

Five-Year Review Report
Second Five-Year Review Report
for
Landfill & Resource Recovery (L&RR) Superfund Site
Town of North Smithfield
Providence County, Rhode Island
September 2004

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LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYM	DEFINITION
1,1- DCA	1,1-Dichloroethane
ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Ambient Water Quality Criteria
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
ESD	Explanation of Significant Difference
ESR	Evaluation Summary Report
FS	Feasibility Study
L&RR	Landfill & Resource Recovery
M&E	Metcalf & Eddy, Inc.
MCL	Maximum Contaminant Level
MEK	Methyl Ethyl Ketone
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
PRP	Potentially Responsible Party
PSD	Performing Settling Defendant
RA	Remedial Action
RAC	Response Action Contract
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI	Remedial Investigation
RI AALs	Rhode Island Ambient Air Levels
RIAT	Rhode Island Air Toxics Regulation No. 22
RIDEM	Rhode Island Department of Environmental Management

ACRONYM	DEFINITION
RIDOH	Rhode Island Department of Health
ROD	Record of Decision
SACD	Settlement Agreement and Consent Decree
SDWA	Safe Drinking Water Act
TBCs	To Be Considereds
trans-1,2-DCE	trans-1,2-Dichloroethene
UAO	Unilateral Administrative Order
VOC	Volatile Organic Compound
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

The Landfill & Resource Recovery (L&RR) Superfund Site (the Site) is a 28-acre closed landfill located in North Smithfield, Providence County, Rhode Island (see Figure 1, provided in Attachment 1 of this report). The landfill is part of a 36-acre parcel owned by L&RR, Inc.

The selected remedy identified in the 1988 Record of Decision (ROD) included upgrading the landfill closure, installing a gas collection and thermal destruction system, remediation of two wetland areas, and periodic monitoring of groundwater and air for a period of thirty years. The ROD has been modified by two Explanations of Significant Difference (ESDs). The first ESD removed the wetlands remediation component of the ROD, stating that it would be more properly addressed through the Federal Clean Water Act or other federal or state statutes or regulations. The second ESD clarified that the groundwater standards referenced in the ROD [i.e., Safe Drinking Water Act Maximum Contaminant Levels (MCLs)] are to be used to evaluate and monitor the integrity and performance of the landfill closure and are not, by themselves, cleanup or performance standards for groundwater.

This is the second five-year review for the L&RR Site. The first five-year review was completed in September 1999, and that date was the trigger for this second review. This statutory five-year review is required due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

This five-year review concluded that the remedy is functioning as designed and continues to be protective of human health and the environment. However, in order for the remedy to remain protective in the long term, the extent of the contaminated groundwater to the northeast and east of the landfill should be investigated, delineated, and monitored. In addition, institutional controls must be put in place.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name (from WasteLAN): Landfill & Resource Recovery, Inc. (L&RR)

EPA ID (from WasteLAN): RID093212439

Region: 01

State: RI

City/County: North Smithfield/Providence County

SITE STATUS

NPL status: Final Deleted Other (specify) _____

Remediation status (choose all that apply): Under Construction Operating Complete

Multiple OUs? YES NO

Construction completion date: 2 /24/ 97

Has site been put into reuse? YES NO

REVIEW STATUS

Lead agency: EPA State Tribe Other Federal Agency _____

Author name: Anna Krasko

Author title: Remedial Project Manager

Author affiliation: U.S. EPA

Review period: 3 /15/ 2004 to 8/30/ 2004

Date of site inspection: 5/17/04

Type of review:

Post-SARA Pre-SARA NPL-Removal only
 Non-NPL Remedial Action Site NPL State/Tribe-lead
 Regional Discretion

Review number: 1 (first) 2 (second) 3 (third) Other (specify) _____

Triggering action:

Actual RA Onsite Construction at OU1 _____

Actual RA Start at OU# _____

Construction Completion

Previous Five-Year Review Report

Other (specify) _____

Triggering action date (from WasteLAN): September 1999

Due date (five years after triggering action date): September 2004

Five-Year Review Summary Form, cont'd.

Issues:

1. Several contaminants have been shown to be present in groundwater just beyond the landfill boundary at concentrations above MCLs, but the downgradient extent of the plume and the discharge area have not been confirmed. Manganese and cadmium, which were listed in the ROD as having been detected in downgradient groundwater and appropriate for quarterly monitoring, are not among the currently tested analytes in the groundwater monitoring program.
2. The presence of landfill gas odors at several of the gas extraction wells, and the detection of benzene in air samples collected atop the landfill, suggest that there may be fugitive emissions from certain areas on the landfill. The liner penetrations at some of the gas extraction wells are possible locations of gas escape and water infiltration.
3. Institutional Controls, not required in the ROD but included in the settlement agreement to clean up the site, have not been finalized.

Recommendations and Follow-up Actions:

1. Delineate the plume between the landfill and the discharge area and install permanent monitoring wells. Add manganese and cadmium to the list of analytes for samples from MW-102A, MW-104A, and CW-5B for the Spring and Fall 2005 rounds of monitoring.
2. Determine the sources of the landfill odors at any gas extraction wells where they are noted. Determine if the extraction well boot/cap liner connections are sealed, or if it is a possible pathway for gas escape or water infiltration.
3. Institutional controls need to be finalized.

Protectiveness Statement(s):

The remedy at the L&RR Superfund Site currently protects human health and the environment because: (a) access to the Site is restricted to prevent direct exposures to waste; (b) the vegetative cover and the drainage system are constructed and maintained to prevent erosion of soil and deposition in the surrounding wetlands; and (c) the cap, the gas extraction system, and the flare capture and treat landfill gases to prevent exposures at the Site boundary. However, in order for the remedy to be protective in the long-term, the extent of the plume needs to be determined, and permanent monitoring wells need to be installed within and beyond the plume and sampled periodically to verify that existing or future private or public water supply wells are not impacted. Finally, the institutional controls required in the settlement agreement must be finalized.

Other Comments:

None.

SECTION 1.0 INTRODUCTION

The purpose of this five-year review is to determine whether the remedy for the L&RR Superfund Site are protective of human health and the environment. The methods, findings, and conclusions of this review are documented in this Five-Year Review report. In addition, Five-Year Review reports identify issues found during the review, if any, and provide recommendations to address them.

EPA Region I has conducted this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP). CERCLA §121 states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgement of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The Agency interpreted this requirement further in the NCP; 40 CFR 300.430(f)(4)(ii):

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

This is the second five-year review for the L&RR Site. The completion of the first five-year review, in September 1999, is the trigger for this second five-year review. This statutory review is required due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

**SECTION 2.0
SITE CHRONOLOGY**

The chronology of the Site, including all significant site events and dates, is included in Table 1.

Table 1: Chronology of Site Events	
Event	Date
L&RR, Inc. submitted plans for installation of 7 monitoring wells to the Rhode Island Department of Health	November 1977
The Rhode Island Department of Environmental Management ordered L&RR, Inc. to stop accepting hazardous wastes for disposal	September 1979
Final listing on EPA National Priorities List	September 8, 1983
Landfill closure began	1985
Completion of Remedial Investigation/Feasibility Study	June 1988
Record of Decision is signed	September 29, 1988
Unilateral Administrative Order (UAO) issued by EPA	June 29, 1990
The Statement of Work attached to the UAO was modified	October 14, 1990
An Explanation of Significant Differences issued for the Site	March 8, 1991
Remedial Design start	March 1993
Remedial Design completion	September 1994
RA construction activities began at the Site	May 1994
RA construction completed	February 1995
Post Closure Operation and Maintenance Plan approved by EPA	September 1996
A second Explanation of Significant Differences issued for the Site	September 16, 1996

Table 1: Chronology of Site Events	
Event	Date
Settlement Agreement and Consent Decree lodged in U.S. District Court	February 18, 1997
Preliminary Close Out Report issued by EPA	February 24, 1997
Final As-Built Drawing submitted for EPA review and approval	March 25, 1997
Remedial Action report issued by EPA	September 4, 1997
First 5-year review report issued by EPA for the Site	September 1999

SECTION 3.0 BACKGROUND

3.1 PHYSICAL CHARACTERISTICS/LAND AND RESOURCE USE

The Landfill & Resource Recovery (L&RR) Superfund Site (the Site) is a 28-acre closed landfill located in North Smithfield, Providence County, Rhode Island (see Figure 1, provided in Attachment 1 of this report). The landfill is part of a 36-acre parcel owned by L&RR, Inc, which is located on Oxford Turnpike (also called Old Forge Road) northwest of its intersection with Pound Hill Road. Oxford Turnpike, a private road, is currently barricaded to traffic just northwest of its intersection with Pound Hill Road, so the Site is now accessed along an unpaved road that connects Douglas Pike (Route 7) to Oxford Turnpike just north of the Site. The access road is used primarily by vehicles traveling to and from the Holliston Sand borrow pit, which is north of the Site on Oxford Turnpike/Tift Road.

The Site is located in an undeveloped area and is primarily surrounded by woodlands. The landfill extends to Oxford Turnpike to the west and southwest; to a wetland and intermittent stream to the southeast; and to the property line or onto the adjacent power line property to the north and east (see Figure 2, provided in Attachment 1 of this report). Three unnamed streams are located to the south and east of the Site. These streams flow through wetland areas and then discharge to Trout Brook. Trout Brook flows into Trout Brook Pond which then discharges to the lower Slatersville Reservoir. Trout Brook and the Slatersville Reservoir are designated as Class B water bodies by the Rhode Island Department of Environmental Management (RIDEM), which indicates that they are suitable for fishing, swimming, and other recreational activities (USEPA, 1988).

The landfill is located over the Slatersville Aquifer, which has been designated as a drinking water source by the State of Rhode Island (USEPA, 1988). The Tift Road well, a public water supply well operated by the North Smithfield Water Authority, is located just north of Tift Road and just west of Trout Brook Pond. The water from this well is pumped through a pipeline along Tift Road out to Providence Pike (Route 5). Residences on most other streets around the Site, including Pound Hill Road, Black Plain Road, and other nearby roads, rely on private wells for water supply.

An increase in the large-scale withdrawals of groundwater from the Slatersville Aquifer is likely in the future. In 1999, a power plant was proposed for construction about 2,000 feet northwest of the Site, on the east shore of the upper Slatersville Reservoir. The proposed water source for the facility, which was not built, was to be an on-site well. The North Smithfield Water Authority has been considering replacing the Tift Road well for several years. The replacement well may be designed to pump at a higher rate than the existing well, which operates at a rate of 100 to 200 gpm.

3.2 HISTORY OF CONTAMINATION

The Site is a former sand and gravel pit which reportedly began accepting municipal wastes for disposal around 1927. Over its years of operation, the landfill also accepted commercial and industrial wastes for disposal. In 1974, the landfill was sold to L&RR, Inc., the current owner of the Site. EPA has estimated that more than 2 million gallons of hazardous chemicals including solvents, plating waste, asbestos, oils, and dyes were brought to the landfill for disposal (*de maximis*, 1997).

3.3 INITIAL RESPONSE

L&RR, Inc. submitted plans for installation of seven monitoring wells to the Rhode Island Department of Health (RIDOH) in November 1977. The wells were installed to comply with State regulations pertaining to hazardous waste disposal. This submittal was the first indication that disposal of hazardous waste was occurring at the Site. In September 1979, RIDEM ordered L&RR to stop accepting hazardous wastes for disposal. In December 1979, L&RR, Inc., placed a synthetic cover over the area that they defined as containing hazardous wastes. Several monitoring wells were installed and sampled between 1977 and 1980.

EPA conducted a Preliminary Site Assessment of the L&RR Site in 1980 and 1981 which resulted in the Site being placed on the National Priorities List (NPL). The Site received final listing on the NPL in September 1983. A Remedial Action Master Plan was completed for the Site in 1983.

The landfill stopped accepting wastes in January 1985. Landfill closure began in 1985 pursuant to a 1983 Court Order and Consent Order and Agreement between RIDEM and L&RR, Inc. In 1986, under the direction of RIDEM, L&RR, Inc., covered a majority of the landfill with a 20-mil polyvinyl chloride (PVC) geomembrane and soil and installed a system of 18 gas vents.

