 279		**Checked by:**	**Date:** 09 Oct 96

[C:\CLEAN\CTO279\DRFS\COST\4-ALT1.DOC]

Site 4 Alternative 1: No Action

ASSUMPTIONS:

1. Long-term annual groundwater, surface water, and sediment monitoring:

   - From 6 existing monitoring wells, 3 QC samples. Total 9 samples annually.

   - From 3 surface water locations, 3 QC samples. Total 6 samples annually.

   - From 3 sediment locations (same as surface water) , 3 QC samples. Total 6 samples annually.

   Sampling and analysis for site-specific contaminants: VOCs and metals.

   Labor: 1 event/year.

   - GW/SW/SED sampling 2 people @ 10 hr/day @ 2 days (add 6 hr each for prep./mob/demob.) ≈ 52 hr annually.
   - Sampling ≈ 52 hours @ $60/hr (w/overhead & profit) = $3120
   - Proj. mgmt/coord. ≈ 20 hours/year @ $80/hr (w/O&P) = $1600
   - Annual: add $300 M&IE; ODCs & supplies @ $200; & shipping @ $200.

   Total ≈ $5420 annually

   Estimated analytical costs:

   - VOCs (EPA Method 624) $324/sample @ 21 samples/yr = $6804
   - metals (EPA 6010/7000s) @ $254/sample @ 21 samples/yr = $5334

   Total = $ 12138 = $12200

2. Reporting of results: data review and report prep. @ 50 hr/yr @ $70 = $3500, add $500 ODCs. Total = $4000

3. 5-year reviews at 200 LOE @ $70/hr. Approx. $1500 ODCs. Total = $ 15500 per event

NWS Earle Site FS
Site 4 - Alternative 3 - Capping, Natural Atten., Long-term Monitoring
Colts Neck New Jersey
Present Worth Analysis
[C:\CLEAN\CTO279\DFFS\COST\PW4ALT3.WK4] 15 OCT 96

PRESENT WORTH ANALYSIS

YEAR	PRESENT WORTH FACTOR	CAPITAL COSTS ($ 000s)	O & M COSTS ($ 000s)	5-YEAR COSTS ($ 000s)	PRESENT WORTH ($ 000s)
0	1.000	1,983			1983.40
1	0.935		29.62		27.68
2	0.873		29.62		25.87
3	0.816		29.62		24.18
4	0.763		29.62		22.60
5	0.713		29.62	15.5	32.17
6	0.666		29.62		19.74
7	0.623		29.62		18.45
8	0.582		29.62		17.24
9	0.544		29.62		16.11
10	0.508		29.62	15.5	22.94
11	0.475		29.62		14.07
12	0.444		29.62		13.15
13	0.415		29.62		12.29
14	0.388		29.62		11.49
15	0.362		29.62	15.5	16.35
16	0.339		29.62		10.03
17	0.317		29.62		9.38
18	0.296		29.62		8.76
19	0.277		29.62		8.19
20	0.258		29.62	15.5	11.66
21	0.242		29.62		7.15
22	0.226		29.62		6.69
23	0.211		29.62		6.25
24	0.197		29.62		5.84
25	0.184		29.62	15.5	8.31
26	0.172		29.62		5.10
27	0.161		29.62		4.77
28	0.150		29.62		4.45
29	0.141		29.62		4.16
30	0.131		29.62	15.5	5.93
		TOTAL PRESENT WORTH =			$2,384,402

Discount rate of 7% per OSWER Directive No. 9355.3-20, June 25, 1993

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 4 ALT. 3 - CAPPING, INST. CONTROLS, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
[C:\CLEAN\CTO279\DRFS\COST\4-ALT3.WK4] 15 OCT 96

Sheet 1 of 3

			Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
Item	Qty	Unit	Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
PRE-DESIGN INVESTIGATION												
1) Topographic survey	5	AC	1,775.00	0.00	0.00	0.00	8,875	0	0	0	8,875	[013 306 0100]
2) Soil gas assessment	1	LS	18,500.00	0.00	0.00	0.00	18,500	0	0	0	18,500	
3) Additional soils boring and analyses	1	LS	20,500.00	1,000.00	3,000.00	0.00	20,500	1,000	3,000	0	24,500	
4) Geotechnical evaluation	1	LS	0.00	500.00	2,000.00	0.00	0	500	2,000	0	2,500	
5) Engineering design (see page 3)												
MOBILIZATION/DEMOBILIZATION												
1) Office Trailer (1 ea)	7	MO	400.00	0.00	0.00	0.00	2,800	0	0	0	2,800	Historical data
2) Storage Trailer (1 ea)	7	MO	400.00	0.00	0.00	0.00	2,800	0	0	0	2,800	Historical data
3) Portable Communication Equipment	4	SETS	400.00	0.00	0.00	0.00	1,600	0	0	0	1,600	
4) Equipment Mobilization/Demobilization	1	LS	10,000.00	0.00	0.00	0.00	10,000	0	0	0	10,000	
5) Site Utility Hook-ups (elec., phone, etc.)	1	LS	3,000.00	0.00	0.00	0.00	3,000	0	0	0	3,000	Historical data
6) Site Utilities	7	MO	4,000.00	0.00	0.00	0.00	28,000	0	0	0	28,000	
7) 1 Pick-up Truck (rental)	7	MO	500.00	100.00	0.00	0.00	3,500	700	0	0	4,200	Historical data
PERSONNEL AND EQUIP. DECON. FACILITIES AND SERVICES												
1) Truck/Heavy Equipment Decon Pad												
a) Excavate & grade area (40' x 50')	70	CY	0.00	0.00	0.70	0.70	0	0	49	49	98	[022 242 2020]
b) Compact area (40' x 50')	75	CY	0.00	0.00	0.11	0.36	0	0	8	27	35	[022 226 6200]
c) Curb & splash guard (poly & lumber)	1	LS	0.00	1,000.00	500.00	200.00	0	1,000	500	200	1,700	
d) Steam cleaner, pumps, hoses, sprayers, etc.	7	MO	1,000.00	0.00	100.00	0.00	7,000	0	700	0	7,700	Historical data
2) Decon Water (1000 gal/mon)	7	GAL	0.20	0.00	0.00	0.00	1	0	0	0	1	
3) Clean Water Storage Tank	1	EA	0.00	3,000.00	300.00	0.00	0	3,000	300	0	3,300	3000 Gallon
4) Spent Water Storage Tank	1	EA	0.00	5,000.00	400.00	0.00	0	5,000	400	0	5,400	5000 Gallon
5) Personnel Decon. Trailer	7	MO	2,500.00	0.00	200.00	0.00	17,500	0	1,400	0	18,900	Vendor catalog
6) PPE rolloff cont.	7	MO	700.00	0.00	0.00	0.00	4,900	0	0	0	4,900	Historical data
SITE MANAGEMENT STAFFING												
1) Site manager	1,260	HR	0.00	0.00	35.86	0.00	0	0	45,184	0	45,184	
2) Site supervisor/foreman	1,260	HR	0.00	0.00	30.00	0.00	0	0	37,800	0	37,800	
3) Site safety officer	1,260	HR	0.00	0.00	25.00	0.00	0	0	31,500	0	31,500	
HOME OFFICE PROJECT MANAGEMENT AND SUPPORT												
1) Project manager	140	HR	0.00	0.00	45.00	0.00	0	0	6,300	0	6,300	
2) Project administrator	150	HR	0.00	0.00	30.00	0.00	0	0	4,500	0	4,500	
3) Health and Safety director	44	HR	0.00	0.00	35.00	0.00	0	0	1,540	0	1,540	
4) Procurement/subcontracting	200	HR	0.00	0.00	30.00	0.00	0	0	6,000	0	6,000	
4) Clerical support	630	HR	0.00	0.00	12.36	0.00	0	0	7,787	0	7,787	

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 4 ALT. 3 - CAPPING, INST. CONTROLS, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
[C:\CLEAN\CTO279\DRFS\COST\4-ALT3.WK4] 15 OCT 96

			Unit Cost ($)				Total Cost ($)				Total Direct	
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.	Cost ($)	Comments
SITE PREPARATION												
1) clear & grub Site 4	5	AC	0.00	0.00	595.00	1,775.00	0	0	0	0	0	[021 108 0550]
2) cut & chip medium trees	5	AC	0.00	0.00	1425.00	1575.00	0	0	7,125	7,875	15,000	[021 104 0200]
3) Site grading	24,200	SY	0.00	0.00	0.16	0.27	0	0	3,872	6,534	10,406	[17 03 0103]
4) Erosion control, silt fences	600	LF	0.00	0.37	0.33	0.00	0	222	198	0	420	[022 704 1100]
4) Erosion control, hay bales	3	ton	0.00	45.00	157.00	54.00	0	135	471	162	768	[022 704 1200]
5) Security fencing (to be installed, as needed)	1,600	LF	0.00	10.15	2.72	1.81	0	16,240	4,352	2,896	23,488	6 ft high
6) Gate	1	EA	0.00	2450.00	340.00	226.00	0	2,450	340	226	3,016	
7) Fugitive dusts control (water tank)	1	EA	0.00	5000.00	0.00	0.00	0	5,000	0	0	5,000	10,000 gal
7a) Spray from tank truck	7	MO	0.00	0.00	1160.00	1292.80	0	0	8,120	9,050	17,170	[18 05 0413]
CONSOLIDATION												
1) Site 19 soils/sediments, spread/grade (possible)	260	CY	0.00	0.00	0.10	0.19	0.00	0.00	26	49	75	[17 03 0501]
GRADING & COMPACTION												
1) Spread and grade (2 passes)	48,400	SY	0.00	0.00	0.16	0.27	0.00	0.00	7,744	13,068	20,812	[17 03 0103]
2) Compact Site 4	24,200	SY	0.00	0.00	0.25	0.15	0.00	0.00	6,050	3,630	9,680	[17 03 0510]
COVER SYSTEM PLACEMENT												
1) Subgrade - sand & gravel, place & comp.	8,070	CY	0.00	11.44	1.72	1.56	0	92,321	13,880	12,589	118,790	[17 03 0430]
2) FML 30 mil L/HDPE (barrier layer)	24,200	SY	4.68	0.00	0.00	0.00	113,256	0	0	0	113,256	vendor data
3) Geosynthetic drainage layer	24,200	SY	5.67	0.00	0.00	0.00	137,214	0	0	0	137,214	vendor data
4) Top layer - 24" total, inc. place, spread, & compact												
4a) top soil - 6"	2,690	CY	0.00	17.31	2.60	1.65	0	46,564	6,994	4,439	57,996	[18 05 0301]
4b) soil - 18"	5,380	CY	0.00	5.00	2.60	1.65	0	26,900	13,988	8,877	49,765	
5) Perimeter drain, trenching, 1600' x 3' x 4'	711	CY	0.00	0.00	2.38	1.37	0	0	1,692	974	2,667	[022 254 0050]
5a) pipe bedding w/sand; backfill gravel	711	CY	0.00	11.44	1.72	1.56	0	8,134	1,223	0.00	9,357	[17 03 0430]
5b) 8" perf. PVC pipe	1,600	LF	0.00	2.38	1.58	0.00	0	3,808	2,528	0	6,336	[027 168 2080]
EROSION CONTROL												
15) Revegetation, hydroseed w/fertilizer & mulch	218	MSF	0.00	25.50	6.50	7.15	0	5,554	1,416	1,557	8,527	[029 308 5400]
STORM WATER RETENTION BASIN												
1) Excavate	926	CY	0.00	0.00	0.84	0.85	0	0	778	787	1,565	[022 208 2420]
2) Grade & compact	185	SY	0.00	0.00	0.25	0.15	0	0	46	28	74	[17 03 0510]
3) Install riprap on sidewalls for erosion control	200	SY	0.00	12.50	22.00	9.55	0	2,500	4,400	1,910	8,810	[022 712 0400]

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 4 ALT. 3 - CAPPING, INST. CONTROLS, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
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		Total Cost ($) Sub.	Mat.	Labor	Equip.	Total Direct Cost ($)	Comments
	PAGE 2 TOTAL	379,446	221,027	234,211	74,927	909,612	
Direct Cost Adjustment Factors							
Safety Level D Multiplier (5% of labor and equipment, for non-Lev. C activities)		0	0	11,711	3,746	15,457	
Safety Level C Multiplier (25% of labor and equipment, as listed)		0	0	0	0	0	
Site & Industrial Health & Safety Monitoring (3% of labor and equipment)		0	0	7,026	2,248	9,274	
	Subtotal Direct Costs	379,446	221,027	245,922	78,673	934,343	
Indirect Cost Adjustment Factors							
Labor Overhead @ 120% (for field mgmt. & home office, only)		0	0	168,732	0	168,732	
Field Construction Labor Overhead @ 60%		0	0	56,161	0	56,161	
Subcontract Overhead @ 5%		18,972	0	0	0	18,972	
Tax on Materials @ 5%		0	11,051	0	0	11,051	
G & A @ 10% (on labor, equip., & matl's.)		0	22,103	24,592	7,867	54,562	
	Subtotal Direct and Indirect Costs	398,419	254,182	495,407	86,541	1,243,822	
Cost Adjustment Factors							
1995 to 1996 Cost Correction Factor @ 4%		15,937	10,167	19,816	3,462	49,382	
City/Location Cost Adjustment Factor @ 21% (ref. 2)						261,203	
	Adjusted Direct and Indirect Costs	414,355	264,349	515,223	90,002	1,554,407	
Engineering @ 6 % of total direct and indirect						93,264	
Prime Contractor Fee @ 10% of Total Adjusted Cost						155,441	
	Total Costs					1,803,112	
Contingency @ 10% of Total Cost						180,311	
	TOTAL ESTIMATED COST					1,983,423	

References used for cost estimates:

1) Means Site Work and Landscape Cost Data, 1995, 14th Annual Edition, R.S. Means Co., Inc., Kingston, MA
2) Environmental Restoration: Assemblies Cost Book; 1995; ECHOS, Los Angeles, CA
3) Historical data based on competitive bids submitted by subcontractors at this or other sites.