In June 1983, L&RR, Inc. requested that EPA accept the reports and plans generated under the 1983 Court Order as fulfilling the requirements of a Remedial Investigation/Feasibility Study (RI/FS). In November 1984, EPA sent L&RR, Inc. a proposed consent order, which would have allowed L&RR, Inc. to submit the data collected under the 1983 Court Order supplemented by additional investigations and studies required by EPA to meet the RI/FS requirements under the NCP. L&RR, Inc. failed to respond to EPA's proposed consent order. On January 29, 1985, EPA notified L&RR, Inc. that EPA was withdrawing from the process of negotiating a formal agreement with L&RR, Inc. regarding the RI/FS (USEPA, 1988).

On June 5, 1986, EPA notified L&RR, Inc. of their potential liability with respect to the Site. EPA initiated the RI/FS process under CERCLA in 1986. The RI/FS Report was completed in June 1988 (Ebasco, 1988).

3.4 BASIS FOR TAKING ACTION

The following summarizes the contaminants detected at the Site as identified in the 1988 RI:

Air. Methane, hydrogen sulfide, and several volatile organic compounds (VOCs) were detected in gas samples collected from the 18 vents on the landfill. Five of the vents, located within the approximate area where hazardous wastes were disposed, contained much higher levels of VOCs. Methane, hydrogen sulfide, and several VOCs were also detected in fugitive emissions from the surface of the uncovered area of the landfill.

Groundwater. Low levels of VOCs and metals (arsenic, cadmium, and lead) were detected in groundwater downgradient of the Site. All concentrations were below Federal MCLs. Iron, manganese, chloride, and specific conductance were detected in downgradient groundwater at slightly elevated levels that are typical of levels found in groundwater migrating from municipal landfills. Contaminants of concern in groundwater which were evaluated as part of the Public Health Assessment included 2-butanone (or methyl ethyl ketone (MEK)), arsenic, and lead.

Subsurface Soil. No significant levels of contaminants were identified in subsurface soils in the RI.

Sediment and Surface Water. Low levels of VOCs and inorganic compounds were detected in surface water and sediments from nearby streams. Contaminants of concern in surface water and/or sediment which were evaluated as part of the Public Health Assessment included 2-butanone (or MEK), toluene, trans-1,2-dichloroethene (trans-1,2-DCE), 1,1-dichloroethane (1,1-DCA), arsenic, lead, and zinc.

A Baseline Public Health Assessment and a Baseline Environmental Assessment were performed as part of the RI/FS (Ebasco, 1988). The Public Health Assessment concluded that exposures to surface water and sediments adjacent to the Site did not pose a significant risk to human health. Also, exposure to groundwater at the boundary of the Site did not pose a significant risk to public health. It was concluded that potential exposure to gaseous emissions from the landfill posed a significant health risk to neighboring residents and children who may play on the landfill.

The Environmental Assessment concluded that there were no risks to wildlife at the Site from exposure to contaminants of concern. However, it was concluded that the wetlands were being impacted by soil eroding from the landfill cover and filling in the wetlands, thereby destroying vegetation and decreasing the ability of the wetland areas to support indigenous plant and animal life.

These conclusions formed the basis of the selected remedy for the Site.

SECTION 4.0 REMEDIAL ACTIONS

4.1 REMEDY SELECTION

The ROD for the L&RR Site was signed on September 29, 1988. The remedial action objectives listed in the ROD are:

- Remediate the landfill so that federal and state applicable, relevant, and appropriate requirements are met and to insure that the landfill is protective of human health and the environment;
- Reduce present and future impacts to wetlands due to sedimentation of eroded landfill cover material;
- Remediate the wetlands already impacted by sedimentation; and
- Remediate the landfill gas so that VOC concentrations in ambient air are reduced and risks to public health and the environment are minimized.

The selected source control remedy for L&RR, as identified in the ROD, consisted of the following components:

1. Upgrading the Landfill Closure. This component included installing a fence; developing a post-closure monitoring plan; upgrading the surface water runoff management system; stabilizing the steep side slopes and installing a synthetic cover on the uncovered northeast area of the landfill; establishing a cover thickness of 24 inches; and establishing vegetation.

2. Gas Collection and Thermal Destruction. This component involved collecting gas from the existing vents and installing a subsurface piping system to direct gaseous emissions to the treatment system. Three potential thermal destruction technologies (combustion, flaring, and incineration) were identified to treat the gaseous emissions.

3. Wetlands Remediation. This component involved excavating sands from two wetlands areas impacted by sedimentation and subsequent revegetating of the excavated areas.

4. Site Monitoring. This component involved periodic monitoring of groundwater and air for a period of thirty years. Groundwater monitoring was to be conducted quarterly while the air monitoring program would be outlined during the design phase.

Two Explanation of Significant Differences (ESDs) have been issued for the L&RR Site. The first ESD, signed on March 8, 1991, stated that EPA had re-evaluated information for the Site and determined that the wetlands remediation required by the ROD would be more properly addressed through the Federal Clean Water Act, or other federal or state statutes or regulations.

The second ESD, signed on September 16, 1996, was issued to clarify that the groundwater standards referenced in the ROD (i.e., Safe Drinking Water Act MCLs) are to be used to evaluate and monitor the integrity and performance of the landfill closure and are not, by themselves, cleanup or performance standards for groundwater.

According to the 1997 Settlement Agreement and Consent Decree, the remedial action will be considered complete only after all performance standards have been attained for three consecutive years, including the standards for air emissions under open vent conditions after discontinuance of the gas collection and thermal treatment system. As described in the Statement of Work for the Settlement Agreement and Consent Decree, the Performing Settling Defendants (PSDs) must submit a petition to EPA, with supporting data, to discontinue operation of the gas collection and treatment system. The petition must include a post-operation sampling and analysis plan for monitoring compliance with the cleanup standards and demonstrating protectiveness after discontinuance of those operations. In any case, as indicated in section IV.C of the 1997 Statement of Work, monitoring and operation and maintenance activities shall continue for 30 years unless extended by EPA.

The 1997 Settlement Agreement and Consent Decree specified that land and water use restrictions are needed to protect public health and the environment, and to protect the remedial measures that have been or will be implemented. Additionally, long-term monitoring of surface water was included as a Site monitoring requirement.

4.2 REMEDY IMPLEMENTATION

The remedial design/remedial action activities were performed by the potentially responsible parties (PRPs) under a Unilateral Administrative Order issued by EPA in June 1990 and modified in October 1990. In a Consent Decree signed with EPA and lodged in U.S. District Court on February 18, 1997, the L&RR Group Performing Settling Defendants (PSDs) agreed to continue the required post closure activities and operation and maintenance for the L&RR Landfill Superfund Site. The Settlement Agreement and Consent Decree also specified institutional controls to be established at the Site.

The design and implementation of the remedial actions identified in the ROD and Consent Decree are discussed below. The information below is primarily summarized from the Remedial Action (RA) report completed in September 1997 (*de maximis*, 1997).

In June 1992, a Draft Evaluation Summary Report (ESR) for Synthetic Cover/ Slope Stabilization Alternatives was prepared by Canonic Environmental Services Corporation. In January 1993, a Draft ESR for Landfill Gas Treatment Alternatives was prepared. Remedial design activities were conducted between March 1993 and September 1994. Remedial Action construction activities began in May 1994. In July 1994, preloading activities were conducted to allow extension of the PVC cover across the remaining 20% of the landfill which was uncovered. Fill was added so that the slope could be extended. Between July and December 1994, the landfill cover was constructed, and a temporary vegetative cover was established. Also, during this period, the flare

system was installed, and all mechanical and electrical subsystems were tested. In April 1995, the landfill was permanently seeded, and a corrective action plan to address landfill gas migration control was prepared. In July 1995, post-closure monitoring activities were initiated (*de maximis*, 1997). In September 1996, the Post Closure Operation and Maintenance Plan was completed and approved by EPA (*de maximis*, 1996). On November 1, 1996, the Final Site Inspection was conducted. The Preliminary Close Out Report was issued by EPA on February 24, 1997, which documented the activities and schedule for site completion. The RA report was completed in September 1997 (*de maximis*, 1997).

From January 1995 through December 1998, the condensate generated from the operation of the landfill gas collection system was collected in three condensate sumps which were automatically emptied via level controlled pneumatic pumps and discharged to a 2,500 gallon double-wall underground storage tank. Condensate from the storage tank was emptied on a regular basis and transported to the PSC Industrial Resources facility in Warwick, Rhode Island for treatment and disposal.

In November 1998, the Settling Defendants submitted a Work Plan for an alternate condensate management option consisting of on-site condensate injection into the flare system, citing advantages of turnkey management of the condensate. Following EPA and RIDEM approval, in December 1998, the condensate injection system was installed by John Zink Company LLC. Flare performance tests, both with and without the condensate injection system in operation, were performed in March 1999. The results of the stack testing and modeling of maximum emissions results demonstrated that the system was in compliance with Rhode Island Air Toxics Regulation No. 22 (RIAT) both with and without condensate injection.

4.3 SYSTEM OPERATIONS/O&M

The Post-Closure Operation & Maintenance Plan (“O&M Plan”), prepared for and referenced in the Consent Decree, forms the basis for operations, maintenance, and monitoring at the L&RR Site through the year 2025. Other related documents, the *Operation and Maintenance (O&M) Manual for Landfill Gas Treatment System* (Emcon, May 1995) and the *Operating Manual for John Zink Company’s Condensate Injection System* (John Zink Co., December 1998), are incorporated into the O&M Plan by reference.

Operation and maintenance, as well as the long-term monitoring of various media at the Site, are performed by the L&RR PSDs in accordance with the Consent Decree, its associated Statement of Work, and the approved O&M Plan. Activities covered by this plan, along with a brief description of issues related to each activity, are listed below.

Landfill Inspection and Maintenance

This part of the program includes monthly inspection and as-needed maintenance of many components of the remedy including the site security system; the landfill cover; the stormwater management system; the groundwater monitoring wells, gas extraction wells, and gas migration monitoring probes; and the landfill settlement monuments. The monthly inspections are documented on Inspection Log forms that are included in quarterly Progress Reports to EPA and RIDEM. Routine maintenance activities, as well as deficiencies and corrective actions, are described in the Progress Reports. Non-routine issues, such as the landfill subsidence that occurred in the summer of 1997 and other conditions that are of more immediate interest to the Agencies, are reported as they occur.

Repairing holes that have been cut through the perimeter fence has been an ongoing maintenance issue. Repairs to the flexible hoses that connect some of the extraction wells to the gas collection header are also required periodically. When winter weather conditions are particularly harsh, problems often occur with the gas collection system such as freezing of condensate in buried lines.

The O&M Plan calls for the grass on the landfill cover to be cut twice per year. Chemical weed control is typically used on the roadways and drainage channels in the summer.

Landfill Gas Extraction and Treatment Systems Operation and Monitoring

The landfill gas extraction system is operated to maintain a negative pressure across the landfill and control methane migration. Monitoring of the extraction and treatment systems includes monthly measurement of methane, oxygen, carbon dioxide, temperature, and vacuum at the 18 gas extraction wells; adjustment of the flow from individual wells as needed; and monitoring of methane, oxygen, carbon dioxide, flame temperature, and air flow rate at the flare. The results of these monthly inspections are documented on Field Gas Well Monitoring Data Sheet forms that are included in the quarterly Progress Reports to EPA and RIDEM. Routine maintenance activities, as well as deficiencies and corrective actions, are summarized in the Progress Reports.

Commonly, 2 or 3 of the 18 gas extraction wells are off line; for example, gas extraction well W-14 was closed in May 2002 due to an apparent leak in the piping between the extraction wellhead and the sampling wellhead, and it was still closed during a site inspection in May 2004. Well W-6 has been closed for several years. Despite these and other well closings, control of methane migration is still achieved when the system is in operation.

Separate manuals exist describing the operation and maintenance of the landfill gas treatment system and the condensate injection system. Recently the flare has been operating at a rate in the range of approximately 500 to 600 cfm.

Landfill Gas Migration Monitoring

The methane gas monitoring task involves monthly measurement of the methane concentrations at three or four landfill gas probes (GP-1, GP-4, GP-5, and GP-8) to evaluate the effectiveness of the extraction system in controlling gas migration. The action level for this monitoring is 1.25% methane content. According to the O&M Plan, measurements are required at GP-1 and GP-4 to monitor potential methane migration to a parcel (Lot 2) west of Oxford Turnpike, and at GP-8 to monitor potential methane migration to a parcel (Lot 15) northeast of the landfill. The plan states that the frequency of measurements can be reduced to quarterly if compliance is achieved. The methane migration monitoring data is submitted to EPA and RIDEM in the quarterly Progress Reports.