NWS Earle Site FS
Site 4 - Alternative 3 - Capping, Natural Attentuation, Long-term monitoring
Colts Neck New Jersey
O & M Analysis
[C:\CLEAN\CTO279\DFFS\COST\OM4ALT3.WK4] 15 OCT 96

Annual Costs

ITEM	ANNUAL O & M ITEMS ($)	5-YEAR ITEMS ($)	NOTES
1. Cap maintenance	$8,000		Quarterly inspections, fencing repairs, mowi cover, reseeding, fertilizer applic., cap repairs
2. Groundwater, surface water, & sediment monitoring	$17,620		collect 9 GW (6 + 3 QC), 6 SW (3 + 3QC), and 6 SED (3 + 3QC) samples annually, plus travel, living & shipping
3. Reporting	$4,000		50 LOE hours for annual reports plus other direct costs
4. 5-year Site reviews		$15,550	Reviews performed for years 5, 10, 15, 20, 25, and 30

BROWN & ROOT ENVIRONMENTAL		COST ESTIMATE ASSUMPTIONS	
CLIENT: Navy CLEAN	FILE NO.:	BY: LC	PAGE: 1 of 1
SUBJECT: Site 4, Alt. 3 Assumptions and Cost Basis, NWS Earle FS, CTO 279		REVIEWED BY:	15 OCT 96

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Site 4 Alternative 3: Capping, Institutional Controls, Natural Attentuation, & Long-term Monitoring

ASSUMPTIONS:

i. Discount rate for net present worth calculation at 7% per OSWER Directive No. 9355.3-20, June 25, 1993.

ii. Site 4 footprint of approx. 5 acres. No current topographic map available.

iii. Cost estimating sources:

- ECHOS Environmental Restoration, Unit Cost Book and Assemblies Cost Book, Delta Technologies Group, Inc. and Marshall & Swift, 1995.
- Means Heavy Construction Cost Data, 9th edition, R.S. Means Company, Inc., 1995.
- Means Site Work & Landscape Cost Data, 14th edition, R.S. Means Company, Inc., 1995.

iv. Abbreviations: SF = square feet; CF = cubic feet; SY = square yard; CY = cubic yard; LF = linear feet; MSF = 1000 SF

CAPITAL COST ITEMS:

1. <u>Pre-design investigations</u>

- Would require topographic survey, 5 acres. Surveying may best be accomplished after site has been cleared of trees and vegetation.

- Would require additional soil boring to delineate extent of landfill materials, obtain soil stratigraphy. Estimate/assume need of a drill rig for 2 weeks to properly catalog landfill extent. Subcontract drill rig @ $500 mob. + $2000/day (inc. crew, supplies, etc.) Total = $20500. Add geologist oversight of driller, to log soil boring and stratigraphy: 2 weeks @ 10 hr/day, + $1000 M&IE.

- Would need soil gas survey to assess need for gas vent layer in cover system. Estimate 1 field crew for 1 week plus equipment and supplies. Use subcontractor: 4 @ 10 hour/day @ 5 days @ $60/hr = $12000. Equip + supplies + M&IE = $2000 + $500 + $2000. Add $2000 for report. Total = $18500.

- Would require geotechnical evaluations. Use borings and performance of compaction tests to assess settlement potentials. Engineering report would be prepared. Assume 1 week field engineer at 10 hours @ 10 days @ $30/hr (w/o O&P), 2 weeks data evaluation and report prep. 8 hr @ 10 days @ $30/hr = $2400, add add $2000 ODCs

- Engineering design as 6% of direct labor.

2. Mobilization/Demobilization Require office trailer, storage trailer, portable communications, equipment mob/demob [lump sum], site utilities (elec./phone lines), site security, decon trailer. Will require drinking and wash water, and sanitary facilities.

3. Personnel & equipment decon. facilities and services Establish truck\heavy equipment decon. pad, personnel decon. pad, clean water storage, spent water storage.

4. Site Preparation:

Tree removal - Remove medium sized trees from 5 acres.

Clearing and grubbing - Clear brush, shrubs, etc. Grub stumps and roots, etc.

Site grading - Grade 5 acres to design specifications. Assume 2 passes required. 5 acres = 217800 SF = 24200 SY. [17 03 0103]

Access road - Existing access roads appear to be adequate to sustain heavy equipment. Assume no further improvements needed.

Erosion controls - will need to establish temporary silt fences and hay bales to protect adjacent wetlands. Polypropylene [022 704 1100]. Total linear ft silt fence = 600 LF. Add approx. 3 tons hay bales.

Security Fencing - Will require ~ 1600 LF to encompass site; 8 ft high, 3 strand barbed wire; 10 ft post spacing [028 308 0600]. 1 sliding gate (45 ft) to accommodate truck/heavy equipment traffic [028 308 0900]. Can be installed after construction completed or in phases

Fugitive dust control - One 10000 gal tank. Have 1 water wagon spray down 2 acres per day, 20 days per month [18 05 0413].

5. Consolidation - may need to consolidate Site 19 soils/sediments @ 260 CY.

- Assume 1 scraper, 14 CY, 3000 ft haul, to move stockpiled materials to desired areas [022 246 1350]. Once materials consolidated back onto plateau, ready for grading and compaction.

6. Grading and Compaction - Grade [025 122 3310] and compaction [17 03 0514]. Use 5 acres = 24200 SY.

7. Cover System Placement

- place/grade subgrade sand/gravel
- install FML (30 mil HDPE)
- install synthetic drainage layer
- place min. 18 in. of compacted soil layer
- place 6 in. min top soil

- Subgrade - Approximately 1 ft of well graded sand/gravel as surcharge over landfill materials to provide smooth working surface prior to FML placement. Compact subgrade. Allow consolidation, assume 6 - 8 weeks to reach low/target rate of settlement.

- AREA: = 24200 SY
- VOLUME: 24200 SY x 1 ft = 8070 CY

- Perimeter drain - for perimeter of covered area = 1600 LF. Would be ditch or trench to 4 ft deep, 3ft wide with perforated 8" dia. PVC pipe, with gravel pack.

8. Erosion Control

- Revegetate to stabilize top cover after completion of cover. Approximately 5 acres. Revegetate with utility mix ground cover.

9. Storm Water Retention Basin

- Will require detention pond to temporarily store Q (flow) from 24-hour, 25-year storm. Actual location and size to be selected during the design.

Use Q = CIA (rational formula) [Handbook of Civil Engineering, Sec 21]
C = 0.2 for lawn, 2-7% slope, poorly drained soils
I = intensity = K/(t+b) (Steel formula)
t = 24 hour = 1440 min
K = 260, b = 32 for New Jersey
A = 5 acres

Q = (0.2) [260/(1440 + 32)] (5)
= 0.18 cfs

Assume 0.18 cfs for 24 hour duration.

V of retension basin = (0.18 cfs) (24 hr) (60 min) (60 sec)
= 15552 CF

For basin of 50 FT x 100 FT, need depth of 3.1 FT. Add 2 ft freeboard, or ~5 ft.
Or V = 50 x 100 x 5 = 25000 cf = 926 CY

- Will need to excavate, grade & compact, and install erosion control on faces of basin.

LONG-TERM O & M COST ITEMS:

1. Quarterly inspections and repairs of the cap, fence, etc.
   - estimate 1 person @ 1 day inspection: 10 @ $15 /hr = $150 + $50 ODCs = $200
   - estimate mowing of 5 acres @ $0.54/MSF = $118, + $50 mob fee = $170
   - estimate repair of soil cover, re-eseeding, and fertilizing @ 2 people @ 2 days @ 10 hours @ 15/hr, + $1000 ODCs = $1600

- Total = $1,970/quarter = $2000

2. Long-term monitoring. Would be same as for no action. For FS to be consistent with NCP requirements, will need to cost out for 30-year duration. It is possible after one of the 5-year reviews that long-term mionitroing would be discontinued once groundwater quality meets the NJ GWQS na surface water quality meets SWQS.

a. Long-term annual post-closure groundwater, surface water, and sediment monitoring:

- From 6 existing monitoring wells, 3 QC samples. Total 9 samples annually.
- From 3 surface water locations, 3 QC samples. Total 6 samples annually.
- From 3 sediment locations (same as surface water) , 3 QC samples. Total 6 samples annually.

Sampling and analysis for site-specific contaminants: VOCs and metals.

Labor: 1 event/year.

- GW/SW/SED sampling 2 people @ 10 hr/day @ 2 days (add 6 hr each for prep./mob/demob.) ≈ 52 hr annually.
- Sampling » 52 hours @ $60/hr (w/overhead & profit) = $3120
- Proj. mgmt/coord. » 20 hours/year @ $80/hr (w/O&P) = $1600
- Annual: add $300 M&IE; ODCs & supplies @ $200; & shipping @ $200.

Total ≈ $5420 annually

Estimated analytical costs:

- VOCs (EPA Method 624) $324/sample @ 21 samples/yr = $6804
- metals (EPA 6010/7000s) @ $254/sample @ 21 samples/yr = $5334

Total = $ 12138 = $12200

b. Reporting of results: data review and report prep. @ 50 hr/yr @ $70 = $3500, add $500 ODCs. Total = $4000

c. 5-year reviews at 200 LOE @ $70/hr. Approx. $1500 ODCs. Total = $ 15500 per event

NWS Earle Site FS
Site 5 - Alternative 1 - No Action
Colts Neck New Jersey
Present Worth Analysis
[C:\CLEAN\CTO279\DFFS\COST\PW5ALT1.WK4] 09 OCT 96

PRESENT WORTH ANALYSIS

YEAR	PRESENT WORTH FACTOR	CAPITAL COSTS ($ 000s)	O & M COSTS ($ 000s)	5-YEAR COSTS ($ 000s)	PRESENT WORTH ($ 000s)
0	1.000	0			0.00
1	0.935		10.40		9.72
2	0.873		10.40		9.08
3	0.816		10.40		8.49
4	0.763		10.40		7.93
5	0.713		10.40	15.5	18.47
6	0.666		10.40		6.93
7	0.623		10.40		6.48
8	0.582		10.40		6.05
9	0.544		10.40		5.66
10	0.508		10.40	15.5	13.17
11	0.475		10.40		4.94
12	0.444		10.40		4.62
13	0.415		10.40		4.32
14	0.388		10.40		4.03
15	0.362		10.40	15.5	9.39
16	0.339		10.40		3.52
17	0.317		10.40		3.29
18	0.296		10.40		3.08
19	0.277		10.40		2.88
20	0.258		10.40	15.5	6.69
21	0.242		10.40		2.51
22	0.226		10.40		2.35
23	0.211		10.40		2.19
24	0.197		10.40		2.05
25	0.184		10.40	15.5	4.77
26	0.172		10.40		1.79
27	0.161		10.40		1.67
28	0.150		10.40		1.56
29	0.141		10.40		1.46
30	0.131		10.40	15.5	3.40
		TOTAL PRESENT WORTH =			$162,500

Discount rate of 7% per OSWER Directive No. 9355.3-20, June 25, 1993

NWS Earle Site FS
Site 5 - Alternative 1 - No Action
Colts Neck New Jersey
O & M Analysis
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Annual Costs

ITEM	ANNUAL O & M ITEMS ($)	5-YEAR ITEMS ($)	NOTES
1. Ground monitoring	$6,400		collect 11 GW (8 + 3 QC) annually, plus travel, living & shipping
2. Reporting	$4,000		50 LOE hours for annual reports plus other direct costs
3. 5-year Site reviews		$15,550	Reviews performed for years 5, 10, 15, 20, 25, and 30

Brown & Root Environmental			Calculation Sheet
Client: Navy CLEAN	File No.	**By:** LC	**Page** 1 of 1
Subject: Site 5, Alt. 1 - Assumptions and Cost Basis, NWS Earle FS, CTO 279		**Checked by:**	**Date:** 09 Oct 96

[C:\CLEAN\CTO279\DRFS\COST\5-ALT1.DOC]

Site 5 Alternative 1: No Action

ASSUMPTIONS:

1. Long-term annual groundwater monitoring:

   - From 8 existing monitoring wells, 3 QC samples. Total 11 samples annually.

   Sampling and analysis for site-specific contaminants: VOCs and metals.

   Labor: 1 event/year.

   - GW sampling 2 people @ 10 hr/day @ 2 days (add 6 hr each for prep./mob/demob.) ≈ 52 hr annually.
   - Sampling ≈ 52 hours @ $60/hr (w/overhead & profit) = $ 3120
   - Proj. mgmt/coord. ≈ 20 hours/year @ $80/hr (w/O&P) = $1600
   - Annual: add $300 M&IE; ODCs & supplies @ $200; & shipping @ $200.

   Total ≈ $5420 annually

   Estimated analytical costs:

   - VOCs (EPA Method 624) $324/sample @ 11 samples/yr = $ 3564
   - metals (EPA 6010/7000s) @ $254/sample @ 11 samples/yr = $ 2794

   Total = $ 6358 ≈ 6400

2. Reporting of results: data review and report prep. @ 50 hr/yr @ $70 = $3500, add $500 ODCs. Total = $4000

3. 5-year reviews at 200 LOE @ $70/hr. Approx. $1500 ODCs. Total = $ 15500 per event

NWS Earle Site FS
Site 5 - Alternative 3 - Capping, Natural Atten., Long-term Monitoring
Colts Neck New Jersey
Present Worth Analysis
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PRESENT WORTH ANALYSIS

YEAR	PRESENT WORTH FACTOR	CAPITAL COSTS ($ 000s)	O & M COSTS ($ 000s)	5-YEAR COSTS ($ 000s)	PRESENT WORTH ($ 000s)
0	1.000	588			587.50
1	0.935		18.62		17.40
2	0.873		18.62		16.26
3	0.816		18.62		15.20
4	0.763		18.62		14.21
5	0.713		18.62	15.5	24.33
6	0.666		18.62		12.41
7	0.623		18.62		11.60
8	0.582		18.62		10.84
9	0.544		18.62		10.13
10	0.508		18.62	15.5	17.34
11	0.475		18.62		8.85
12	0.444		18.62		8.27
13	0.415		18.62		7.73
14	0.388		18.62		7.22
15	0.362		18.62	15.5	12.37
16	0.339		18.62		6.31
17	0.317		18.62		5.89
18	0.296		18.62		5.51
19	0.277		18.62		5.15
20	0.258		18.62	15.5	8.82
21	0.242		18.62		4.50
22	0.226		18.62		4.20
23	0.211		18.62		3.93
24	0.197		18.62		3.67
25	0.184		18.62	15.5	6.29
26	0.172		18.62		3.21
27	0.161		18.62		3.00
28	0.150		18.62		2.80
29	0.141		18.62		2.62
30	0.131		18.62	15.5	4.48
		TOTAL PRESENT WORTH =			$852,003

Discount rate of 7% per OSWER Directive No. 9355.3-20, June 25, 1993

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 5 ALT. 3 - CAPPING, INST. CONTROLS, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
[C:\CLEAN\CTO279\DRFS\COST\5-ALT3.WK4] 15 OCT 96

Sheet 1 of 3

Item	Qty	Unit	Unit Cost ($) Sub.	Mat.	Labor	Equip.	Total Cost ($) Sub.	Mat.	Labor	Equip.	Total Direct Cost ($)	Comments
PRE-DESIGN INVESTIGATION												
1) Topographic survey	1	AC	1,775.00	0.00	0.00	0.00	1,775	0	0	0	1,775	[013 306 0100]
2) Soil gas assessment	1	LS	7,400.00	0.00	0.00	0.00	7,400	0	0	0	7,400	
3) Additional soils boring and analyses	1	LS	6,500.00	400.00	600.00	0.00	6,500	400	600	0	7,500	
4) Geotechnical evaluation	1	LS	0.00	2,400.00	3,300.00	0.00	0	2,400	3,300	0	5,700	
5) Engineering design (see page 3)												
MOBILIZATION/DEMOBILIZATION												
1) Office Trailer (1 ea)	2	MO	400.00	0.00	0.00	0.00	800	0	0	0	800	Historical data
2) Storage Trailer (1 ea)	2	MO	400.00	0.00	0.00	0.00	800	0	0	0	800	Historical data
3) Portable Communication Equipment	4	SETS	400.00	0.00	0.00	0.00	1,600	0	0	0	1,600	
4) Equipment Mobilization/Demobilization	1	LS	10,000.00	0.00	0.00	0.00	10,000	0	0	0	10,000	
5) Site Utility Hook-ups (elec., phone, etc.)	1	LS	3,000.00	0.00	0.00	0.00	3,000	0	0	0	3,000	Historical data
6) Site Utilities	2	MO	4,000.00	0.00	0.00	0.00	8,000	0	0	0	8,000	
7) 1 Pick-up Truck (rental)	2	MO	500.00	100.00	0.00	0.00	1,000	200	0	0	1,200	Historical data
PERSONNEL AND EQUIP. DECON. FACILITIES AND SERVICES												
1) Truck/Heavy Equipment Decon Pad												
a) Excavate & grade area (40' x 50')	70	CY	0.00	0.00	0.70	0.70	0	0	49	49	98	[022 242 2020]
b) Compact area (40' x 50')	75	CY	0.00	0.00	0.11	0.36	0	0	8	27	35	[022 226 6200]
c) Curb & splash guard (poly & lumber)	1	LS	0.00	1,000.00	500.00	200.00	0	1,000	500	200	1,700	
d) Steam cleaner, pumps, hoses, sprayers, etc.	2	MO	1,000.00	0.00	100.00	0.00	2,000	0	200	0	2,200	Historical data
2) Decon Water (1000 gal/mon)	2,000	GAL	0.20	0.00	0.00	0.00	400	0	0	0	400	
3) Clean Water Storage Tank	1	EA	0.00	3,000.00	300.00	0.00	0	3,000	300	0	3,300	3000 Gallon
4) Spent Water Storage Tank	1	EA	0.00	5,000.00	400.00	0.00	0	5,000	400	0	5,400	5000 Gallon
5) Personnel Decon. Trailer	2	MO	2,500.00	0.00	200.00	0.00	5,000	0	400	0	5,400	Vendor catalog
6) PPE rolloff cont.	2	MO	700.00	0.00	0.00	0.00	1,400	0	0	0	1,400	Historical data
SITE MANAGEMENT STAFFING												
1) Site manager	360	HR	0.00	0.00	35.86	0.00	0	0	12,910	0	12,910	
2) Site supervisor/foreman	360	HR	0.00	0.00	30.00	0.00	0	0	10,800	0	10,800	
3) Site safety officer	360	HR	0.00	0.00	25.00	0.00	0	0	9,000	0	9,000	
HOME OFFICE PROJECT MANAGEMENT AND SUPPORT												
1) Project manager	40	HR	0.00	0.00	45.00	0.00	0	0	1,800	0	1,800	
2) Project administrator	40	HR	0.00	0.00	30.00	0.00	0	0	1,200	0	1,200	
3) Health and Safety director	8	HR	0.00	0.00	35.00	0.00	0	0	280	0	280	
4) Procurement/subcontracting	150	HR	0.00	0.00	30.00	0.00	0	0	4,500	0	4,500	
4) Clerical support	180	HR	0.00	0.00	12.36	0.00	0	0	2,225	0	2,225	

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 5 ALT. 3 - CAPPING, INST. CONTROLS, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
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			Unit Cost ($)				Total Cost ($)				Total Direct	
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.	Cost ($)	Comments
SITE PREPARATION												
1) clear & grub Site 5	1	AC	0.00	0.00	595.00	1,775.00	0	0	0	0	0	[021 108 0550]
2) Site grading	4,840	SY	0.00	0.00	0.16	0.27	0	0	774	1,307	2,081	[17 03 0103]
3) Fugitive dusts control (water tank)	1	EA	0.00	5000.00	0.00	0.00	0	5,000	0	0	5,000	10,000 gal
4) Spray from tank truck	2	MO	0.00	0.00	1160.00	1292.80	0	0	2,320	2,586	4,906	[18 05 0413]
GRADING & COMPACTION												
1) Grade (2 passes)	9,680	SY	0.00	0.00	0.16	0.27	0.00	0.00	1,549	2,614	4,162	[17 03 0103]
2) Compact Site 5	4,840	SY	0.00	0.00	0.25	0.15	0.00	0.00	1,210	726	1,936	[17 03 0510]
COVER SYSTEM PLACEMENT												
1) Subgrade - sand & gravel, place & comp.	1,613	CY	0.00	11.44	1.72	1.56	0	18,457	2,775	2,517	23,748	[17 03 0430]
2) FML 30 mil L/HDPE (barrier layer)	4,840	SY	4.68	0.00	0.00	0.00	22,651	0	0	0	22,651	vendor data
3) Geosynthetic drainage layer	4,840	SY	5.67	0.00	0.00	0.00	27,443	0	0	0	27,443	vendor data
4) Top layer - 24" total, inc. place, spread, & compact												
4a) top soil - 6"	807	CY	0.00	17.31	2.60	1.65	0	13,963	2,097	1,331	17,392	[18 05 0301]
4b) soil - 18"	2,420	CY	0.00	5.00	2.60	1.65	0	12,100	6,292	3,993	22,385	
5) Perimeter drain, trenching, 1600' x 3' x 4'	711	CY	0.00	0.00	2.38	1.37	0	0	1,692	974	2,667	[022 254 0050]
5a) pipe bedding w/sand; backfill gravel	711	CY	0.00	11.44	1.72	1.56	0	8,134	1,223	0.00	9,357	[17 03 0430]
5b) 8" perf. PVC pipe	1,600	LF	0.00	2.38	1.58	0.00	0	3,808	2,528	0	6,336	[027 168 2080]
EROSION CONTROL												
15) Revegetation, hydroseed w/fertilizer & mulch	44	MSF	0.00	25.50	6.50	7.15	0	1,111	283	311	1,705	[029 308 5400]
STORM WATER RETENTION BASIN												
1) Excavate	204	CY	0.00	0.00	0.84	0.85	0	0	171	173	345	[022 208 2420]
2) Grade & compact	111	SY	0.00	0.00	0.25	0.15	0	0	28	17	44	[17 03 0510]
3) Install erosion control material on sidewalls	75	SY	0.00	12.50	22.00	9.55	0	938	1,650	716	3,304	[022 712 0400]

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 5 ALT. 3 - CAPPING, INST. CONTROLS, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
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	Total Cost ($) Sub.	Mat.	Labor	Equip.	Total Direct Cost ($)	Comments
PAGE 2 TOTAL	99,769	75,510	73,065	17,541	265,885	
Direct Cost Adjustment Factors						
Safety Level D Multiplier (5% of labor and equipment, for non-Lev. C activities)	0	0	3,653	877	4,530	
Safety Level C Multiplier (25% of labor and equipment, as listed)	0	0	0	0	0	
Site & Industrial Health & Safety Monitoring (3% of labor and equipment)	0	0	2,192	526	2,718	
Subtotal Direct Costs	99,769	75,510	76,718	18,418	273,133	
Indirect Cost Adjustment Factors						
Labor Overhead @ 120% (for field mgmt. & home office, only)	0	0	51,257	0	51,257	
Field Construction Labor Overhead @ 60%	0	0	18,210	0	18,210	
Subcontract Overhead @ 5%	4,988	0	0	0	4,988	
Tax on Materials @ 5%	0	3,776	0	0	3,776	
G & A @ 10% (on labor, equip., & matl's.)	0	7,551	7,672	1,842	17,065	
Subtotal Direct and Indirect Costs	104,757	86,837	153,857	20,260	368,429	
Cost Adjustment Factors						
1995 to 1996 Cost Correction Factor @ 4%	4,190	3,473	6,154	810	14,628	
City/Location Cost Adjustment Factor @ 21% (ref. 2)					77,370	
Adjusted Direct and Indirect Costs	108,948	90,310	160,012	21,070	460,428	
Engineering @ 6 % of total direct and indirect					27,626	
Prime Contractor Fee @ 10% of Total Adjusted Cost					46,043	
Total Costs					534,096	
Contingency @ 10% of Total Cost					53,410	
TOTAL ESTIMATED COST					587,506	

References used for cost estimates:

1) Means Site Work and Landscape Cost Data, 1995, 14th Annual Edition, R.S. Means Co., Inc., Kingston, MA
2) Environmental Restoration: Assemblies Cost Book; 1995; ECHOS, Los Angeles, CA
3) Historical data based on competitive bids submitted by subcontractors at this or other sites.