Flare Performance Monitoring

Blower and flare inspection and maintenance are performed twice per year by John Zink Company LLC. Once per year, the flare inlet gas is sampled and tested for VOCs by Method TO-14. Every five years, a performance test is conducted to ensure that the enclosed flare is operating at the appropriate efficiencies, and that flare emissions are compliant with Rhode Island Air Toxics Regulation No. 22 (RIAT). Flare performance tests were conducted in January 1995, February 1996, and March 1999, and next test is scheduled for October 2004.

In June 2002, the PSDs proposed modifications to the Post-Closure O&M Plan, including elimination of the annual flare inlet gas sampling. The PSDs' rationale for requesting that the inlet gas sampling be deleted from the program was that the overall composition of the extracted landfill gas has not changed substantially over the years, and that the three flare performance tests have demonstrated that the flare is effective. As of the writing of this report, EPA has not agreed to delete the inlet gas sampling from the monitoring program.

Groundwater Monitoring

The groundwater monitoring well network at the Site consists of eighteen monitoring wells at nine locations. The wells are located either on the L&RR parcel or on adjacent parcels associated with the Site or with the power lines east and north of the landfill. One to three wells exist at each location, allowing samples to be collected from one or more of the three main hydrogeologic zones (shallow overburden kame delta deposits, deep overburden ice-contact deposits, and bedrock) that underlie the Site. In accordance with the O&M Plan, water levels are measured and samples are collected semiannually from seven wells at seven locations to determine the direction of groundwater movement and to detect changes in groundwater quality over time. The samples are analyzed for VOCs; chloride; biological and chemical oxygen demand; ammonia; total iron, lead, and arsenic; and dissolved lead and arsenic.

Validated data from these sampling events are submitted to EPA and RIDEM in the semiannual Post-Closure Site Monitoring Reports. Once per year, a statistical analysis of the groundwater data from 1996 through the current year is performed to identify increasing or decreasing trends

and concentrations that exceed water quality standards.

In June 2002, the PSDs proposed modifications to the Post-Closure O&M Plan, including a reduction in the number of wells sampled from seven to five and a reduction of sampling frequency from semiannual to annual. The PSDs' rationale for deleting two wells (CW-7A and MW-103A) from the program was that contaminants have not been detected in these wells since the program began. As of the writing of this report, EPA has not agreed to delete these wells from the groundwater monitoring program nor to reduce the sampling frequency to annual. According to the O&M Plan, the sampling frequency will change to annual starting in October 2006 if there is statistically significant evidence that contamination is not increasing over time.

Surface Water Monitoring

Once per year, typically in the spring, surface water samples are collected at six locations on the south and east sides of the landfill. The samples are analyzed for VOCs, arsenic, chloride, pH, and specific conductance. The results are reported in the Post-Closure Site Monitoring Reports.

Ambient Air Monitoring

The ambient air sampling program at L&RR consists of the collection of 24-hour composite air samples once per year at four locations (two upwind and two downwind) around the perimeter of the landfill. The samples are analyzed for VOCs by Method TO-14 (although in years prior to 2002, a modified Method TO-14 was used that quantified several non-TO-14 compounds). The purpose of the sampling is to confirm, to the extent possible, the protectiveness of the air-related part of the remedy. As stated in the Settlement Agreement and Consent Decree, the cleanup levels that must be met at the perimeter of the landfill are as dictated by the Rhode Island Air Toxics Regulations.

In June 2002, the PSDs proposed modifications to the Post-Closure O&M Plan, including elimination of the annual ambient air sampling. The PSD's rationale for requesting that the ambient air sampling be deleted from the program was that the demonstration of compliance with Rhode Island Air Pollution Regulation No. 22 is based on testing of the source and on modeling, and that the air sampling is irrelevant to demonstrating compliance with the Applicable or Relevant and Appropriate Requirement (ARAR). As of the writing of this report, EPA has not agreed to delete the ambient air sampling from the monitoring program.

Settlement Monitoring

In 1994, twelve settlement monuments were established on the landfill. Following the repair of an area of subsidence between gas extraction wells W-4 and W-5 in August 1997, two additional settlement monuments were installed in that area. The monuments are surveyed annually to monitor settlement across the landfill.

SECTION 5.0 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The following recommendations were made in the previous Five-Year Review report (USEPA, 1999).

- Finalize implementation of the Institutional Controls required by the Settlement Agreement and Consent Decree.
- Continue discussion with the Settling Defendants regarding groundwater monitoring program, including potential installation of two new sentinel wells on the abutting property downgradient from the landfill.
- Continue evaluation of the groundwater monitoring data and exceedances of MCLs, including periodic statistical analysis and hydrogeologic setting of the Site to monitor effectiveness of the landfill cap.
- Assist RIDEM and other EPA programs in evaluation of potential impacts from the Site on new land development considered by the Town of North Smithfield in the vicinity of the Site, such as a power plant and industrial park.

Institutional Controls. Some discussions have taken place and correspondence exchanged between EPA and the Parties required to implement the institutional controls. The Parties have provided draft institutional control documents to EPA. However, a survey needs to be conducted on one parcel to legally define the actual boundaries that will require the imposition of institutional controls. Once the site survey has been completed, the draft institutional control documents will need to be revised and updated before they can be finalized.

Groundwater Monitoring. As discussed below, groundwater samples from monitoring wells on the northeast and east sides of the landfill continue to have concentrations of several contaminants that exceed MCLs. Discussions are ongoing regarding the installation of additional monitoring wells on property to the northeast of the landfill, so that the extent of the plume can be delineated. The PSDs have retained a hydrogeological consultant to provide services related to the installation of additional wells.

Groundwater Data Evaluation. Groundwater monitoring wells continue to be sampled on a semiannual basis, and the results are documented in the Post-Closure Site Monitoring Reports which are submitted to EPA and RIDEM. Also, once per year, a statistical analysis of the groundwater data from 1996 through the current year is performed to identify increasing or decreasing trends and concentrations that exceed water quality standards. The analysis of the data is used to assess the adequacy of the monitoring well network and the sampling frequency.

Evaluation of Potential Impacts from New Land Development. EPA has assisted in the evaluation of potential impacts of the Site on proposed developments in the surrounding area. In

1999, a combined cycle natural gas power plant, known as the Indeck-North Smithfield Energy Center, was proposed to be constructed about 2,000 feet northwest of the Site, on the east shore of the upper Slatersville Reservoir. The proposed water source for the facility was to be an on-site well. EPA reviewed groundwater modeling that had been conducted to support the application to construct the facility. The modeling showed that the proposed water withdrawal did not capture groundwater from L&RR and did not substantially change the direction of groundwater flow downgradient of the landfill. EPA was provided with the groundwater model and made additional simulations that showed that, if large-scale municipal wells were developed in the aquifer, the additional withdrawal from one of the proposed power plant well sites could influence movement of groundwater from the Site to a potential municipal well site. EPA recommended that a more refined regional model be developed and used to guide groundwater developments in the aquifer. For reasons unrelated to the Site, the proposed power plant was not built.

SECTION 6.0 FIVE-YEAR REVIEW PROCESS

This section describes the activities performed during the five-year review process and provides a summary of findings. The L&RR five-year review team consisted of representatives of EPA and RIDEM and was also assisted by staff from Metcalf & Eddy, Inc. with expertise in hydrogeology, landfill closure, and risk assessment.

6.1 COMMUNITY NOTIFICATION AND INVOLVEMENT

Since closure of the landfill, community interest in this Site has been largely related to issues involving potential impact of the L&RR site on the proposed upgrade to the Tiff Road public water supply well. A telephone interview with Linda Thibault, Town Administrator was conducted on August 10, 2004. The town is going ahead with rehabilitation of the Tiff Road municipal well and is conducting additional study and testing in accordance with the Rhode Island Department of Health regulations. Some residents, including members of the North Smithfield Town Council, continue to be concerned with development of the Tiff Road well in proximity to the L&RR site.

Since the last Five Year Review, EPA and PSDs held periodic discussions with the owner of abutting property north of the Site, regarding his potential development plans, including a brief discussion during the May 17, 2004 site inspection. At the owner's request results of the past monitoring reports have been provided to him and the owner expressed an interest in continuing to receive the water quality results from future monitoring events.

Copy of the Five-Year Review report is being placed in the information repository located at the Town Hall.

6.2 DOCUMENT REVIEW

This five-year review consisted of a review of the documents listed below.

- ROD (9/29/88)
- ESDs (3/8/91 and 9/16/96)
- 5-Year Review (9/10/99)
- Remedial Action Report (9/4/97)
- Post-Closure O&M Plan (9/96)
- Post-Closure Site Monitoring Reports and data submitted by the PSDs
- applicable state and local documentation regarding groundwater data/classification/water supply plans

6.3 DATA REVIEW

6.3.1 Groundwater Monitoring

When the ROD was written in 1988, current and past data from the sampling of 14 monitoring wells at the Site indicated only sporadic occurrences of VOCs and several metals, and none of the concentrations exceeded MCLs. Since disposal of hazardous waste in the landfill was documented, it was anticipated that a plume of contamination could eventually appear, and groundwater monitoring was included in the remedy to be protective.

Since October 1996, VOC contamination has been evident in monitoring wells just beyond the northeast and east sides of the landfill. As shown in Table 2, the most recent data submitted by the PSDs (October 2003 samples) show numerous parameters present at concentrations above MCLs in monitoring wells MW-102A, MW-104A, and CW-5B. The groundwater sampling and the statistical analyses that have been performed during the last five years indicate that the overall pattern of groundwater quality remains fairly stable, with both decreasing and increasing trends having been observed for the concentrations of different contaminants. Plots of concentration versus time for select contaminants in three of the affected monitoring wells are shown in Attachment 5. The plots are illustrative of both stable and increasing trends in groundwater quality.

Table 2. Contaminant Concentrations in Groundwater that Exceeded MCLs, October 2003

Contaminant	MCL (µg/l)	MW-102A (µg/l)	MW-104A (µg/l)	CW-5B (µg/l)
Benzene	5	-	36	-
Vinyl Chloride	2	35	5	3
cis-1,2-Dichloroethene	70	275	-	-
Trichloroethene	5	39	-	-
1,2-Dichloropropane	5	7	7	-
Tetrachloroethene	5	48	-	29
Arsenic	10*	-	84	-

* The MCL for arsenic was formerly 50 ppb but was changed to 10 ppb, effective February 22, 2002. The date by which water systems must comply with the new standard is January 23, 2006.

The ESD that was issued on September 16, 1996 clarified that the groundwater standards (MCLs) referenced in the ROD are to be used to judge the performance of the landfill cap and closure and are not, by themselves, cleanup or performance standards for groundwater. Even though the only risks related to the Site were from air emissions at the time the ROD was written, EPA stated in the ROD and restated in the ESD its reservation of its right to address groundwater

in the future if it is determined that it poses a threat to human health or the environment.

A plume of contamination currently exists northeast and east of the landfill in the deeper part of the aquifer. EPA is discussing with the PSDs the need to install new monitoring wells on private property downgradient of the Site in the presumed direction of groundwater flow. No agreement has been reached thus far. As a result, the exact extent of the area within which the contaminant concentrations exceed one or more MCLs is not confirmed, nor is the discharge point of the plume to surface water currently known. This raises a question about the adequacy of current monitoring data to verify the effectiveness and integrity of the landfill cap in protecting human health in the future. As efforts to install downgradient wells proceed, EPA and RIDEM will continue to evaluate the results of the groundwater monitoring program.

Although no known monitoring wells are available to define the downgradient edge of the plume, information regarding its likely extent can be gleaned from a recent U.S. Geological Survey (USGS) report (USGS, 2004) that includes a delineation of the contributing areas to the Tiff Road supply well under the different conditions. The delineations were done using a groundwater flow model developed by USGS. At simulated pumping rates of 200 and 500 gpm, the contributing areas to the well were west of the L&RR site. The report suggests that under pumping or non-pumping conditions, the plume would move toward and discharge to Trout Brook or the southern end of Trout Brook Pond.