NWS Earle Site FS
Site 5 - Alternative 3 - Capping, Natural Attentuation, Long-term monitoring
Colts Neck New Jersey
O & M Analysis
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Annual Costs

ITEM	ANNUAL O & M ITEMS ($)	5-YEAR ITEMS ($)	NOTES
1. Cap maintenance	$2,800		Quarterly inspections, fencing repairs, mowi cover, reseeding, fertilizer applic., cap repairs
1. Groundwater monitoring	$11,820		collect 11 GW (8 + 3 QC) annually, plus travel, living & shipping
2. Reporting	$4,000		50 LOE hours for annual reports plus other direct costs
3. 5-year Site reviews		$15,550	Reviews performed for years 5, 10, 15, 20, 25, and 30

BROWN & ROOT ENVIRONMENTAL		COST ESTIMATE ASSUMPTIONS	
CLIENT: Navy CLEAN	FILE NO.:	BY: LC	PAGE: 1 of 1
SUBJECT: Site 5, Alt. 3 Assumptions and Cost Basis, NWS Earle FS, CTO 279		REVIEWED BY:	15 OCT 96

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Site 5 Alternative 3: Capping, Institutional Controls, Natural Attentuation, & Long-term Monitoring

ASSUMPTIONS:

i. Discount rate for net present worth calculation at 7% per OSWER Directive No. 9355.3-20, June 25, 1993.

ii. Site 5 footprint of area to be addressed approx. 1 acre. No current topographic map available.

iii. Cost estimating sources:

- ECHOS Environmental Restoration, Unit Cost Book and Assemblies Cost Book, Delta Technologies Group, Inc. and Marshall & Swift, 1995.
- Means Heavy Construction Cost Data, 9th edition, R.S. Means Company, Inc., 1995.
- Means Site Work & Landscape Cost Data, 14th edition, R.S. Means Company, Inc., 1995.

iv. Abbreviations: SF = square feet; CF = cubic feet; SY = square yard; CY = cubic yard; LF = linear feet; MSF = 1000 SF

CAPITAL COST ITEMS:

1. <u>Pre-design investigations</u>

- Would require topographic survey, 1 acres. Surveying may best be accomplished after site has been cleared of trees and vegetation.

- Would require additional soil boring to delineate extent of landfill materials, obtain soil stratigraphy. Estimate/assume need of a drill rig for 3 days to properly catalog landfill extent. Subcontract drill rig @ $500 mob. + $2000/day (inc. crew, supplies, etc.) Total = $6500.

Add geologist oversight of driller, to log soil boring and stratigraphy: 3 days @ 10 hr/day @ $20/hr, + $300 M&IE + $100 supplies= $1000.

- Would need soil gas survey to assess need for gas vent layer in cover system. Estimate 1 field crew for 2 day plus equipment and supplies. Use subcontractor: 4 @ 10 hour/day @ 2 days @ $60/hr = $4800. Equip + supplies + M&IE = $1000 + $200 + $400. Add $1000 for report. Total = $.

- Would require geotechnical evaluations. Use borings and performance of compaction tests to assess settlement potentials. Engineering report would be prepared. Assume field engineer at 10 hours @ 3 days @ $30/hr (w/o O&P) = $900 + $300 ODCs + $100 supplies = $1300, 2 weeks data evaluation and report prep. 8 hr @ 10 days @ $30/hr = $2400, add add $2000 ODCs

- Engineering design as 6% of direct labor.

2. Mobilization/Demobilization Require office trailer, storage trailer, portable communications, equipment mob/demob [lump sum], site utilities (elec./phone lines), site security, decon trailer. Will require drinking and wash water, and sanitary facilities.

3. Personnel & equipment decon. facilities and services Establish truck\heavy equipment decon. pad, personnel decon. pad, clean water storage, spent water storage.

4. Site Preparation:

Tree removal - Remove medium sized trees from 5 acres.

Clearing and grubbing - Clear brush, shrubs, etc. Grub stumps and roots, etc.

Site grading - Grade 1 acres to design specifications. Assume 2 passes required.
1 acre = 4840 SY. [17 03 0103]

Access road - Existing access roads appear to be adequate to sustain heavy equipment. Assume no further improvements needed.

No erosion controls needed. No adjacent wetlands.

Fugitive dust control - One 10000 gal tank. Have 1 water wagon spray down 2 acres per day, 20 days per month [18 05 0413].

5. Grading and Compaction - Grade [025 122 3310] and compaction [17 03 0514]. Use 1 acre = 4840 SY.

7. Cover System Placement

- place/grade subgrade sand/gravel
- install FML (30 mil HDPE)
- install synthetic drainage layer
- place min. 18 in. of compacted soil layer
- place 6 in. min top soil

- Subgrade - Approximately 1 ft of well graded sand/gravel as surcharge over landfill materials to provide smooth working surface prior to FML placement. Compact subgrade. Allow consolidation, assume 6 - 8 weeks to reach low/target rate of settlement.

- AREA = 4840 SY
- VOLUME = 4840 SY x 1 FT = 4840 CY

- Perimeter drain - for a portion of perimeter of covered area = 500 LF. Would be ditch or trench to 4 ft deep, 3ft wide with perforated 8" dia. PVC pipe, with gravel pack.

8. Erosion Control

- Revegetate to stabilize top cover after completion of cover. Approximately 1 acre. Revegetate with utility mix ground cover.

9. Storm Water Retention Basin

- Will require detention pond to temporarily store Q (flow) from 24-hour, 25-year storm. Actual location and size to be selected during the design.

Use Q = CIA (rational formula) [Handbook of Civil Engineering, Sec 21]
C = 0.2 for lawn, 2-7% slope, poorly drained soils
I = intensity = K/(t+b) (Steel formula)
t = 24 hour = 1440 min
K = 260, b = 32 for New Jersey
A = 1 acres

Q = (0.2) [260/(1440 + 32)] (1)
= 0.04 cfs

Assume 0.18 cfs for 24 hour duration.

V of retension basin = (0.04 cfs) (24 hr) (60 min) (60 sec)
= 3456 CF

For basin of 20 FT x 50 FT, need depth of 3.5 FT. Add 2 ft freeboard, or ~5.5 ft.
Or V = 20 x 50 x 5.5 = 5500 CF = 204 CY

- Will need to excavate, grade & compact, and install erosion control on faces of basin.

LONG-TERM O & M COST ITEMS:

1. Quarterly inspections and repairs of the cap, fence, etc.
   - estimate 1 person @ 1 day inspection: 10 @ $15 /hr = $150 + $50 ODCs = $200
   - estimate mowing of 1 acres @ $0.54/MSF = $45, + $50 mob fee = $170
   - estimate repair of soil cover, re-seeding, and fertilizing @ 2 people @ 1 day @ 10 hours @ $15/hr, + $400 ODCs = $700

   - Total = $700/quarter

2. Long-term monitoring. Would be same as for no action. For FS to be consistent with NCP requirements, will need to cost out for 30-year duration. It is possible after one of the 5-year reviews that long-term mionitroing would be discontinued once groundwater quality meets the NJ GWQS na surface water quality meets SWQS.

   a. Long-term annual post-closure groundwater monitoring:

   - From 8 existing monitoring wells, 3 QC samples. Total 11 samples annually.

   Sampling and analysis for site-specific contaminants: VOCs and metals.

Labor: 1 event/year.

- GW/SW/SED sampling 2 people @ 10 hr/day @ 2 days (add 6 hr each for prep./mob/demob.) ≈ 52 hr annually.
- Sampling » 52 hours @ $60/hr (w/overhead & profit) = $3120
- Proj. mgmt/coord. » 20 hours/year @ $80/hr (w/O&P) = $1600
- Annual: add $300 M&IE; ODCs & supplies @ $200; & shipping @ $200.

Total ≈ $5420 annually

Estimated analytical costs:

- VOCs (EPA Method 624) $324/sample @ 11 samples/yr = $3564
- metals (EPA 6010/7000s) @ $254/sample @ 11 samples/yr = $2794

Total = $ 6358 ≈ $6400

b. Reporting of results: data review and report prep. @ 50 hr/yr @ $70 = $3500, add $500 ODCs. Total = $4000

c. 5-year reviews at 200 LOE @ $70/hr. Approx. $1500 ODCs. Total = $ 15500 per event

NWS Earle Site FS
Site 19 - Alternative 1 - No Action
Colts Neck New Jersey
Present Worth Analysis
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PRESENT WORTH ANALYSIS

YEAR	PRESENT WORTH FACTOR	CAPITAL COSTS ($ 000s)	O & M COSTS ($ 000s)	5-YEAR COSTS ($ 000s)	PRESENT WORTH ($ 000s)
0	1.000	0			0.00
1	0.935		16.20		15.14
2	0.873		16.20		14.15
3	0.816		16.20		13.22
4	0.763		16.20		12.36
5	0.713		16.20	15.5	22.60
6	0.666		16.20		10.79
7	0.623		16.20		10.09
8	0.582		16.20		9.43
9	0.544		16.20		8.81
10	0.508		16.20	15.5	16.11
11	0.475		16.20		7.70
12	0.444		16.20		7.19
13	0.415		16.20		6.72
14	0.388		16.20		6.28
15	0.362		16.20	15.5	11.49
16	0.339		16.20		5.49
17	0.317		16.20		5.13
18	0.296		16.20		4.79
19	0.277		16.20		4.48
20	0.258		16.20	15.5	8.19
21	0.242		16.20		3.91
22	0.226		16.20		3.66
23	0.211		16.20		3.42
24	0.197		16.20		3.19
25	0.184		16.20	15.5	5.84
26	0.172		16.20		2.79
27	0.161		16.20		2.61
28	0.150		16.20		2.44
29	0.141		16.20		2.28
30	0.131		16.20	15.5	4.16
			TOTAL PRESENT WORTH =		$234,473

Discount rate of 7% per OSWER Directive No. 9355.3-20, June 25, 1993

NWS Earle Site FS
Site 19 - Alternative 1 - No Action
Colts Neck New Jersey
O & M Analysis
[C:\CLEAN\CTO279\DFFS\COST\OM19ALT1.WK4] 09 OCT 96

Annual Costs

ITEM	ANNUAL O & M ITEMS ($)	5-YEAR ITEMS ($)	NOTES
1. Ground, surface water, & sediment monitoring	$12,200		collect 9 GW (6 + 3 QC), 6 SW (3 + 3QC), and 6 SED (3 + 3QC) samples annually, plus travel, living & shipping
2. Reporting	$4,000		50 LOE hours for annual reports plus other direct costs
3. 5-year Site reviews		$15,550	Reviews performed for years 5, 10, 15, 20, 25, and 30

Brown & Root Environmental			Calculation Sheet
Client: Navy CLEAN	File No.	**By:** LC	**Page** 1 of 1
Subject: Site 19, Alt. 1 - Assumptions and Cost Basis, NWS Earle FS, CTO 279		**Checked by:**	**Date:** 09 Oct 96

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Site 19 Alternative 1: No Action

ASSUMPTIONS:

1. Long-term annual groundwater, surface water, and sediment monitoring:

   - From 6 existing monitoring wells, 3 QC samples. Total 9 samples annually.

   - From 3 surface water locations, 3 QC samples. Total 6 samples annually.

   - From 3 sediment locations (same as surface water) , 3 QC samples. Total 6 samples annually.

   Sampling and analysis for site-specific contaminants: VOCs and metals.

   Labor: 1 event/year.

   - GW/SW/SED sampling 2 people @ 10 hr/day @ 2 days (add 6 hr each for prep./mob/demob.) ≈ 52 hr annually.
   - Sampling ≈ 52 hours @ $60/hr (w/overhead & profit) = $3120
   - Proj. mgmt/coord. ≈ 20 hours/year @ $80/hr (w/O&P) = $1600
   - Annual: add $300 M&IE; ODCs & supplies @ $200; & shipping @ $200.

   Total ≈ $5420 annually

   Estimated analytical costs:

   - VOCs (EPA Method 624) $324/sample @ 21 samples/yr = $6804
   - metals (EPA 6010/7000s) @ $254/sample @ 21 samples/yr = $5334

   Total = $ 12138 = $12200

2. Reporting of results: data review and report prep. @ 50 hr/yr @ $70 = $3500, add $500 ODCs. Total = $4000

3. 5-year reviews at 200 LOE @ $70/hr. Approx. $1500 ODCs. Total = $ 15500 per event

NWS Earle Site FS
Site 19 - Alternative 4 - Excavation, On-Site Solidification, Natural Atten., L
Colts Neck New Jersey
Present Worth Analysis
[C:\CLEAN\CTO279\DFFS\COST\PW19ALT4.WK4] 15 OCT 96

PRESENT WORTH ANALYSIS

YEAR	PRESENT WORTH FACTOR	CAPITAL COSTS ($ 000s)	O & M COSTS ($ 000s)	5-YEAR COSTS ($ 000s)	PRESENT WORTH ($ 000s)
0	1.000	491			491.20
1	0.935		21.60		20.19
2	0.873		21.60		18.87
3	0.816		21.60		17.63
4	0.763		21.60		16.48
5	0.713		21.60	15.5	26.45
6	0.666		21.60		14.39
7	0.623		21.60		13.45
8	0.582		21.60		12.57
9	0.544		21.60		11.75
10	0.508		21.60	15.5	18.86
11	0.475		21.60		10.26
12	0.444		21.60		9.59
13	0.415		21.60		8.96
14	0.388		21.60		8.38
15	0.362		21.60	15.5	13.45
16	0.339		21.60		7.32
17	0.317		21.60		6.84
18	0.296		21.60		6.39
19	0.277		21.60		5.97
20	0.258		21.60	15.5	9.59
21	0.242		21.60		5.22
22	0.226		21.60		4.88
23	0.211		21.60		4.56
24	0.197		21.60		4.26
25	0.184		21.60	15.5	6.84
26	0.172		21.60		3.72
27	0.161		21.60		3.48
28	0.150		21.60		3.25
29	0.141		21.60		3.04
30	0.131		21.60	15.5	4.87
		TOTAL PRESENT WORTH =			$792,681

Discount rate of 7% per OSWER Directive No. 9355.3-20, June 25, 1993

NWS Earle Site FS
Site 19 - Alternative 4 - Excavation, On-site solidification, Natural Attentuation, Long-term monitoring
Colts Neck New Jersey
O & M Analysis
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Annual Costs

ITEM	ANNUAL O & M ITEMS ($)	5-YEAR ITEMS ($)	NOTES
1. Groundwater, surface water, & sediment monitoring	$17,620		collect 9 GW (6 + 3 QC), 6 SW (3 + 3QC), and 6 SED (3 + 3QC) samples annually, plus travel, living & shipping
2. Reporting	$4,000		50 LOE hours for annual reports plus other direct costs
3. 5-year Site reviews		$15,550	Reviews performed for years 5, 10, 15, 20, 25, and 30

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 19 ALT. 4 - ON-SITE SOLIDIFICATION, ON-SITE DISPOSAL, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
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Sheet 1 of 4

			Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
Item	Qty	Unit	Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
INITIAL ACTIVITIES												
1) Field delineation of soils	1	LS	0.00	1,200.00	2,000.00	400.00	0	1,200	2,000	400	3,600	[013 306 0100]
3) Engineering design (see page 3)												
MOBILIZATION/DEMOBILIZATION												
1) Portable Communication Equipment	2	SETS	400.00	0.00	0.00	0.00	800	0	0	0	800	
2) Equipment Mobilization/Demobilization	1	LS	10,000.00	0.00	0.00	0.00	10,000	0	0	0	10,000	
3) Site Utility Hook-ups (elec., phone, etc.)	1	LS	3,000.00	0.00	0.00	0.00	3,000	0	0	0	3,000	Historical data
4) Site Utilities	2	MO	4,000.00	0.00	0.00	0.00	8,000	0	0	0	8,000	
5) 1 Pick-up Truck (rental)	2	MO	500.00	100.00	0.00	0.00	1,000	200	0	0	1,200	Historical data
PERSONNEL AND EQUIP. DECON. FACILITIES AND SERVICES												
1) Truck/Heavy Equipment Decon Pad												
a) Excavate & grade area (40' x 50')	70	CY	0.00	0.00	0.70	0.70	0	0	49	49	98	[022 242 2020]
b) Compact area (40' x 50')	75	CY	0.00	0.00	0.11	0.36	0	0	8	27	35	[022 226 6200]
c) Curb & splash guard (poly & lumber)	1	LS	0.00	1,000.00	500.00	200.00	0	1,000	500	200	1,700	
d) Steam cleaner, pumps, hoses, sprayers, etc.	2	MO	1,000.00	0.00	100.00	0.00	2,000	0	200	0	2,200	Historical data
2) Decon Water (1000 gal/mon)	2,000	GAL	0.20	0.00	0.00	0.00	400	0	0	0	400	
3) Clean Water Storage Tank	1	EA	0.00	1,500.00	300.00	0.00	0	1,500	300	0	1,800	3000 Gallon
4) Spent Water Storage Tank	1	EA	0.00	2,500.00	400.00	0.00	0	2,500	400	0	2,900	5000 Gallon
5) Personnel Decon. Trailer	2	MO	2,500.00	0.00	200.00	0.00	5,000	0	400	0	5,400	Vendor catalog
6) PPE rolloff cont.	2	MO	700.00	0.00	0.00	0.00	1,400	0	0	0	1,400	Historical data
SITE MANAGEMENT STAFFING												
1) Site manager	630	HR	0.00	0.00	35.86	0.00	0	0	22,592	0	22,592	
2) Site supervisor/foreman	630	HR	0.00	0.00	30.00	0.00	0	0	18,900	0	18,900	
3) Site safety officer	200	HR	0.00	0.00	25.00	0.00	0	0	5,000	0	5,000	
HOME OFFICE PROJECT MANAGEMENT AND SUPPORT												
1) Project manager	40	HR	0.00	0.00	45.00	0.00	0	0	1,800	0	1,800	
2) Project administrator	40	HR	0.00	0.00	30.00	0.00	0	0	1,200	0	1,200	
3) Health and Safety director	8	HR	0.00	0.00	35.00	0.00	0	0	280	0	280	
4) Procurement/subcontracting	150	HR	0.00	0.00	30.00	0.00	0	0	4,500	0	4,500	
4) Clerical support	300	HR	0.00	0.00	12.36	0.00	0	0	3,708	0	3,708	

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 19 ALT. 4 - ON-SITE SOLIDIFICATION, ON-SITE DISPOSAL, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
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			Unit Cost ($)				Total Cost ($)				Total Direct	
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.	Cost ($)	Comments
SITE PREPARATION												
1) clear & grub Site 19	0.5	AC	0.00	0.00	595.00	1,775.00	0	0	0	0	0	[021 108 0550]
2) cut & chip medium trees	0.5	AC	0.00	0.00	1425.00	1575.00	0	0	713	788	1,500	[021 104 0200]
4) Erosion control, silt fences	100	LF	0.00	0.37	0.33	0.00	0	37	33	0	70	[022 704 1100]
4) Erosion control, hay bales	0.5	ton	0.00	45.00	157.00	54.00	0	23	79	27	128	[022 704 1200]
7) Fugitive dusts control (water tank)	1	EA	0.00	2500.00	0.00	0.00	0	2,500	0	0	2,500	10,000 gal
7a) Spray from tank truck	2	MO	0.00	0.00	1160.00	1292.80	0	0	2,320	2,586	4,906	[18 05 0413]
EXCAVATION												
1)Excavate Site 19 soils/sediments	260	CY	0.00	0.00	1.06	1.24	0.00	0.00	276	322	598	[022 238 0360]
2) Haul 300 ft to treatment area	260	CY	0.00	0.00	0.51	0.51	0.00	0.00	133	133	265	[022 208 2200]
SOLIDIFICATION												
1) Equipment mob/demob.	1	EA	17513.00	0.00	0.00	0.00	17,513	0	0	0	17,513	[33 15 0436]
2) Vibrating screen	1	EA	2765.00	0.00	0.00	0.00	2,765	0	0	0	2,765	[33 18 8601]
3) Conveyor belts	1	EA	3000.00	0.00	0.00	0.00	3,000	0	0	0	3,000	[33 18 8401]
4) 50 CY/HR batch plant	1	EA	10000.00	0.00	0.00	0.00	10,000	0	0	0	10,000	[33 15 0429]
5) Water system for mixer	1	EA	1000.00	0.00	0.00	0.00	1,000	0	0	0	1,000	[33 15 0426]
6) Water pump	1	EA	1300.00	0.00	0.00	0.00	1,300	0	0	0	1,300	[33 15 0431]
7) Dust collection system	1	EA	1300.00	0.00	0.00	0.00	3,500	0	0	0	3,500	[33 15 0430]
8) Ancillary equipment	1	EA	3500.00	0.00	0.00	0.00	3,500	0	0	0	3,500	[33 15 0435]
9) Maintenance	1	YR	500.00	0.00	7652.00	0.00	500	0	7,652	0	8,152	[33 15 0437]
10) Pressure washer	1	EA	2000.00	0.00	0.00	0.00	2,000	0	0	0	2,000	[33 17 0816]
11) Portland cement	65	TON	0.00	68.02	0.00	0.00	0	4,421	0	0	4,421	[33 15 0405]
12) Truck scale	1	MO	1484.00	0.00	0.00	0.00	742	0	0	0	742	[33 01 0462]
13) Labor	320	HR	0.00	0.00	30.00	0.00	0	0	9,600	0	9,600	
14) Load materials to screen	260	CY	0.42	0.00	0.51	0.00	109	0	133	0	242	[022 216 4050]
15) Leaching test (TCLP metals); 1 per 10	10	EA	125.00	0.00	0.00	0.00	1,250	0	0	0	1,250	[33 02 1755]
BACKFILL TOPO. DEPRESSION												
1) Backfill treated mat'ls. into topo. depression	325	CY	0.00	0.00	0.51	0.51	0.00	0.00	166	166	332	[022 208 2200]
2) Compact treated mat'l, 6" lifts in depression	325	CY	0.00	0.00	0.21	0.42	0.00	0.00	68	137	205	[022 226 5600]
3) Backfill with some barricade materials	94	CY	0.00	0.00	0.51	0.51	0.00	0.00	48	48	96	[022 208 2200]
4) Compact barricade mat'l, 6" lifts in depression	94	CY	0.00	0.00	0.21	0.42	0.00	0.00	20	39	59	[022 226 5600]

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 19 ALT. 4 - ON-SITE SOLIDIFICATION, ON-SITE DISPOSAL, NAT. ATTEN. LONG-TERM MONIT.
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			Unit Cost ($)				Total Cost ($)				Total Direct	
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.	Cost ($)	Comments
BARRICADE DEMOLITION												
1) Remove 1280 CY soils	1,186	CY	0.00	0.00	0.51	0.51	0.00	0.00	605	605	1,210	[022 208 2200]
2) Haul to stockpile area (1000 ft)	1,186	CY	0.00	0.00	0.21	0.42	0.00	0.00	249	498	747	[022 226 5600]
3) Disassemble/demolish wood structure (B-2 crew)	10	days	0.00	0.00	792.00	100.00	0.00	0.00	7,920	1,000	8,920	B-4 daily rate
4) Haul to stockpile area	2,295	CY	0.00	0.00	0.21	0.42	0.00	0.00	482	964	1,446	[022 226 5600]
Pave Depression												
1) 3" asphalt binder	335	SY	0.00	3.94	0.38	0.34	0.00	0.00	127	114	241	[025 104 0160]
2) 3" asphalt wearing course	335	SY	0.00	4.32	0.42	0.39	0.00	0.00	141	131	271	[025 104 0460]
Fill Cement Pipe												
1) Block buried cement pipe	2	CY	0.00	54.00	0.00	0.00	0.00	108	0.00	0.00	108	[025 104 0460]