The groundwater sampling frequency is scheduled to be semiannual through fiscal year 2006 (September 2006) and annual thereafter through the end of the program. However, as stated in the O&M Plan, the frequency of sampling will decline as scheduled only if it is determined on the basis of the ongoing data reviews that the contamination is not increasing over time. As stated in a previous section of this report, the PSDs' request in June 2002 to eliminate two wells from the program and to reduce the sampling frequency to annual ahead of schedule has not been approved.

6.3.2 Surface Water Monitoring

In the annual sampling rounds since 1999, the concentrations of individual VOCs at the most downstream surface water sampling point (SW-10) in the wetland southeast and east of the Site have typically been low (<1 µg/l) to non-detected. The number of VOCs detected at SW-10 has typically been two or less. In the most upstream sampling point (SW-5) in the wetland, VOCs are typically not detected, except for a single detection of toluene in June 2003. Conversely, at the intervening surface water sampling points in the wetland (SW-8 and SW-16), up to a dozen VOCs have been detected during one or more sampling rounds. The concentrations of the individual VOCs at these locations have typically been between <1 and 5 µg/l.

In addition to the surface water samples from the stream and wetland, samples are collected from the two surface water seeps identified in the monitoring plan (LCH-2 on the southwest slope of the landfill and LCH-3 in Detention Basin No. 3) if water is present. Two other seep locations, east of Detention Basin No. 3 (LCH-4) and Detention Basin No. 2 (LCH-5), have also been

sampled during several of the rounds. In the samples from the seeps, up to 20 or more individual VOCs have been detected at times, at concentrations ranging from <1 to 24 µg/l.

6.3.3 Ambient Air Monitoring

As stated in a previous section of this report, the PSDs requested in June 2002 that this element of the program be eliminated. In response to discussions among the PSDs, EPA, and RIDEM, the sampling procedures and sample locations were changed for the most recent (December 2003) annual ambient air monitoring event from those in the O&M Plan. The changes were that instead of four samples, five were collected; instead of all the samples being collected on the perimeter of the Site, three were on the perimeter and two were within the landfill area; and instead of 24 hours, the samples were collected over a period of 4 hours.

In the five samples that were collected and analyzed, the only VOC detected was benzene, which was detected in the two samples within the landfill area at concentrations above the annual average Rhode Island Ambient Air Levels (RI AALs). Samples downwind of these two locations, at the perimeter of the landfill, had no VOCs detected. The elimination of perimeter air monitoring from the O&M requirements has been proposed by the Settling Defendants and has recently been agreed to by RIDEM and EPA.

6.3.4 Methane Migration Monitoring

Since the landfill is bordered by wetlands on the south and east, the methane migration probes are located on the west and north sides of the Site. As noted during the site inspection in May 2004 (see Section 6.4), there are currently no structures on adjoining parcels either to the west or north of the Site. Methane levels in one or more of the monitoring probes on the west side of the landfill have temporarily exceeded the action level during shutdowns of the gas control system, which most commonly occur during winter. For example, in the 2003-2004 season, the gas collection and treatment system was out of operation in November due to damaged electrical equipment and unusual Site conditions (the flexible hose connections that join the gas extraction wells to the collection header were disconnected at W-4 and W-17, and the temperature at W-4 was elevated). The system was restarted in December, but shut down on numerous occasions in December and January due to a faulty thermocouple in the flare, a faulty timer in the control panel, and freezing in the condensate collection system. As a result, the methane levels in two of the probes rose above the action level in December 2003. The methane levels returned to acceptable concentrations in March 2004. Following similar shutdowns of the extraction system to control methane migration during the three previous winters, the methane concentrations in the probes returned to compliant levels by spring or summer.

6.3.5 Flare Inlet Gas Monitoring

The annual flare inlet gas samples are collected and analyzed to determine if major changes occur in the composition of the gas extracted from the landfill. The most recent sample, taken in October 2003, showed that the concentrations of VOCs are significantly lower than they were in

1999, when the last flare performance test was conducted. The total VOC concentration in the most contaminated sample in 1999 (~580,000 ppbv) was seven to eight times higher than the equivalent total VOC concentrations in 2000, 2001, and 2002 (~73,000 ppbv, ~83,000 ppbv, and ~76,000 ppbv, respectively) and about seventeen times higher than the equivalent total VOC concentration in 2003 (~34,000 ppbv).

6.3.6 Flare Performance Testing

The flare performance tests are conducted once every five years. The last performance test was conducted in 1999. The results from that test and from the subsequent air dispersion modeling indicated that the flare was compliant with the RI AALs. The next test is scheduled for September 2004.

6.3.7 Settlement Monitoring

The most recent settlement data were collected in October and November 2003. Compared to the elevations determined in 1994 when most of the settlement monuments were installed, the most recent data show total settlements of about 3 feet or less on the landfill slopes but 2 to almost 8 feet on the relatively flat top section. The two locations where the largest measured settlements have occurred are near extraction wells W-18 and W-2; the latter location is just northwest of the major subsidence event of 1997.

6.4 SITE INSPECTION

A Site inspection was conducted on May 17, 2004. Representatives from USEPA, RIDEM, the Rhode Island Department of Health, Metcalf & Eddy (USEPA contractor), and O & M, Inc. (PSD contractor) participated in the inspection. The purpose of the inspection was to help assess the protectiveness of the remedy by observing the condition of the Site fence, the landfill cover and drainage system, the gas extraction system, the flare, and the various monitoring points. Some of the roads near the Site, including Pound Hill Road, Black Plain Road, and Tiffit Road, were traveled to make general observations in the area surrounding the Site.

Several minor issues were noted during the Site inspection. Four or five animal burrows were noted on the landfill, including a group of three on the southeast-facing slope below extraction well W-6 (see photo in Attachment 3). Several holes were observed on the unpaved landfill road at the northwest corner of the Site, near the entrance gate. The holes had the appearance of being the surface expressions of “soil piping”, which occurs when soil is lost into a subsurface void such as a broken pipeline or a mass of gravel/rip-rap (such as pipe bedding) that is not isolated from adjacent soil with a geotextile or other filter. Cracks were visible in the soil at the top of the slope on the southern side of the detention basin at the northwest corner of the landfill (see photo in Attachment 3). The cracks were probably due to slumping of the soil on the slope.

Most of the gas extraction wells and nearby valves are in vaults made of stacked rectangular plastic forms. Most of the vaults are approximately 3 to 4 feet deep, although some of the well

vaults are partly or largely filled with soil. In most or all cases, the well vault covers are not in place because the extraction wells project above the tops of the vaults. The suspected cause of this condition is settlement of the landfill. On several of the extraction well casings, what appeared to be a crude boot seal was visible, consisting of a piece of plastic material attached to the extraction well casing with a large hose clamp (see photo in Attachment 3). Drawings of details from the extraction system design suggest that, prior to settlement, the plastic may have been at the bottom of the vault. A similar piece of plastic is shown on the detail on top of the landfill cap liner, functioning as a seal between the liner and the extraction well. If these pieces of plastic have been moved vertically by settlement, the seal between the well and the cap may be compromised. A landfill gas odor was noted at several of the extraction wells, but the source of the odor was not readily apparent.

On the top of landfill, settlement appears to have created some low areas, such as just south of well W-10 where evidence of previously ponded water was noted. Water was present in some of the vaults on the top of the landfill (see photos in Attachment 3). The water may simply have been precipitation that accumulated in the uncovered vaults; however, it is also possible that the water in some of the vaults is representative of the water level in the drainage layer on top of the liner. If low spots have been created by differential settlement, drainage could be impeded. If the liner is not sealed to the extraction well casings where they penetrate it, the water could seep down into the landfill at these locations. A retention pond on the Northwest side of the landfill near the entrance gate was observed to have an unstable sidewall, that condition is expected to be routinely monitored and repaired as needed by extending the rip-rap along the face of the retention pond.

The wetland along the southeast side of the Site was stained orange-brown, presumably from iron precipitates (see photo in Attachment 3). The water in the upstream portions of this wetland, on the west side of Oxford Road, was dark-colored like typical standing water in a wetland, but no orange-brown staining was seen. However, immediately east of Oxford Road, where the water emerges in several small springs (no culvert was visible to carry the water beneath the road), the stream channels were stained orange-brown, leading down into the wetland area just south of the Detention Basin No. 1 overflow outlets.

The conditions that cause shutdowns of the extraction system due to freezing of the condensate handling system during periods of extreme cold were discussed during the May 17, 2004 site inspection. Since the above-ground condensate piping is heat-traced and insulated, the freezing reportedly occurs in the buried condensate pipes and tank outside the blower building and at the injection nozzle on the flare housing. Since the piping and tank are covered by either the concrete apron in front of the blower building or the condensate tank slab, the PSDs have thus far elected to manually unfreeze and restart the system rather than redesign and reconstruct the problematic components.

6.5 INTERVIEWS

A brief, unscheduled interview was conducted on the day of the site inspection with the owner of

an abutting property (Lot 15) to the north. The property owner's primary concern was the quality of the groundwater during recent rounds of monitoring, since his parcel is north of the Site and is probably partly downgradient. While currently undeveloped, the owner indicated the possibility that the parcel could be developed for residential use in the future, and that the homes would have private wells.

A representative of the U.S. Geological Survey (USGS) was also interviewed for the review. The USGS recently developed a groundwater flow model for the aquifer that underlies the L&RR Site and the Tiff Road well. USGS used the model to simulate existing (200 gpm) and proposed future (500 gpm) withdrawals from the Tiff Road well location, either the existing well or a proposed replacement well. The simulations were used to delineate the contributing areas to the well under the different conditions. The report was released to the public in August 2004, and the modeled interactions between the Site and the Tiff Road well were examined as part of the five-year review and are summarized in Section 6.3.

SECTION 7.0 TECHNICAL ASSESSMENT

This section discusses the technical assessment of the remedy and provides answers to the three questions posed in the EPA Guidance (USEPA, 2001).

7.1 QUESTION A: IS THE REMEDY FUNCTIONING AS INTENDED BY THE DECISION DOCUMENTS?

The review of documents, ARARs, and risk assumptions indicates that the remedy was constructed in accordance with the ROD. The fence around the Site is intact and kept in good repair. Operation and maintenance of the cap and drainage structures have been effective. The last flare performance test (1999) and subsequent modeling showed that the flare emissions would not result in violations of the RIAALs at the Site boundaries. Annual monitoring has indicated that the concentrations of VOCs in the flare inlet gas have decreased since 1999.

During periods of extreme winter cold, the gas extraction system sometimes shuts down due to freezing in the condensate piping and storage tank. Since the affected system components are beneath the concrete building apron and tank slab, significant redesign and reconstruction would be needed to eliminate this problem. With the extraction system off, methane levels in the two probes (GP-1 and GP-4) on the west side of the landfill rise above the performance standard of 1.25% and can remain elevated for several months. However, since the area north and west side of the Site is undeveloped woodlands, the possible migration of methane in this direction during winter and spring is not problematic. When the weather warms and the system returns to more continuous operation, the methane concentrations return to compliant levels as gas migration is again controlled.

Groundwater samples collected from monitoring wells just north, northeast, and east of the landfill on parcels associated with the power line rights-of-way have shown that groundwater contamination is present in the deep overburden just beyond the landfill boundary. The concentrations of several VOCs and arsenic exceed the MCLs; however, and the most recent statistical analyses of the data indicate that the levels are fairly stable over time. No evidence exists of large-scale progressive deterioration of groundwater and surface water quality.

The full extent of the groundwater plume to the north and east of the landfill has not been delineated. This information is necessary to determine whether the landfill closure, including the cap, is performing effectively and in protective manner and the ARARs are met. The absence of contamination in MW-202, located between Pound Hill Road and the wetlands and streams east of the Site, shows that the plume has not moved that far to the east. A groundwater flow model, recently developed by the USGS to delineate the contributing area to the Tiff Road supply well, indicates that the plume would move toward and discharge to Trout Brook and the southern end of Trout Brook Pond. It is also possible that the plume attenuates to concentrations below the MCLs prior to discharge. Movement of the plume to the east of these surface water bodies is not indicated, since they are groundwater discharge areas; significant withdrawals of groundwater

east of the pond and brook would be needed to cause migration beneath the pond, and no such withdrawals are known to exist. There are no known monitoring or supply wells within the projected path of the plume. However, the potential for future groundwater use downgradient of the Site suggests that a future risk may exist.