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 19 ALT. 4 - ON-SITE SOLIDIFICATION, ON-SITE DISPOSAL, NAT. ATTEN. LONG-TERM MONIT.
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	Total Cost ($) Sub.	Mat.	Labor	Equip.	Total Direct Cost ($)	Comments
PAGE 3 TOTAL	78,779	13,489	92,599	8,232	193,100	
Direct Cost Adjustment Factors						
Safety Level D Multiplier (5% of labor and equipment, for non-Lev. C activities)	0	0	4,630	412	5,042	
Safety Level C Multiplier (25% of labor and equipment, as listed)	0	0	0	0	0	
Site & Industrial Health & Safety Monitoring (3% of labor and equipment)	0	0	2,778	247	3,025	
Subtotal Direct Costs	78,779	13,489	97,229	8,644	201,166	
Indirect Cost Adjustment Factors						
Labor Overhead @ 120% (for field mgmt. & home office, only)	0	0	69,576	0	69,576	
Field Construction Labor Overhead @ 60%	0	0	20,772	0	20,772	
Subcontract Overhead @ 5%	3,939	0	0	0	3,939	
Tax on Materials @ 5%	0	674	0	0	674	
G & A @ 10% (on labor, equip., & matl's.)	0	1,349	9,723	864	11,936	
Subtotal Direct and Indirect Costs	82,718	15,512	197,300	9,508	308,063	
Cost Adjustment Factors						
1995 to 1996 Cost Correction Factor @ 4%	3,309	620	7,892	380	12,202	
City/Location Cost Adjustment Factor @ 21% (ref. 2)					64,693	
Adjusted Direct and Indirect Costs	86,027	16,133	205,192	9,889	384,958	
Engineering @ 6 % of total direct and indirect					23,097	
Prime Contractor Fee @ 10% of Total Adjusted Cost					38,496	
Total Costs					446,551	
Contingency @ 10% of Total Cost					44,655	
TOTAL ESTIMATED COST					491,206	

References used for cost estimates:

1) Means Site Work and Landscape Cost Data, 1995, 14th Annual Edition, R.S. Means Co., Inc., Kingston, MA
2) Environmental Restoration: Assemblies Cost Book; 1995; ECHOS, Los Angeles, CA
3) Historical data based on competitive bids submitted by subcontractors at this or other sites.

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Site 19 Alternative 4: Excavation, On-Site Solidification, On-Site Disposal, Nat. Atten., Long-term Monitoring

ASSUMPTIONS:

i. Discount rate for net present worth calculation at 7% per OSWER Directive No. 9355.3-20, June 25, 1993.

ii. Cost estimating sources:

- ECHOS Environmental Restoration, Unit Cost Book and Assemblies Cost Book, Delta Technologies Group, Inc. and Marshall & Swift, 1995.
- Means Heavy Construction Cost Data, 9th edition, R.S. Means Company, Inc., 1995.
- Means Site Work & Landscape Cost Data, 14th edition, R.S. Means Company, Inc., 1995.

iii. Abbreviations: SF = square feet; CF = cubic feet; SY = square yard; CY = cubic yard; LF = linear feet; MSF = 1000 SF

CAPITAL COST ITEMS:

1. Initial Activities

   - Field delineation of contaminated soils 2 people @ 10 hours @ @ 5 days @ $20/hr + $1000 M&IE + $400 equip + $200 supplies = $3600.

2. Mobilization/Demobilization Require portable communications, equipment mob/demob [lump sum], site utilities (elec./phone lines), decon. trailer. Will require drinking and wash water, and sanitary facilities.

3. Personnel & equipment decon. facilities and services Establish truck\heavy equipment decon. pad, personnel decon. pad, clean water storage, spent water storage.

4. Site Preparation:

   Clearing and grubbing 0.5 acres - Clear brush, shrubs, etc.

   Access road - Existing access roads appear to be adequate to sustain heavy equipment. Assume no further improvements needed.

   Erosion controls - will need to establish temporary silt fences and hay bales to protect adjacent wetlands. Polypropylene [022 704 1100]. Total linear ft silt fence = 100 LF.

Fugitive dust control - One 10000 gal tank. Have 1 water wagon spray down .5 acres per day, 20 days per month [18 05 0413].

5. Excavation:

Excavate 260 CY from topographic depression and drainage way. Haul to treatment area on Site 19.

6. Field confirmatory analyses: to verify or confirm that desired PRG levels (concentrations) have been achieved through excavation. Will need to field screen for metals. Assume use of field screening kits for metals.

ODCs & supplies: ~$1000/month

7. Solidification Treatment Rate:

Solidification: up to 35 CY/HR can be treated daily using small, transportable mixing units. Assume an effective 30 CY/HR soil/sediment processing capability including downtime. Using reasonable estimated soil-cement ratio of 5:1, to meet TCLP. Treatability study should be conducted. A soil-like treated product is anticipated.

Process: Soils/sediments from source areas are excavated and stockpiled. Load into shaker screen, which feeds conveyor, which feeds into batch plant [cement, soil, and water in 10 CY mixer]. Will require small (3/4 CY) loader to feed screen and convey mixed product to stock pile or to load into trucks.

Assume rental of solidification equipment is 1/2 of purchase price.

- Equipment mob.: $17513 [33 15 0436]
- Vibrating screen: $1445/wk + $16.5/hr operating cost [016 408 3720]
- 41.5 FT Belt conveyor: $6020 ea [33 18 8401]
- 50 CY/HR batch plant: use $10000 for 2 week
- Water system for mixer: $2003 [33 15 0426]
- Water pump: $2623 [33 15 0431]
- Dust collection system: $4020 [33 15 0430]
- 41.5 FT belt conveyor: $6020 ea [33 18 8401]
- Ancillary equipment: $7420 [33 15 0435]
- Maintenance of solid. equip.: $7652/yr
- Pressure washer: $3960 + $32/hr op.
- Labor: Supervisor + 3 technicians @ $30/HR
- Portland cement Type I: $68.02/ton [33 15 0405]
- Truck scale: $1484/MO

Solidification Rate:

- 260 CY @ 35 CY/HR = 680 HR = 7.5 days = 2 weeks
- Qty. of cement = [260 CY x 1.5 TON/CY]/5 = 65 TONS

- Labor = 4 x 10 x 10 HR/day = 400 HR

Bulk After solidification, expect up to 25% bulking of volume:

Vol. = 1.25 x 260 CY = 325 CY

Confirmatory TCLP analyses: Use 10% batch sampling rate to confirm leachate below 40 CFR 261.24 requirements using TCLP. 10 samples

8. Backfill - backfill treated materials into topographic depression which is 419 CY.

   Assume F.E. loader, 150 ft haul, to move stockpiled materials to desired areas [022 246 1350].

9. Grading and Compaction - Grade [025 122 3310] and compaction [17 03 0514]. Use 3000 SF = 335 SY

10. Barricade Demolition

    Estimated 1280 CY of backfill from barricade.
    Use 4-men crew of laborers (B-2) to dismantle barricade, @ 10 days
    Estimated barricade treated lumber of 108 FT x 35 FT (12 ft @ top) x 15 ft H; each lumber of 12" x 18"
    Total wood volume = 2[0.5 x (15)(35 +12)] 1 ft + [106 x 15] x 1 ft = 2295 CF
    Stage materials on Site 19 for future use.

11. Backfill Depression and Pave

    Add 94 CY of barricade material to depression. Grade and compact. Stockpile remainder of soils Pave 3000 SY with 6" asphalt.

12. Backfill Drainage way

    - Replace excavated drainage way with common earth. Use barricade materials if suitable.

LONG-TERM O & M COST ITEMS:

1. Long-term monitoring. Would be same as for no action. For FS to be consistent with NCP requirements, will need to cost out for 30-year duration. It is possible after one of the 5-year reviews that long-term monitoring would be discontinued once groundwater quality meets the NJ GWGS and surface water quality meets SWQS.

   a. Long-term annual post-closure groundwater, surface water, and sediment monitoring:

   - From 6 existing monitoring wells, 3 QC samples. Total 9 samples annually.
   - From 3 surface water locations, 3 QC samples. Total 6 samples annually.
   - From 3 sediment locations (same as surface water) , 3 QC samples. Total 6 samples annually.

Sampling and analysis for site-specific contaminants: VOCs and metals.

Labor: 1 event/year.

- GW/SW/SED sampling 2 people @ 10 hr/day @ 2 days (add 6 hr each for prep./mob/demob.) ≈ 52 hr annually.
- Sampling » 52 hours @ $60/hr (w/overhead & profit) = $3120
- Proj. mgmt/coord. » 20 hours/year @ $80/hr (w/O&P) = $1600
- Annual: add $300 M&IE; ODCs & supplies @ $200; & shipping @ $200.

Total ≈ $5420 annually

Estimated analytical costs:

- VOCs (EPA Method 624) $324/sample @ 21 samples/yr = $6804
- metals (EPA 6010/7000s) @ $254/sample @ 21 samples/yr = $5334

Total = $ 12138 = $12200

b. Reporting of results: data review and report prep. @ 50 hr/yr @ $70 = $3500, add $500 ODCs. Total = $4000

c. 5-year reviews at 200 LOE @ $70/hr. Approx. $1500 ODCs. Total = $ 15500 per event

NWS Earle Site FS
Site 19 - Alternative 5A - Excavation, Off-Site Disposal, Nat. Atten., Long-ter
Colts Neck New Jersey
Present Worth Analysis
[C:\CLEAN\CTO279\DFFS\COST\PW19-5A.WK4] 15 OCT 96

PRESENT WORTH ANALYSIS

YEAR	PRESENT WORTH FACTOR	CAPITAL COSTS ($ 000s)	O & M COSTS ($ 000s)	5-YEAR COSTS ($ 000s)	PRESENT WORTH ($ 000s)
0	1.000	375			375.30
1	0.935		21.60		20.19
2	0.873		21.60		18.87
3	0.816		21.60		17.63
4	0.763		21.60		16.48
5	0.713		21.60	15.5	26.45
6	0.666		21.60		14.39
7	0.623		21.60		13.45
8	0.582		21.60		12.57
9	0.544		21.60		11.75
10	0.508		21.60	15.5	18.86
11	0.475		21.60		10.26
12	0.444		21.60		9.59
13	0.415		21.60		8.96
14	0.388		21.60		8.38
15	0.362		21.60	15.5	13.45
16	0.339		21.60		7.32
17	0.317		21.60		6.84
18	0.296		21.60		6.39
19	0.277		21.60		5.97
20	0.258		21.60	15.5	9.59
21	0.242		21.60		5.22
22	0.226		21.60		4.88
23	0.211		21.60		4.56
24	0.197		21.60		4.26
25	0.184		21.60	15.5	6.84
26	0.172		21.60		3.72
27	0.161		21.60		3.48
28	0.150		21.60		3.25
29	0.141		21.60		3.04
30	0.131		21.60	15.5	4.87
		TOTAL PRESENT WORTH =			$676,781

Discount rate of 7% per OSWER Directive No. 9355.3-20, June 25, 1993

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 19 ALT. 5A - EXCAVATION, OFF-SITE DISPOSAL, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
[C:\CLEAN\CTO279\DRFS\COST\19-ALT5A.WK4] 15 OCT 96