The ROD did not require institutional controls as part of the remedy. The 1997 Settlement Agreement and Consent Decree did require institutional controls to be put in place on a number of parcels that generally prohibit the use of groundwater, prohibit disturbance of the cap, prohibit use of the property in any other way that would disturb remedial measures taken or violate any other restrictions required by EPA. A review of activities conducted on these parcels indicate that no one is currently using these properties in a manner inconsistent with these institutional controls, although no formal institutional controls are presently in place.

7.2 QUESTION B: ARE THE EXPOSURE ASSUMPTIONS, TOXICITY DATA, CLEANUP LEVELS, AND REMEDIAL ACTION OBJECTIVES (RAOs) USED AT THE TIME OF REMEDY SELECTION STILL VALID?

7.2.1 Review of Risk Assessments and Toxicity Factors Serving as the Basis for the Remedy

The human health risk assessment (Ebasco, 1988) evaluated groundwater for future household use (drinking, showering, and bathing), surface water and sediment for current/future childhood recreational exposures (dermal exposures only), and childhood/adult exposures via inhalation of outdoor air at the landfill and at downwind locations. The most significant risks identified in 1988 were associated with the inhalation of gaseous emissions from the landfill. Cleanup standards for air were established as AALs listed in the Rhode Island Air Toxic Regulations. Compliance with AALs is required at the perimeter of the Site.

The installation and maintenance of a fence prevent access and exposures at the landfill proper. The 1988 ROD determined there was no current exposure from groundwater ingestion and that potential future exposure to groundwater did not pose a significant risk, based on average concentrations, and the fact that no contaminants exceeded MCLs. A potential future risk may now be identified (based on the 1988 or the current groundwater quality data) using current risk assessment methodologies for the future drinking water pathway. Though MCLs are not considered cleanup standards for groundwater as described in the 1996 ESD, they are to be used to monitor the performance and integrity of the landfill closure, based on classification of the aquifer as a potential drinking water source. A groundwater monitoring program was established to determine migration of contamination to off-site residential wells. Sediment and surface water were not indicated as posing significant risk to human receptors in the 1988 ROD.

The 1988 risk assessment was conducted using methodologies which would partially comply with current EPA risk assessment guidance. The primary discrepancies between current guidance and previous guidance exist in the areas of toxicity values, which have been significantly refined since 1988; exposure assumptions selected to model exposure doses; and the selection of exposure pathways for quantitative evaluation. In addition, the 1988 risk assessment characterized risks

based on maximum detected concentrations. Current guidance prescribes the use of the upper confidence limit on the arithmetic mean for risk characterization. Use of the maximum detected concentration results in an overestimate of risk in all cases. The following provides an evaluation of these discrepancies and their impact on the protectiveness of the remedy.

Changes in Toxicity

Table 3 presents the changes in toxicity values (oral reference doses and oral cancer slope factors) for compounds selected as Contaminants of Potential Concern (COPCs) in 1988. Only minor changes (i.e., slight increases or decreases) in COPC toxicity values have occurred for most COPCs. However, for two compounds detected in groundwater that lacked reference doses in 1988 (manganese and trans-1,2-dichloroethene), adequate information now exists to support the development of toxicity values. Trans-1,2-dichloroethene is included in the groundwater monitoring program and is evaluated for MCL exceedances. Based on current trans-1,2-dichloroethene data and available toxicity value the remedy is still protective with respect to trans-1,2,-dichloroethene.

Groundwater manganese concentrations in 1988 ranged from ND to 32,015 μ g/L (in CW-7A). The average manganese concentration in groundwater was 6361 μ g/L. Similarly high concentrations were detected in 1995 and 1996, before manganese was dropped from the monitoring program. The manganese reference dose (RfD) in the IRIS database was revised in November 1995. A hazard index (HI) of 1 under drinking water exposures corresponds to a concentration of 840 μ g/l. The maximum and average groundwater concentrations significantly exceed this risk-based value for manganese of 840 μ g/l.

Table 3. Comparison of 1988 and 1994 Oral Reference Doses and Oral Cancer Slope Factors for Compounds of Potential Concern

Contaminant of Potential Concern	Oral Reference Dose (RfD) (mg/kg-day)		Oral Slope Factor (SF) (mg/kg-day)	
	1988	2004	1988	2004
1,2-Dichloroethane	N/A	N/A	0.091	0.091
2-Butanone	0.5	0.6	N/A	N/A
Toluene	0.3	0.2	N/A	N/A
trans-1,2-Dichloroethene	N/A	0.02	N/A	N/A
Arsenic	N/A	0.0004	1.5	1.5
Iron	N/A	N/A	N/A	N/A
Lead	N/A	N/A	N/A	N/A
Manganese (water)	N/A	0.024	N/A	N/A
Manganese (other media)	N/A	0.07	N/A	N/A
Zinc	0.21	0.3	N/A	N/A

N/A = Not Applicable or Not Available

Changes in Exposure Pathways/Assumptions

The human health risk assessment (Ebasco, 1988) evaluated the older child receptor for inhalation exposures incurred at the landfill surface in addition to adult/child inhalation exposures downwind of the landfill. The 1988 risk assessment found the inhalation of gaseous emissions from the landfill to be the most significant risk contributing pathway for human receptors. Therefore, landfill gas collection and thermal destruction was included as part of the remedy. Annual AALs were selected as clean-up standards for ambient air at the property boundary. The last flare performance test (1999) and subsequent modeling showed that the flare emissions would not result in violations of the AALs at the Site boundaries. Also, flare inlet VOC concentrations have decreased since 1999, with the October 2003 total VOC results being approximately 17 times lower than the 1999 data. The next flare performance test is scheduled for Fall 2004.

The human health risk assessment also evaluated an older child wading scenario for exposures to sediments and surface water at the eastern, southern, and western edge of the Site. This scenario assumes that the wetlands surrounding the Site are currently being used and will continue to be used, to some degree, for recreational purposes. No changes in land use have occurred to these wetland areas, and no changes are anticipated in the near future. Due to the presence of the landfill cap, the construction of residential or commercial buildings on the landfill proper is highly unlikely. The non-wetland areas surrounding the Site are utilized as residential, commercial, and recreational space. The degree to which the surrounding land is used may be expanded through the construction of additional homes, commercial buildings, or parks. However, because the type of land usage is not expected to change significantly in the future (i.e., land is expected to remain residential, recreational, and commercial near the Site), the land use assumptions used in the 1988 risk assessment continue to be valid.

For the older child wader, the exposure pathways evaluated include dermal contact with sediment and surface water while wading. Contrary to current guidance, incidental ingestion of sediment was not evaluated, resulting in a potential underestimate of risk. The method used to estimate dermal doses differs from the current method, but overall, resulted in an overestimate of dermal risk. The exposure assumptions selected were, in general, lower than current recommended values. For example, the skin surface area assumed exposure to hands, legs, and feet. Current accepted guidance for wading exposures assumes exposure to hands, forearms, lower legs, feet, and head. An exposure frequency of 24 days/year was used. Current guidance would likely result in the selection of a higher exposure frequency to characterize future exposures (e.g., 52 days/year). Overall, the use of the lower exposure assumptions resulted in an underestimate of risk. However, the differences noted are unlikely to result in a change in the conclusion of the risk assessment since contaminants in sediment and surface water were detected infrequently and at low levels. Surface water monitoring continues to document that contaminants in surface water are seen infrequently and at low levels.

Soil exposures at the landfill were not evaluated in the risk assessment because the landfill is capped and fenced. As part of the remedy, the cap and fencing are inspected regularly and repaired, as needed. As long as the integrity of the landfill cap and the fencing continues to be

maintained, the soil exposure pathway remains incomplete and this assumption remains valid.

Private wells currently exist in the vicinity of the Site, with the closest being located approximately 1,200 feet from the southeast portion of the landfill. Based on the location of the landfill relative to Trout Brook and regional groundwater flow, groundwater contaminants are not expected to impact nearby private wells. Future residential groundwater use was also evaluated in the risk assessment. Although the ROD indicated that potential future exposure to groundwater did not pose a significant risk, a potential future risk could be determined for the future drinking water pathway based on current risk assessment methodology and contaminant levels in excess of MCLs. With exceedences of MCLs developed since the landfill was capped, the exact extent of the plume needs to be investigated, and the area in which MCLs are exceeded should be confirmed. Additional measures also need to be implemented including evaluating the landfill cap to ensure that it is functioning properly given the potential that this exposure between human receptors and groundwater contaminants might be a complete pathway in the future.

Summary and Conclusions

A number of differences were noted between the 1988 human health risk assessment and current risk assessment practices. Because of the variable nature of the differences, some tending to underestimate and others overestimate risk, the estimated risks are unlikely to be substantially different from risks estimated using current guidance.

Because soils are capped and the landfill is fenced, the soil remedy is protective of human health as long as the cap and fence are maintained. Although institutional controls have not been put in place on the parcels identified in the Settlement Agreement and Consent Decree, conditions and activities on these parcels have not changed such that the site conditions currently present a risk. Once institutional controls are in place on these parcels, these controls will ensure that no significant risk occurs in the future. Because sediments and surface water did not present a risk to human health, and contaminant levels continue to be low and infrequently detected, the remedy is also protective of sediments and surface water exposures at the perimeter of the Site.

Since the current extent of the plume has not been confirmed and monitoring wells need to be put in place beyond the northeast and east sides of the landfill where groundwater contaminants in excess of MCLs are present, the cap should be evaluated to ensure the integrity and performance of the landfill closure. If the cap is operating at its maximum effectiveness then additional actions will be evaluated, if necessary, to prevent completion of the exposure pathway between groundwater and human receptors, through the use of institutional controls and the sampling of perimeter monitoring wells, to allow the remedy to be considered protective.

The groundwater monitoring program does not currently include analysis of manganese and cadmium to determine if groundwater concentrations of these two inorganic compounds exceed risk-based drinking water concentrations. As stated in Table 7-1 of the Post-Closure O&M Plan, every five years coinciding with the five-year review at the Site, EPA may require that select monitoring wells be analyzed for additional parameters. In accordance with that provision of the

plan, manganese and cadmium should be added to the list of analytes for the groundwater samples from MW-102A, MW-104A, and CB-5A in the Spring and Fall 2005 monitoring rounds. The results from those two rounds will be used to determine if these analytes need to be analyzed in future rounds.

7.2.2 ARARs Review

M&E performed a review of Applicable or Relevant and Appropriate Requirements to check the impact on the remedy due to changes in standards that were identified as ARARs in the ROD, newly promulgated standards for chemicals of potential concern, and TBCs (to be considered) that may affect the protectiveness of the remedy. The tables in Attachment 4 provide the ARARs review. The review is summarized below.

The ROD set forth the following ARARs for the selected remedy:

Location-specific:

- Resource Conservation and Recovery Act (RCRA)
- Clean Water Act (CWA)
- Fish and Wildlife Coordination Act (16 U.S.C. 661)
- Wetlands Executive Order (EO 11990)
- EPA Guidance - "Covers for Uncontrolled Hazardous Waste Sites" (EPA/540/2-85/002)
- Rhode Island Rules for Solid Waste Management Facilities
- Rhode Island Hazardous Waste Rules and Regulations
- Rhode Island Freshwater Wetlands Law
- Rhode Island Water Quality Regulations

Chemical-specific:

- Safe Drinking Water Act (SDWA)
- Federal Ambient Water Quality Criteria (AWQC)
- Health Advisories (EPA Office of Drinking Water)
- EPA Reference Doses (RfDs) and Carcinogen Assessment Group Potency Factors
- Acceptable Intake - Chronic (AIC) and Subchronic (AIS) - EPA Health Assessment Documents
- Rhode Island Water Quality Standards
- Rhode Island Air Toxics Regulation

Action-Specific:

- Resource Conservation and Recovery Act (RCRA)
- Clean Water Act (CWA)
- Clean Air Act
- Occupational Safety and Health Administration (OSHA)
- Department of Transportation
- Fish and Wildlife Coordination Act (16 U.S.C 661)
- Rhode Island Rules for Solid Waste Management Facilities
- Rhode Island Hazardous Waste Rules and Regulations

- Rhode Island Freshwater Wetlands Law
- Rhode Island Water Pollution Control Law and Water Quality Regulations
- Rhode Island Air Pollution Control Act and Regulations
- Rhode Island Rules and Regulations Pertaining to the Disposal, Utilization, and Transportation of Wastewater Treatment Facility Sludge
- Rhode Island Air Toxic Regulations
- Wetlands Executive Order (EO 11990)
- EPA Guidance Document - "Covers for Uncontrolled Hazardous Waste Sites"

Tables A4-1, A4-2, and A4-3 of Attachment 4 provide an evaluation of ARARs using the regulations and requirement synopses listed in the ROD as a basis. The evaluation includes a determination of whether the regulation is currently ARAR or TBC and whether the requirements have been met. Most of the listed ARARs remain applicable or relevant and appropriate to the Site and are being complied with. As indicated in the attached tables, the requirements which specifically applied to the wetlands remediation component of the remedy as identified in the ROD are no longer considered ARAR, since this component was eliminated by the March 1991 ESD.

The post-closure groundwater monitoring indicates release of contaminants into groundwater with several contaminants exceeding their respective MCLs, where the exact extent of the plume has not been confirmed, thus the entirety of Subpart F are now relevant and appropriate, 40 CFR § 264.90 - 264.101.

It should be noted that Rhode Island Air Toxics Regulation No. 22 was amended effective 4/27/04. The list of air toxics was expanded, AALs were updated, and permitting requirements were clarified. AALs for several VOCs are listed in the Consent Decree as clean-up standards for gaseous emissions from the Site. For the listed VOCs, the revised AALs are either the same or less stringent than the levels listed in the Consent Decree. In the latest round of ambient air sampling, benzene exceeded the AAL in two samples from the landfill surface, but benzene was not detected at perimeter sampling locations. A gas collection and treatment system is in place to reduce gaseous emissions to ambient air, and the latest flare performance test and subsequent modeling showed that flare emissions would not result in violations of the AALs at the Site boundaries. Hence, this regulation is being complied with.

7.3 QUESTION C: HAS ANY OTHER INFORMATION COME TO LIGHT THAT COULD CALL INTO QUESTION THE PROTECTIVENESS OF THE REMEDY?

There is no other information that calls into question the protectiveness of the remedy.

7.4 TECHNICAL ASSESSMENT SUMMARY

According to the data reviewed, the site inspection, and the interviews, the remedy is generally functioning as intended by the ROD, as modified by the two ESDs. There have been no changes in the physical conditions of the Site that would affect the protectiveness of the remedy. Most of the ARARs identified in the ROD remain applicable or relevant and appropriate and either have

been met or are being complied with; Tables A4-1, A4-2, and A4-3 of Attachment 4 provide an evaluation of ARARs. Groundwater monitoring has detected the presence of a plume just beyond the landfill, but no groundwater supply wells are currently known to exist within the pathway of plume migration that is predicted by the USGS groundwater flow model. The presumption has been made that the plume of contaminated groundwater from the Site discharges to nearby surface water. However, this presumption needs to be confirmed with additional hydrogeologic investigation and monitoring of the plume to ensure that the remedy remains protective in the future.

**SECTION 8.0
ISSUES**

Based on the activities conducted during this Five-Year Review, the issues identified in Table 4 have been noted.

Table 4: Issues

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Several contaminants have been shown to be present in groundwater just beyond the landfill boundary at concentrations above MCLs, but the downgradient extent of the plume and the discharge area have not been confirmed. Manganese and cadmium, which were listed in the ROD as having been detected in downgradient groundwater and appropriate for quarterly monitoring, are not among the currently tested analytes in the groundwater monitoring program.	N	Y
The presence of landfill gas odors at one or more of the gas extraction wells, and the detection of benzene in air samples collected atop the landfill, suggest that there may be fugitive emissions from certain areas on the landfill. The liner penetrations for the gas extraction wells are possible locations of gas escape and water infiltration.	N	Y
Institutional Controls are planned but not yet in place, draft institutional control documents need to be revised and updated before they can be finalized.	N	Y

SECTION 9.0
RECOMMENDATIONS AND FOLLOW-UP ACTIONS

In response to the issues noted in Section 8.0, it is recommended that the actions listed in Table 5 be taken:

Table 5: Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness	
					Current	Future
The plume extends beyond the monitoring well network to the north/northeast, so the extent of the plume has not been confirmed. Manganese and cadmium, which were listed in the ROD as analytes, are not among the currently tested analytes in the groundwater monitoring program.	Delineate the plume between the landfill and the discharge area and install permanent monitoring wells. Add manganese and cadmium to the list of analytes for samples from MW-102A, MW-104A, and CW-5B for the Spring and Fall 2005 rounds of monitoring.	PSDs	USEPA	9/30/05	N	Y
Landfill gas odors at some of the gas extraction wells, and the detection of benzene in air atop the landfill, suggest that gas may be escaping (and water infiltrating) at liner penetrations. ¹	Determine if unsealed gaps exist between the liner and the gas extraction wells. Seal the gaps if necessary.	PSDs	USEPA	9/30/05	N	Y
Institutional Controls planned but not in place. ²	Follow up to finalize site survey and update draft IC documents so that ICs can be finalized.	Owner Settling Defendants/ PSDs	USEPA	9/30/05	N	Y

Notes:

¹ Approximately three to four of the 18 extraction wells have been off line since 1998/1999. PSDs need to clarify in future monitoring reports whether repairs can be made to these extraction wells. Typically, Well Nos. 6, 8 & 14 have been off with high oxygen and low methane levels (lost connection, broken valve). With these wells out, the design well spacing has been altered, and its effect on the radius of influence of gas extraction system in several areas on the landfill needs to be evaluated. Additional information provided as part of such evaluation would include a.) a cost estimate for the repairs, b.) the reason for the wells being turned off and c.) whether including these wells in the system would further optimize the Landfill Gas Extraction System.

² Based on the 1997 Settlement Agreement and Consent Decree, Institutional controls are required at a minimum on Lots 9, 9A, 10, 11, 23, 67 and 68 on Assessors Plat 7 in North Smithfield, Rhode Island, and a portion of Lot 3 on Plat 7.

SECTION 10.0

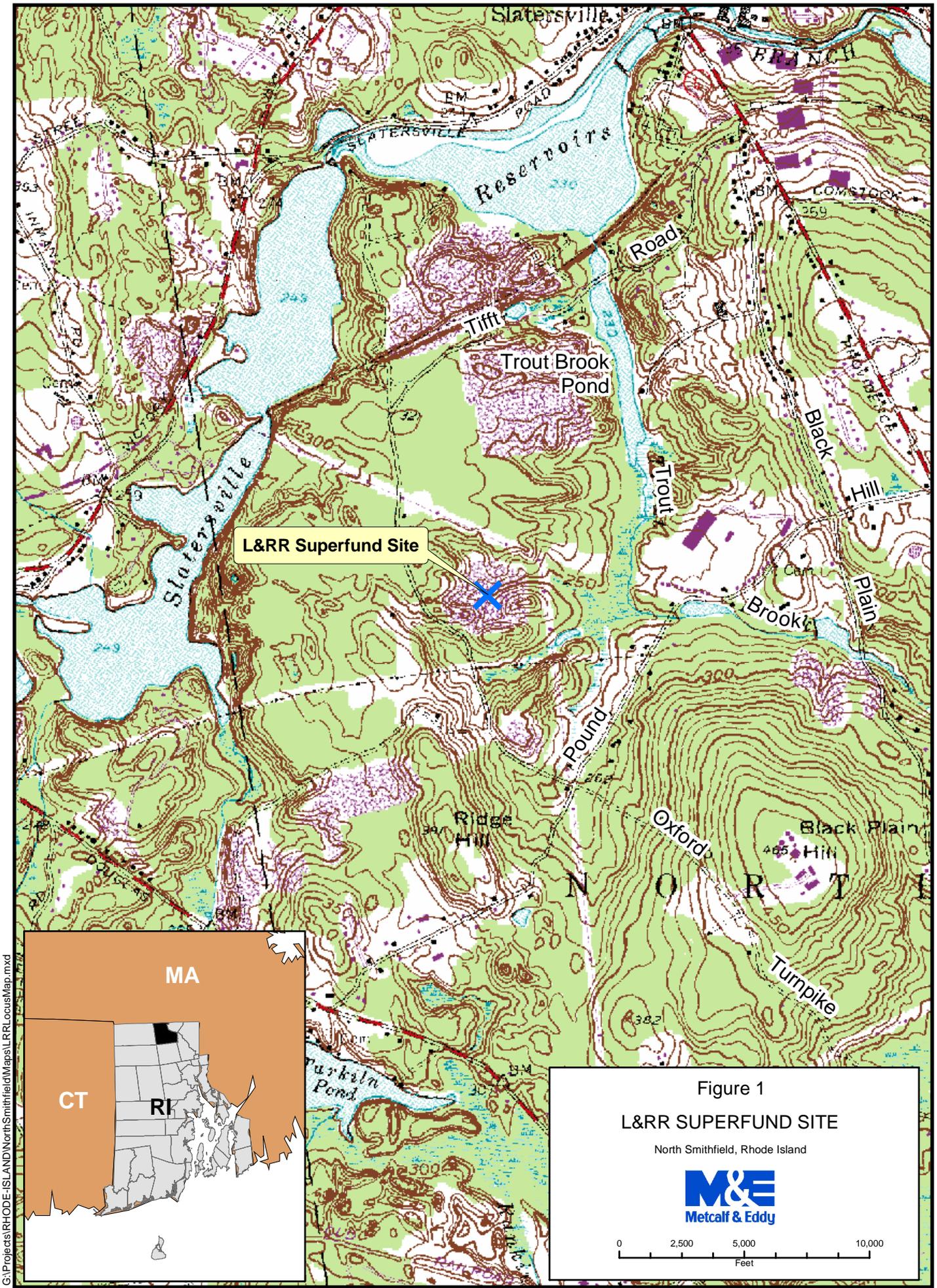
PROTECTIVENESS STATEMENTS

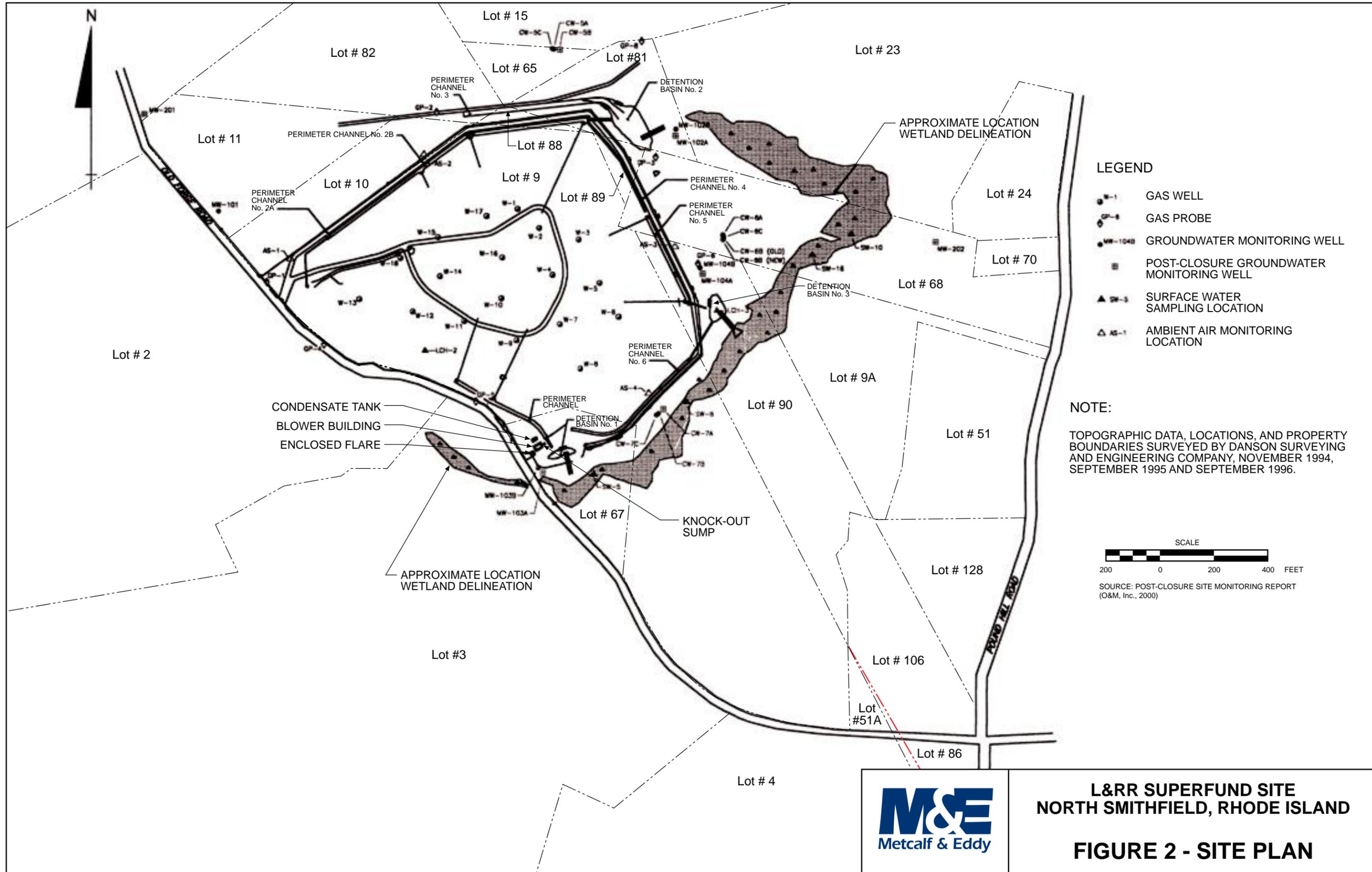
The remedy at the L&RR Superfund Site currently protects human health and the environment because: (a) access to the Site is restricted to prevent direct exposures to waste; (b) the vegetative cover and the drainage system are constructed and maintained to prevent erosion of soil and deposition in the surrounding wetlands; and (c) the cap, the gas extraction system, and the flare capture and treat landfill gases to prevent exposures at the Site boundary. However, in order for the remedy to be protective in the long-term, the extent of the plume needs to be confirmed, and permanent monitoring wells need to be installed within and beyond the plume and sampled periodically to confirm that existing or future private or public water supply wells are not contaminated. Finally, the institutional controls required in the settlement agreement must be finalized.