Sheet 1 of 3

			Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
Item	Qty	Unit	Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
INITIAL ACTIVITIES												
1) Field delineation of soils	1	LS	0.00	1,200.00	2,000.00	400.00	0	1,200	2,000	400	3,600	[013 306 0100]
3) Engineering design (see page 3)												
MOBILIZATION/DEMOBILIZATION												
1) Portable Communication Equipment	2	SETS	400.00	0.00	0.00	0.00	800	0	0	0	800	
2) Equipment Mobilization/Demobilization	1	LS	10,000.00	0.00	0.00	0.00	10,000	0	0	0	10,000	
3) Site Utility Hook-ups (elec., phone, etc.)	1	LS	3,000.00	0.00	0.00	0.00	3,000	0	0	0	3,000	Historical data
4) Site Utilities	0.5	MO	4,000.00	0.00	0.00	0.00	2,000	0	0	0	2,000	
5) 1 Pick-up Truck (rental)	0.5	MO	500.00	100.00	0.00	0.00	250	50	0	0	300	Historical data
PERSONNEL AND EQUIP. DECON. FACILITIES AND SERVICES												
1) Truck/Heavy Equipment Decon Pad												
a) Excavate & grade area (40' x 50')	70	CY	0.00	0.00	0.70	0.70	0	0	49	49	98	[022 242 2020]
b) Compact area (40' x 50')	75	CY	0.00	0.00	0.11	0.36	0	0	8	27	35	[022 226 6200]
c) Curb & splash guard (poly & lumber)	1	LS	0.00	1,000.00	500.00	200.00	0	1,000	500	200	1,700	
d) Steam cleaner, pumps, hoses, sprayers, etc.	2	MO	1,000.00	0.00	100.00	0.00	2,000	0	200	0	2,200	Historical data
2) Decon Water (1000 gal/mon)	500	GAL	0.20	0.00	0.00	0.00	100	0	0	0	100	
3) Clean Water Storage Tank	1	EA	0.00	1,500.00	300.00	0.00	0	1,500	300	0	1,800	3000 Gallon
4) Spent Water Storage Tank	1	EA	0.00	2,500.00	400.00	0.00	0	2,500	400	0	2,900	5000 Gallon
5) Personnel Decon. Trailer	0.5	MO	2,500.00	0.00	200.00	0.00	1,250	0	100	0	1,350	Vendor catalog
6) PPE rolloff cont.	0.5	MO	700.00	0.00	0.00	0.00	350	0	0	0	350	Historical data
SITE MANAGEMENT STAFFING												
1) Site manager	90	HR	0.00	0.00	35.86	0.00	0	0	3,227	0	3,227	
2) Site supervisor/foreman	90	HR	0.00	0.00	30.00	0.00	0	0	2,700	0	2,700	
3) Site safety officer	10	HR	0.00	0.00	25.00	0.00	0	0	250	0	250	
HOME OFFICE PROJECT MANAGEMENT AND SUPPORT												
1) Project manager	10	HR	0.00	0.00	45.00	0.00	0	0	450	0	450	
2) Project administrator	10	HR	0.00	0.00	30.00	0.00	0	0	300	0	300	
3) Health and Safety director	2	HR	0.00	0.00	35.00	0.00	0	0	70	0	70	
4) Procurement/subcontracting	100	HR	0.00	0.00	30.00	0.00	0	0	3,000	0	3,000	
4) Clerical support	100	HR	0.00	0.00	12.36	0.00	0	0	1,236	0	1,236	

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 19 ALT. 5A - EXCAVATION, OFF-SITE DISPOSAL, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
[C:\CLEAN\CTO279\DRFS\COST\19-ALT5A.WK4] 15 OCT 96

			Unit Cost ($)				Total Cost ($)				Total Direct	
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.	Cost ($)	Comments
SITE PREPARATION												
1) clear & grub Site 19	0.5	AC	0.00	0.00	595.00	1,775.00	0	0	0	0	0	[021 108 0550]
2) cut & chip medium trees	0.5	AC	0.00	0.00	1425.00	1575.00	0	0	713	788	1,500	[021 104 0200]
4) Erosion control, silt fences	100	LF	0.00	0.37	0.33	0.00	0	37	33	0	70	[022 704 1100]
4) Erosion control, hay bales	0.5	ton	0.00	45.00	157.00	54.00	0	23	79	27	128	[022 704 1200]
7) Fugitive dusts control (water tank)	1	EA	0.00	2500.00	0.00	0.00	0	2,500	0	0	2,500	10,000 gal
7a) Spray from tank truck	2	MO	0.00	0.00	1160.00	1292.80	0	0	2,320	2,586	4,906	[18 05 0413]
EXCAVATION												
1)Excavate Site 19 soils/sediments	260	CY	0.00	0.00	1.06	1.24	0.00	0.00	276	322	598	[022 238 0360]
2) Haul 300 ft to treatment area	260	CY	0.00	0.00	0.51	0.51	0.00	0.00	133	133	265	[022 208 2200]
OFF-SITE DISPOSAL												
1) load dump trucks	260	CY	0.00	0.00	0.51	0.42	0	0	133	109	242	[022 216 4050]
2) Haul to TSDF, 260 CY @ 20 CY @ 350 miles	4550	miles	3.46	0.00	0.00	0.00	15,743	0	0	0	15,743	@ 350 miles/trip
3) Offsite disposal charge	260	CY	450.00	0.00	0.00	0.00	117,000	0	0	0	117,000	[33 19 7265]
BACKFILL TOPO. DEPRESSION												
1) Backfill with barricade materials	354	CY	0.00	0.00	0.51	0.51	0.00	0.00	181	181	361	[022 208 2200]
2) Compact barricade mat'l, 6" lifts in depression	354	CY	0.00	0.00	0.21	0.42	0.00	0.00	74	149	223	[022 226 5600]
BARRICADE DEMOLITION												
1) Remove 1280 CY soils	1,280	CY	0.00	0.00	0.51	0.51	0.00	0.00	653	653	1,306	[022 208 2200]
2) Haul to stockpile area (1000 ft)	926	CY	0.00	0.00	0.21	0.42	0.00	0.00	194	389	583	[022 226 5600]
3) Disassemble/demolish wood structure (B-2 crew)	10	days	0.00	0.00	792.00	100.00	0.00	0.00	7,920	1,000	8,920	B-4 daily rate
4) Haul to stockpile area	85	CY	0.00	0.00	0.21	0.42	0.00	0.00	18	36	54	[022 226 5600]
Pave Depression												
1) 3" asphalt binder	335	SY	0.00	3.94	0.38	0.34	0.00	0.00	127	114	241	[025 104 0160]
2) 3" asphalt wearing course	335	SY	0.00	4.32	0.42	0.39	0.00	0.00	141	131	271	[025 104 0460]
Fill Cement Pipe												
1) Block buried cement pipe	2	CY	0.00	54.00	0.00	0.00	0.00	108	0.00	0.00	108	[025 104 0460]

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 19 ALT. 5A - EXCAVATION, OFF-SITE DISPOSAL, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
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	Total Cost ($) Sub.	Mat.	Labor	Equip.	Total Direct Cost ($)	Comments
PAGE 3 TOTAL	152,493	8,918	27,783	7,291	196,485	
Direct Cost Adjustment Factors						
Safety Level D Multiplier (5% of labor and equipment, for non-Lev. C activities)	0	0	1,389	365	1,754	
Safety Level C Multiplier (25% of labor and equipment, as listed)	0	0	0	0	0	
Site & Industrial Health & Safety Monitoring (3% of labor and equipment)	0	0	834	219	1,052	
Subtotal Direct Costs	152,493	8,918	29,173	7,656	199,291	
Indirect Cost Adjustment Factors						
Labor Overhead @ 120% (for field mgmt. & home office, only)	0	0	13,480	0	13,480	
Field Construction Labor Overhead @ 60%	0	0	9,930	0	9,930	
Subcontract Overhead @ 5%	7,625	0	0	0	7,625	
Tax on Materials @ 5%	0	446	0	0	446	
G & A @ 10% (on labor, equip., & matl's.)	0	892	2,917	766	4,575	
Subtotal Direct and Indirect Costs	160,118	10,255	55,500	8,422	235,347	
Cost Adjustment Factors						
1995 to 1996 Cost Correction Factor @ 4%	6,405	410	2,220	337	9,372	
City/Location Cost Adjustment Factor @ 21% (ref. 2)					49,423	
Adjusted Direct and Indirect Costs	166,522	10,665	57,720	8,759	294,141	
Engineering @ 6 % of total direct and indirect					17,648	
Prime Contractor Fee @ 10% of Total Adjusted Cost					29,414	
Total Costs					341,204	
Contingency @ 10% of Total Cost					34,120	
TOTAL ESTIMATED COST					375,324	

References used for cost estimates:

1) Means Site Work and Landscape Cost Data, 1995, 14th Annual Edition, R.S. Means Co., Inc., Kingston, MA
2) Environmental Restoration: Assemblies Cost Book; 1995; ECHOS, Los Angeles, CA
3) Historical data based on competitive bids submitted by subcontractors at this or other sites.

NWS Earle Site FS
Site 19 - Alternative 5A - Excavation, Off-site disposal, Natural Attentuation, Long-term monitoring
Colts Neck New Jersey
O & M Analysis
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Annual Costs

ITEM	ANNUAL O & M ITEMS ($)	5-YEAR ITEMS ($)	NOTES
1. Groundwater, surface water, & sediment monitoring	$17,620		collect 9 GW (6 + 3 QC), 6 SW (3 + 3QC), and 6 SED (3 + 3QC) samples annually, plus travel, living & shipping
2. Reporting	$4,000		50 LOE hours for annual reports plus other direct costs
3. 5-year Site reviews		$15,550	Reviews performed for years 5, 10, 15, 20, 25, and 30

NWS Earle Site FS
Site 19 - Alternative 5B - Excavation, On-Base Disposal, Nat. Atten., Long-t
Colts Neck New Jersey
Present Worth Analysis
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PRESENT WORTH ANALYSIS

YEAR	PRESENT WORTH FACTOR	CAPITAL COSTS ($ 000s)	O & M COSTS ($ 000s)	5-YEAR COSTS ($ 000s)	PRESENT WORTH ($ 000s)
0	1.000	153			153.10
1	0.935		21.60		20.19
2	0.873		21.60		18.87
3	0.816		21.60		17.63
4	0.763		21.60		16.48
5	0.713		21.60	15.5	26.45
6	0.666		21.60		14.39
7	0.623		21.60		13.45
8	0.582		21.60		12.57
9	0.544		21.60		11.75
10	0.508		21.60	15.5	18.86
11	0.475		21.60		10.26
12	0.444		21.60		9.59
13	0.415		21.60		8.96
14	0.388		21.60		8.38
15	0.362		21.60	15.5	13.45
16	0.339		21.60		7.32
17	0.317		21.60		6.84
18	0.296		21.60		6.39
19	0.277		21.60		5.97
20	0.258		21.60	15.5	9.59
21	0.242		21.60		5.22
22	0.226		21.60		4.88
23	0.211		21.60		4.56
24	0.197		21.60		4.26
25	0.184		21.60	15.5	6.84
26	0.172		21.60		3.72
27	0.161		21.60		3.48
28	0.150		21.60		3.25
29	0.141		21.60		3.04
30	0.131		21.60	15.5	4.87
		TOTAL PRESENT WORTH =			$454,581

Discount rate of 7% per OSWER Directive No. 9355.3-20, June 25, 1993

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 19 ALT. 5B - EXCAVATION, ON-BASE DISPOSAL, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
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Sheet 1 of 3

			Unit Cost ($)				Total Cost ($)				Total Direct Cost ($)	Comments
Item	Qty	Unit	Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
INITIAL ACTIVITIES												
1) Field delineation of soils	1	LS	0.00	1,200.00	2,000.00	400.00	0	1,200	2,000	400	3,600	[013 306 0100]
3) Engineering design (see page 3)												
MOBILIZATION/DEMOBILIZATION												
1) Portable Communication Equipment	2	SETS	400.00	0.00	0.00	0.00	800	0	0	0	800	
2) Equipment Mobilization/Demobilization	1	LS	10,000.00	0.00	0.00	0.00	10,000	0	0	0	10,000	
3) Site Utility Hook-ups (elec., phone, etc.)	1	LS	3,000.00	0.00	0.00	0.00	3,000	0	0	0	3,000	Historical data
4) Site Utilities	0.5	MO	4,000.00	0.00	0.00	0.00	2,000	0	0	0	2,000	
5) 1 Pick-up Truck (rental)	0.5	MO	500.00	100.00	0.00	0.00	250	50	0	0	300	Historical data
PERSONNEL AND EQUIP. DECON. FACILITIES AND SERVICES												
1) Truck/Heavy Equipment Decon Pad												
a) Excavate & grade area (40' x 50')	70	CY	0.00	0.00	0.70	0.70	0	0	49	49	98	[022 242 2020]
b) Compact area (40' x 50')	75	CY	0.00	0.00	0.11	0.36	0	0	8	27	35	[022 226 6200]
c) Curb & splash guard (poly & lumber)	1	LS	0.00	1,000.00	500.00	200.00	0	1,000	500	200	1,700	
d) Steam cleaner, pumps, hoses, sprayers, etc.	2	MO	1,000.00	0.00	100.00	0.00	2,000	0	200	0	2,200	Historical data
2) Decon Water (1000 gal/mon)	500	GAL	0.20	0.00	0.00	0.00	100	0	0	0	100	
3) Clean Water Storage Tank	1	EA	0.00	1,500.00	300.00	0.00	0	1,500	300	0	1,800	3000 Gallon
4) Spent Water Storage Tank	1	EA	0.00	2,500.00	400.00	0.00	0	2,500	400	0	2,900	5000 Gallon
5) Personnel Decon. Trailer	0.5	MO	2,500.00	0.00	200.00	0.00	1,250	0	100	0	1,350	Vendor catalog
6) PPE rolloff cont.	0.5	MO	700.00	0.00	0.00	0.00	350	0	0	0	350	Historical data
SITE MANAGEMENT STAFFING												
1) Site manager	90	HR	0.00	0.00	35.86	0.00	0	0	3,227	0	3,227	
2) Site supervisor/foreman	90	HR	0.00	0.00	30.00	0.00	0	0	2,700	0	2,700	
3) Site safety officer	10	HR	0.00	0.00	25.00	0.00	0	0	250	0	250	
HOME OFFICE PROJECT MANAGEMENT AND SUPPORT												
1) Project manager	10	HR	0.00	0.00	45.00	0.00	0	0	450	0	450	
2) Project administrator	10	HR	0.00	0.00	30.00	0.00	0	0	300	0	300	
3) Health and Safety director	2	HR	0.00	0.00	35.00	0.00	0	0	70	0	70	
4) Procurement/subcontracting	100	HR	0.00	0.00	30.00	0.00	0	0	3,000	0	3,000	
4) Clerical support	100	HR	0.00	0.00	12.36	0.00	0	0	1,236	0	1,236	

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 19 ALT. 5B - EXCAVATION, ON-BASE DISPOSAL, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
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			Unit Cost ($)				Total Cost ($)				Total Direct	
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.	Cost ($)	Comments
SITE PREPARATION												
1) clear & grub Site 19	0.5	AC	0.00	0.00	595.00	1,775.00	0	0	0	0	0	[021 108 0550]
2) cut & chip medium trees	0.5	AC	0.00	0.00	1425.00	1575.00	0	0	713	788	1,500	[021 104 0200]
4) Erosion control, silt fences	100	LF	0.00	0.37	0.33	0.00	0	37	33	0	70	[022 704 1100]
4) Erosion control, hay bales	0.5	ton	0.00	45.00	157.00	54.00	0	23	79	27	128	[022 704 1200]
7) Fugitive dusts control (water tank)	1	EA	0.00	2500.00	0.00	0.00	0	2,500	0	0	2,500	10,000 gal
7a) Spray from tank truck	2	MO	0.00	0.00	1160.00	1292.80	0	0	2,320	2,586	4,906	[18 05 0413]
EXCAVATION												
1)Excavate Site 19 soils/sediments	260	CY	0.00	0.00	1.06	1.24	0.00	0.00	276	322	598	[022 238 0360]
2) Haul 300 ft to treatment area	260	CY	0.00	0.00	0.51	0.51	0.00	0.00	133	133	265	[022 208 2200]
ON-BASE DISPOSAL												
1) load dump trucks	260	CY	0.00	0.00	0.51	0.42	0	0	133	109	242	[022 216 4050]
2) Haul to Site 4, 260 CY @ 20 CY @ 2 miles	26	miles	3.46	0.00	0.00	0.00	90	0	0	0	90	@ 2 miles/trip
BACKFILL TOPO. DEPRESSION												
1) Backfill with barricade materials	354	CY	0.00	0.00	0.51	0.51	0.00	0.00	181	181	361	[022 208 2200]
2) Compact barricade mat'l, 6" lifts in depression	354	CY	0.00	0.00	0.21	0.42	0.00	0.00	74	149	223	[022 226 5600]
BARRICADE DEMOLITION												
1) Remove 1280 CY soils	1,280	CY	0.00	0.00	0.51	0.51	0.00	0.00	653	653	1,306	[022 208 2200]
2) Haul to stockpile area (1000 ft)	926	CY	0.00	0.00	0.21	0.42	0.00	0.00	194	389	583	[022 226 5600]
3) Disassemble/demolish wood structure (B-2 crew)	10	days	0.00	0.00	792.00	100.00	0.00	0.00	7,920	1,000	8,920	B-4 daily rate
4) Haul to stockpile area	85	CY	0.00	0.00	0.21	0.42	0.00	0.00	18	36	54	[022 226 5600]
Pave Depression												
1) 3" asphalt binder	335	SY	0.00	3.94	0.38	0.34	0.00	0.00	127	114	241	[025 104 0160]
2) 3" asphalt wearing course	335	SY	0.00	4.32	0.42	0.39	0.00	0.00	141	131	271	[025 104 0460]
Fill Cement Pipe												
1) Block buried cement pipe	2	CY	0.00	54.00	0.00	0.00	0.00	108	0.00	0.00	108	[025 104 0460]

NWS EARLE FEASIBILITY STUDY COLTS NECK, NJ
SITE 19 ALT. 5B - EXCAVATION, ON-BASE DISPOSAL, NAT. ATTEN. LONG-TERM MONIT.
NAVY CLEAN CTO 0279; B&RE JOB NO.7452
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	Total Cost ($) Sub.	Mat.	Labor	Equip.	Total Direct Cost ($)	Comments
PAGE 2 TOTAL	19,840	8,918	27,783	7,291	63,832	
Direct Cost Adjustment Factors						
Safety Level D Multiplier (5% of labor and equipment, for non-Lev. C activities)	0	0	1,389	365	1,754	
Safety Level C Multiplier (25% of labor and equipment, as listed)	0	0	0	0	0	
Site & Industrial Health & Safety Monitoring (3% of labor and equipment)	0	0	834	219	1,052	
Subtotal Direct Costs	19,840	8,918	29,173	7,656	66,638	
Indirect Cost Adjustment Factors						
Labor Overhead @ 120% (for field mgmt. & home office, only)	0	0	13,480	0	13,480	
Field Construction Labor Overhead @ 60%	0	0	9,930	0	9,930	
Subcontract Overhead @ 5%	992	0	0	0	992	
Tax on Materials @ 5%	0	446	0	0	446	
G & A @ 10% (on labor, equip., & matl's.)	0	892	2,917	766	4,575	
Subtotal Direct and Indirect Costs	20,832	10,255	55,500	8,422	96,061	
Cost Adjustment Factors						
1995 to 1996 Cost Correction Factor @ 4%	833	410	2,220	337	3,800	
City/Location Cost Adjustment Factor @ 21% (ref. 2)					20,173	
Adjusted Direct and Indirect Costs	21,665	10,665	57,720	8,759	120,034	
Engineering @ 6 % of total direct and indirect					7,202	
Prime Contractor Fee @ 10% of Total Adjusted Cost					12,003	
Total Costs					139,240	
Contingency @ 10% of Total Cost					13,924	
TOTAL ESTIMATED COST					153,164	

References used for cost estimates:

1) Means Site Work and Landscape Cost Data, 1995, 14th Annual Edition, R.S. Means Co., Inc., Kingston, MA
2) Environmental Restoration: Assemblies Cost Book; 1995; ECHOS, Los Angeles, CA
3) Historical data based on competitive bids submitted by subcontractors at this or other sites.

NWS Earle Site FS
Site 19 - Alternative 5B - Excavation, On-Base Disposal, Natural Attentuation, Long-term monitoring
Colts Neck New Jersey
O & M Analysis
[C:\CLEAN\CTO279\DFFS\COST\OM19-5B.WK4] 15 OCT 96

Annual Costs

ITEM	ANNUAL O & M ITEMS ($)	5-YEAR ITEMS ($)	NOTES
1. Groundwater, surface water, & sediment monitoring	$17,620		collect 9 GW (6 + 3 QC), 6 SW (3 + 3QC), and 6 SED (3 + 3QC) samples annually, plus travel, living & shipping
2. Reporting	$4,000		50 LOE hours for annual reports plus other direct costs
3. 5-year Site reviews		$15,550	Reviews performed for years 5, 10, 15, 20, 25, and 30

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Site 19 Alternative 5: Excavation, Off-site Disposal, Nat. Atten., Long-term Monitoring

Scenario A: Off-site disposal

Scenario B: On-base disposal at Site 4

ASSUMPTIONS:

i. Discount rate for net present worth calculation at 7% per OSWER Directive No. 9355.3-20, June 25, 1993.

ii. Cost estimating sources:

- ECHOS Environmental Restoration, Unit Cost Book and Assemblies Cost Book, Delta Technologies Group, Inc. and Marshall & Swift, 1995.
- Means Heavy Construction Cost Data, 9th edition, R.S. Means Company, Inc., 1995.
- Means Site Work & Landscape Cost Data, 14th edition, R.S. Means Company, Inc., 1995.

iii. Abbreviations: SF = square feet; CF = cubic feet; SY = square yard; CY = cubic yard; LF = linear feet; MSF = 1000 SF

CAPITAL COST ITEMS:

1. Initial Activities

   - Field delineation of contaminated soils 2 people @ 10 hours @ @ 5 days @ $20/hr + $1000 M&IE + $400 equip + $200 supplies = $3600.

2. Mobilization/Demobilization Require portable communications, equipment mob/demob [lump sum], site utilities (elec./phone lines), decon. trailer. Will require drinking and wash water, and sanitary facilities.

3. Personnel & equipment decon. facilities and services Establish truck\heavy equipment decon. pad, personnel decon. pad, clean water storage, spent water storage.

4. Site Preparation:

   Clearing and grubbing 0.5 acres - Clear brush, shrubs, etc.

   Access road - Existing access roads appear to be adequate to sustain heavy equipment. Assume no further improvements needed.

   Erosion controls - will need to establish temporary silt fences and hay bales to protect adjacent

wetlands. Polypropylene [022 704 1100]. Total linear ft silt fence = 100 LF.

Fugitive dust control - One 10000 gal tank. Have 1 water wagon spray down .5 acres per day, 20 days per month [18 05 0413].

5. Excavation:

Excavate 260 CY from topographic depression and drainage way. Haul to treatment area on Site 19.

6. Field confirmatory analyses: to verify or confirm that desired PRG levels (concentrations) have been achieved through excavation. Will need to field screen for metals. Assume use of field screening kits for metals.

ODCs & supplies: ~$1000/month

7. Scenario 1: Off-site disposal

Assume worst case, that contaminated soils would fail TCLP. Dispose of in RCRA C landfill. Model City, New York. Distance from Tinton Falls to Model City ~ 350 miles

8. Scenario 2: On-base disposal

Consolidate into Site 4 for closure if materials are not hazardous by regulatory definition.

9. Backfill - backfill treated materials into topographic depression which is 419 CY.

Assume F.E. loader, 150 ft haul, to move stockpiled materials to desired areas [022 246 1350].

10. Grading and Compaction - Grade [025 122 3310] and compaction [17 03 0514]. Use 3000 SF = 335 SY

11. Barricade Demolition

Estimated 1280 CY of backfill from barricade.
Use 4-men crew of laborers (B-2) to dismantle barricade, @ 10 days
Estimated barricade treated lumber of 108 FT x 35 FT (12 ft @ top) x 15 ft H; each lumber of 12" x 18"
Total wood volume = 2[0.5 x (15)(35 +12)] 1 ft + [106 x 15] x 1 ft = 2295 CF
Stage materials on Site 19 for future use.

12. Backfill Depression and Pave

Add 94 CY of barricade material to depression. Grade and compact. Stockpile remainder of soils Pave 3000 SY with 6" asphalt.

13. Backfill Drainage way
- Replace excavated drainage way with common earth. Use barricade materials if suitable.

LONG-TERM O & M COST ITEMS:

1. Long-term monitoring. Would be same as for no action. For FS to be consistent with NCP requirements, will need to cost out for 30-year duration. It is possible after one of the 5-year reviews that long-term monitoring would be discontinued once groundwater quality meets the NJ GWGS and surface water quality meets SWQS.

   a. Long-term annual post-closure groundwater, surface water, and sediment monitoring:

   - From 6 existing monitoring wells, 3 QC samples. Total 9 samples annually.
   - From 3 surface water locations, 3 QC samples. Total 6 samples annually.
   - From 3 sediment locations (same as surface water) , 3 QC samples. Total 6 samples annually.

   Sampling and analysis for site-specific contaminants: VOCs and metals.

   Labor: 1 event/year.

   - GW/SW/SED sampling 2 people @ 10 hr/day @ 2 days (add 6 hr each for prep./mob/demob.) ≈ 52 hr annually.
   - Sampling » 52 hours @ $60/hr (w/overhead & profit) = $3120
   - Proj. mgmt/coord. » 20 hours/year @ $80/hr (w/O&P) = $1600
   - Annual: add $300 M&IE; ODCs & supplies @ $200; & shipping @ $200.

   Total ≈ $5420 annually

   Estimated analytical costs:

   - VOCs (EPA Method 624) $324/sample @ 21 samples/yr = $6804
   - metals (EPA 6010/7000s) @ $254/sample @ 21 samples/yr = $5334

   Total = $ 12138 = $12200

   b. Reporting of results: data review and report prep. @ 50 hr/yr @ $70 = $3500, add $500 ODCs. Total = $4000

   c. 5-year reviews at 200 LOE @ $70/hr. Approx. $1500 ODCs. Total = $ 15500 per event