SECTION 11.0
NEXT REVIEW

The next Five-Year Review for the L&RR Superfund Site is September, 2009, five years from the signature date of this review. The next Five-Year Review should include a complete review of data generated from groundwater, surface water, and air monitoring to confirm that the remedial actions are protective of human health and the environment.

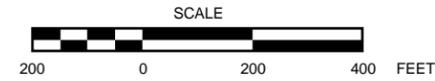
**ATTACHMENT 1
SITE MAPS**





- LEGEND**
- W-1 GAS WELL
 - GP-1 GAS PROBE
 - MW-104B GROUNDWATER MONITORING WELL
 - PC-GM POST-CLOSURE GROUNDWATER MONITORING WELL
 - SW-1 SURFACE WATER SAMPLING LOCATION
 - AS-1 AMBIENT AIR MONITORING LOCATION

NOTE:
 TOPOGRAPHIC DATA, LOCATIONS, AND PROPERTY BOUNDARIES SURVEYED BY DANSON SURVEYING AND ENGINEERING COMPANY, NOVEMBER 1994, SEPTEMBER 1995 AND SEPTEMBER 1996.



SOURCE: POST-CLOSURE SITE MONITORING REPORT (O&M, Inc., 2000)

**L&RR SUPERFUND SITE
 NORTH SMITHFIELD, RHODE ISLAND**

FIGURE 2 - SITE PLAN

ATTACHMENT 2
LIST OF DOCUMENTS REVIEWED

- de maximis, Inc. (de maximis). 1996. Post Closure Operation and Maintenance Plan, Landfill and Resource Recovery Site, North Smithfield, Rhode Island, September 1996.*
- de maximis, Inc. (de maximis). 1997. Remedial Action Report, Landfill and Resource Recovery (L&RR) Superfund Site, North Smithfield, Rhode Island. Prepared for The L&RR Group Performing Settling Defendants. September 1997.*
- Ebasco Services, Inc. (Ebasco). 1988. Remedial Investigation/Feasibility Study, Landfill and Resource Recovery (L&RR), Town of North Smithfield, Providence County, Rhode Island. June 1988.*
- O & M, Inc. (O & M). 2000. Post-Closure Site Monitoring Report, Landfill and Resource Recovery Superfund Site, North Smithfield, Rhode Island. Prepared on behalf of Landfill and Resource Recovery Site Group. February 2000.*
- O & M, Inc. (O & M). 2000. Post-Closure Site Monitoring Report, Landfill and Resource Recovery Superfund Site, North Smithfield, Rhode Island. Prepared on behalf of Landfill and Resource Recovery Site Group. December 2000.*
- O & M, Inc. (O & M). 2001. Post-Closure Site Monitoring Report, Landfill and Resource Recovery Superfund Site, North Smithfield, Rhode Island. Prepared on behalf of Landfill and Resource Recovery Site Group. June 2001.*
- O & M, Inc. (O & M). 2001. Post-Closure Site Monitoring Report, Landfill and Resource Recovery Superfund Site, North Smithfield, Rhode Island. Prepared on behalf of Landfill and Resource Recovery Site Group. December 2001.*
- O & M, Inc. (O & M). 2002. Post-Closure Site Monitoring Report, Landfill and Resource Recovery Superfund Site, North Smithfield, Rhode Island. Prepared on behalf of Landfill and Resource Recovery Site Group. May 2002.*
- O & M, Inc. (O & M). 2002. Post-Closure Site Monitoring Report, Landfill and Resource Recovery Superfund Site, North Smithfield, Rhode Island. Prepared on behalf of Landfill and Resource Recovery Site Group. September 2002.*
- O & M, Inc. (O & M). 2003. Post-Closure Site Monitoring Report, September through December 2002, Landfill and Resource Recovery Superfund Site, North Smithfield, Rhode Island. Prepared on behalf of Landfill and Resource Recovery Site Group. April 2003.*
- O & M, Inc. (O & M). 2003. Post-Closure Site Monitoring Report, January through June 2003,*

Landfill and Resource Recovery Superfund Site, North Smithfield, Rhode Island.
Prepared on behalf of Landfill and Resource Recovery Site Group. October 2003.

O & M, Inc. (O & M). 2004. *Post-Closure Site Monitoring Report, July through December 2003, Landfill and Resource Recovery Superfund Site, North Smithfield, Rhode Island.*
Prepared on behalf of Landfill and Resource Recovery Site Group. February 2004.

United States Environmental Protection Agency (USEPA). 1988. *Record of Decision, Landfill & Resource Recovery (L&RR) Site, North Smithfield, Rhode Island.* September 29, 1988.

United States Environmental Protection Agency (USEPA). 1991. *EPA Superfund Explanation of Significant Differences: Landfill & Resource Recovery, Inc. (L&RR), EPA ID: RID093212439, OU 01, North Smithfield, Rhode Island,* March 8, 1991.

United States Environmental Protection Agency (USEPA). 1996. *EPA Superfund Explanation of Significant Differences: Landfill & Resource Recovery, Inc. (L&RR), EPA ID: RID093212439, OU 01, North Smithfield, Rhode Island,* September 16, 1996.

United States Environmental Protection Agency (USEPA). 1999. *Five Year Review, Landfill and Resource Recovery Superfund Site, North Smithfield, Rhode Island.* September 1999.

United States Environmental Protection Agency (USEPA). 2001. *Comprehensive Five-Year Review Guidance.* June 2001.

United States Geological Survey (USGS). 2004. *Delineation of Areas Contributing Recharge to Selected Public-Supply Wells in Glacial Valley-Fill and Wetland Settings, Rhode Island, SIR 2004-5070.*

ATTACHMENT 3
SITE INSPECTION PHOTOGRAPHS
MAY 17, 2004



Gas Extraction Well W-2 (tilting of well may be due to settlement)



Gas Extraction Well W-15 (note water in vault and possible well/liner "boot" or seal that may have been torn off by settlement)



Detention Basin in NW Corner of Landfill (note cracks in soil at top of slope on left side, probably due to slumping)



Wetland Southeast of Landfill (note iron staining)



Animal Burrow on Landfill Slope below W-6



Vault for Control Valve for Gas Extraction Well W-6 (note water)



Flare and Blower/Control Building

**ATTACHMENT 4
ARARS REVIEW**

**TABLE A4-1. LOCATION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
<u>Landfill</u>				
Federal Regulatory Requirements	Fish and Wildlife Coordination Act (16 U.S.C. 661)	Applicable	This regulation requires any federal agency proposing to modify a body of water to consult with the U.S. Fish and Wildlife Services. This requirement is addressed under CWA Section 404. During the identification, screening, and evaluation of alternatives, the effects on wetlands will be evaluated. If an alternative would modify a body of water, U.S. Fish and Wildlife Services will be consulted.	The landfill cover and surface water management system were updated as part of the remedy to minimize erosion and further sedimentation in the wetlands. The March 1991 ESD eliminated the wetlands remediation component required by the ROD, stating that it is more properly addressed through the Federal Clean Water Act or other federal or state statutes or regulations. However, if work is to be performed in wetland areas in the future, this requirement would be applicable.

**TABLE A4-1 (continued). LOCATION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
<u>Wetlands, Trout Brook</u>				
Federal Regulatory Requirements (continued)	Clean Water Act (CWA) (40 CFR Section 404)	Applicable	Regulates discharges of dredged or fill material into U.S. waters. Applicable to protection of the adjacent wetland. Applies to sedimentation caused by erosion of landfill cap fill material.	The landfill cover and surface water management system were updated as part of the remedy to minimize erosion and further sedimentation in the wetlands. The March 1991 ESD eliminated the wetlands remediation component required by the ROD, stating that it is more properly addressed through the Federal Clean Water Act or other federal or state statutes or regulations. However, if work is performed in wetland areas in the future, this requirement would be applicable.

**TABLE A4-1 (continued). LOCATION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
State Regulatory Requirements	Rhode Island Freshwater Wetlands Law- Rhode Island General Law (RIGL) - Title 2 Chapter 1 (2-1)	Applicable	Regulates and preserves swamps, marshes, and wetlands. Includes maintaining capacity to support wildlife and act as buffer zone for flood conditions.	The landfill cover and surface water management system were updated as part of the remedy to minimize erosion and further sedimentation in the wetlands. The March 1991 ESD eliminated the wetlands remediation component required by the ROD, stating that it is more properly addressed through the Federal Clean Water Act or other federal or state statutes or regulations. However, if work is performed in wetland areas in the future, this requirement would be applicable.
	Rhode Island Water Quality Regulations (RIGL 46-12, 42-17.1, 42-35)	Applicable	Regulates restoration, enhancement, and preservation of state waters.	The landfill cover and surface water management system were updated as part of the remedy to minimize erosion and further sedimentation in the wetlands. The March 1991 ESD eliminated the wetlands remediation component required by the ROD, stating that it is more properly addressed through the Federal Clean Water Act or other federal or state statutes or regulations. However, if work is performed in wetland areas in the future, this requirement would be applicable.

**TABLE A4-1 (continued). LOCATION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
Federal Criteria, Guidance, Advisories to be Considered	Wetlands Executive Order (EO 11990)	To be Considered	Prohibits the undertaking of new construction in wetlands.	No construction took place in wetlands during remedy implementation. As stated above, the wetland remediation component of the ROD was removed by the 1991 ESD.

**TABLE A4-2. CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
L&RR SITE**

SITE FEATURES	REQUIREMENTS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
Federal Regulatory Requirements	SDWA - Maximum Contaminant Levels (MCLs) (40 CFR 141.11 - 141.16)	MCLs have been promulgated for a number of organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, but may also be considered relevant and appropriate for groundwater aquifers used for drinking water. When the risks to human health due to consumption of groundwater were assessed, contaminant concentrations were compared to their MCLs. Only iron and manganese exceeded their secondary levels.	Several VOCs (including benzene, cis-1,2-dichloroethene, 1,2-dichloropropane, tetrachloroethene, trichloroethene, and vinyl chloride) and arsenic exceeded MCLs in groundwater samples collected in October 2003. The 1996 ESD clarified that MCLs were included in the ROD to evaluate and monitor the integrity and performance of the landfill closure and are not, by themselves, cleanup or performance standards.
Federal Criteria, Advisories, and Guidance	Health Advisories (EPA Office of Drinking Water)	Health advisories are estimates of risks due to consumption of contaminated drinking water; they consider noncarcinogenic effects only. Health advisories were considered for contaminants in groundwater that may be used for drinking water.	Contaminated groundwater at the site is not being used as a drinking water source.
	EPA Risk Reference Doses (RfDs)	RfDs are dose levels developed by EPA for noncarcinogenic effects. EPA RfDs were used to characterize risks due to exposure to groundwater contaminants. They were considered for noncarcinogens including 2-butanone and lead.	See review of risk assessments.
	EPA Carcinogen Assessment Group Potency Factors	Potency factors are developed by EPA from Health Effects Assessments or evaluation by the carcinogen assessment group. EPA carcinogenic potency factors were used to compute the individual incremental cancer risk resulting from exposure to arsenic.	See review of risk assessments.

**TABLE A4-2 (continued). CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
L&RR SITE**

SITE FEATURES	REQUIREMENTS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
Federal Criteria, Advisories, and Guidance (continued)	Acceptable Intake - Chronic (AIC) and Subchronic (AIS) - EPA Health Assessment Documents	AIC and AIS values are developed from RfDs and HEAs for noncarcinogenic compounds. AIS and AIC values were used to characterize the risks due to several noncarcinogens including 2-butanone, trans-1,2-dichloroethene, 1,1-dichloroethane, lead, and zinc.	These values are no longer used for risk assessment.

**TABLE A4-3. ACTION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
Federal Regulatory Requirements	RCRA - Subpart B: General Facility Standards (40 CFR 264.10 - 264.19)	Relevant and Appropriate	General facility requirements outline waste analysis, security measures, and training requirements. Because RCRA-listed hazardous wastes were placed before 1980, RCRA Subtitle C requirements are relevant and appropriate.	These measurements remain relevant and appropriate and have been complied with.
	RCRA - Subpart C: Preparedness and Prevention (40 CFR 264.30 - 264.37)	Relevant and Appropriate	This regulation outlines safety equipment and spill-control requirements for hazardous waste facilities. Part of the regulation includes a requirement that facilities be designed, maintained, constructed, and operated to minimize the possibility of an unplanned release that could threaten human health or the environment.	These requirements remain relevant and appropriate and are being complied with.
	RCRA - Subpart D: Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)	Relevant and Appropriate	This regulation outlines the requirements for emergency procedures to be used following explosions and fires. This regulation also requires that threats to public health and the environment be minimized.	These requirements remain relevant and appropriate and are being complied with.
	RCRA - Subpart E: Manifest System, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)	Relevant and Appropriate	This regulation describes the requirements for recording and maintaining information in the operating record of the facility	These requirements remain relevant and appropriate and are being complied with.
	RCRA - Subpart F: Releases From Solid Waste Management Units (40 CFR 264.90 - 264.101)	Relevant and Appropriate	Under this regulation, groundwater monitoring program requirements are outlined.	A groundwater monitoring program has been implemented at the site in accordance with the Post Closure Operation and Maintenance Plan.

**TABLE A4-3 (Continued). ACTION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
Federal Regulatory Requirements (continued)	RCRA - Subpart G: Closure and Post-Closure (40 CFR 264.110 - 264.120))	Relevant and Appropriate	This requirement details the specific requirements for closure and post-closure of hazardous waste facilities.	These requirements remain relevant and appropriate. Post-closure operations, maintenance and monitoring are currently being performed in accordance with the Post Closure Operation and Maintenance Plan. The landfill closure was updated to meet RCRA requirements for landfill closure.
	RCRA - Subpart N: Landfills (40 CFR 264.300 - 264.339)	Relevant and Appropriate	Covers design and operating requirements, as well as post-closure care options for landfills. Closure and post-closure care must be attained in accordance with either the outlined disposal requirements or by the site-specific alternative method.	These requirements remain relevant and appropriate. The landfill closure was updated to meet the requirements for landfill closure. Post-closure operations, maintenance and monitoring are currently being performed in accordance with the Post Closure Operation and Maintenance Plan.
	RCRA - Subpart O: Incinerators (40 CFR 264.340 - 264.599)	Relevant and Appropriate	This regulation specifies the performance standards, operating requirements, monitoring, inspection, and closure guidelines of any incinerator burning hazardous waste.	Flaring, and not incineration, was implemented as the means of thermal destruction of landfill gas. Therefore, these requirements are not relevant and appropriate.

**TABLE A4-3 (Continued). ACTION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
	Clean Air Act - National Air Quality Standards for Total Suspended Particulates (40 CFR 50.6 - 50.7)	Relevant and Appropriate	This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter.	These requirements are not ARARs per se. However, the standards established under these regulations are met through approved State Implementation Plans under the Clean Air Act.
Federal Regulatory Requirements (continued)	OSHA - General Industry Standards (29 CFR 1910)	Applicable	This regulation specifies the 8-hour, time-weighted average concentrations for various organic compounds.	The OSHA rules are not ARARs per se but are rather independent requirements which must be met when conducting work at Superfund sites.
	OSHA - Safety and Health Standards for Federal Service Contracts (29 CFR 1926)	Applicable	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.	The OSHA rules are not ARARs per se but are rather independent requirements which must be met when conducting work at Superfund sites.
	OSHA - Recordkeeping, Reporting, and Related Regulations (29 CFR 1904)	Applicable	This regulation outlines the record-keeping and reporting requirements for an employer under OSHA.	The OSHA rules are not ARARs per se but are rather independent requirements which must be met when conducting work at Superfund sites.
	DOT Rules for the Transportation of Hazardous Materials (49 CFR 107, 171.1 - 171.500)	Applicable	This regulation outlines procedures for the packaging, labeling, manifesting, and transport of hazardous materials.	DOT rules are off-site requirements which must be complied with when activities are conducted off-site and are not ARARs per se.

**TABLE A4-3 (Continued). ACTION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
State Regulatory Requirements	Rhode Island Rules for Solid Waste Management Facilities (November 1, 1982)	Applicable	Outlines regulations for sanitary landfills. Includes initial investigation, site groundwater, and operating and closure plans. Closure requirements include 24 inches of cover material to be maintained on all surfaces and faces of the landfill. Potential remedial alternatives must address areas of landfill cover that do not meet 24-inch requirement, as well as any other areas of noncompliance.	These requirements remain applicable. The remedy was constructed to comply with these regulations.
State Regulatory Requirements (continued)	Rhode Island Hazardous Waste Rules and Regulations	Relevant and Appropriate	These requirements correspond to RCRA hazardous waste regulations. Compliance with RCRA will generally achieve compliance with these regulations. Where RCRA regulations have jurisdiction, these requirements will generally correspond and be attained if more stringent than RCRA.	These requirements remain relevant and appropriate and are being complied with.
	Rhode Island Water Pollution Control Law (RIGL 46-12)	Relevant and Appropriate	These requirements correspond to CWA regulations. Compliance with the relevant sections of CWA will generally achieve compliance with these requirements.	There is no direct discharge of contaminants from a point source at the Site to surface water. However, best management practices (BMPs) were implemented during design and included a stormwater management system designed to minimize erosion and soil loss of the landfill cover and reduce the impact on the adjacent wetlands.

**TABLE A4-3 (Continued). ACTION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
State Regulatory Requirements (continued)	Rhode Island Water Quality Standards (RIGL 46-12)	Applicable	<p>Water quality standards to be maintained in state waters. Generally, a chemical-specific ARAR, but action-specific here because it provides physical criteria such as Best Management Practices (BMPs) to control sedimentation.</p> <p>Freshwater guidelines were developed for several organics and inorganics. Water quality standards were compared to AWQCs for compounds such as toluene and arsenic.</p>	<p>This regulation prohibits activities which are likely to result in a violation of the water quality standards. The BMPs of this ARAR have been met. Part of the remedial action included a stormwater management system designed to minimize erosion and soil loss of the landfill cover and reduce the impact on the adjacent wetlands.</p> <p>RIDEM has derived freshwater aquatic life criteria for many pollutants for which federal water quality criteria are not available. These guidelines are still appropriate for monitoring surface water quality.</p>
	Rhode Island Air Pollution Control Regulations (August 2, 1967)	Relevant and Appropriate	Details the requirements, limitations, and exemption of state air emission regulations for specified substances.	These requirements remain relevant and appropriate.
	Rhode Island Air Pollution Control Act (23-23, 23-23.1)	Relevant and Appropriate	Outlines the policy of preserving, protecting, and improving the air resources of Rhode Island.	These requirements remain relevant and appropriate.

**TABLE A4-3 (Continued). ACTION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
State Regulatory Requirements (continued)	Rhode Island Rules and Regulations Pertaining to the Disposal, Utilization, and Transportation of Wastewater Treatment Facility Sludge. (September 1985)	Applicable	This requirement applies to the disposal of sludge by land application or incorporation of the sludge into the soil for silvicultural purposes.	These requirements would have been applicable to the incorporation of sewerage sludge into top soil to enhance vegetation on the landfill as indicated in the ROD. Based on the RA report this was not done. These requirements are no longer applicable.
	Rhode Island Air Toxic Regulations (Regulation No. 22)	Applicable	Limits the emission of listed substances from stationary sources.	Regulation No. 22 was amended effective 4/27/04. The list of air toxics was expanded, AALs were updated, and permitting requirements were clarified. AALs for several VOCs are listed in the Consent Decree as clean-up standards for gaseous emissions from the site. For the listed VOCs, the revised AALs are either the same or higher than the levels listed in the Consent Decree. In the latest round of ambient air sampling, benzene exceeded the AAL in two samples. These regulations remain applicable and must be complied with. A gas collection and treatment system is in place to reduce gaseous emissions to ambient air.

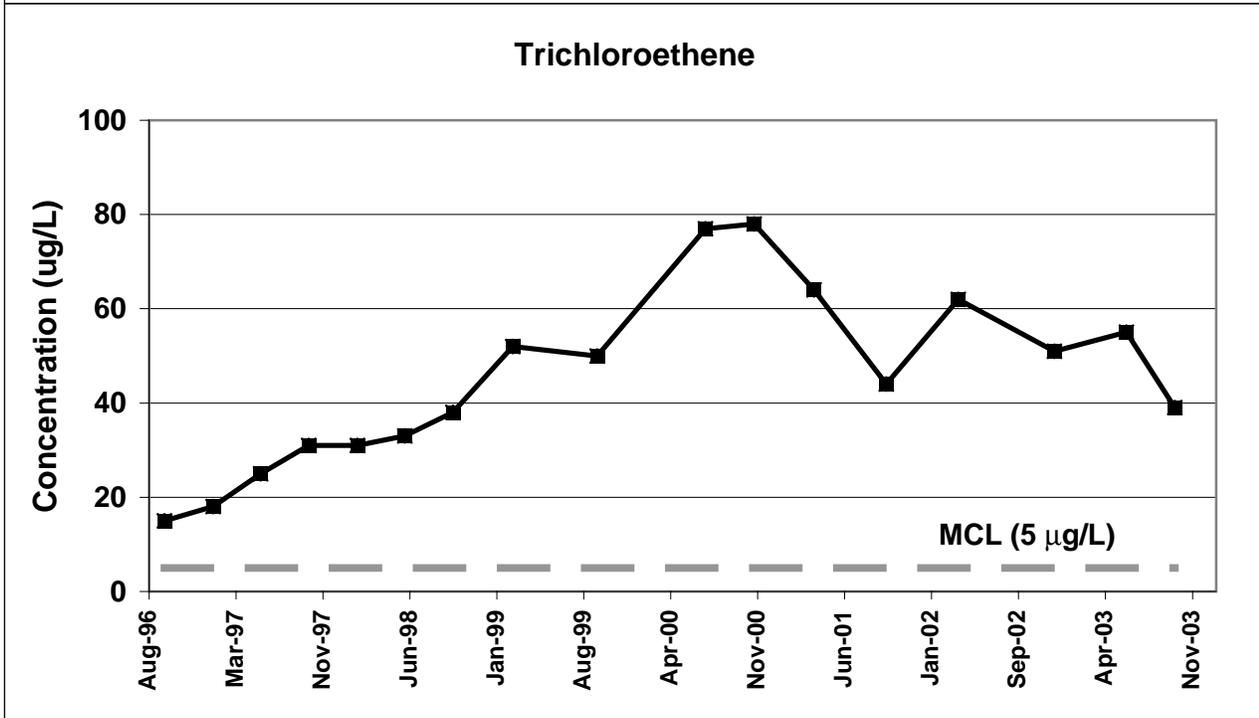
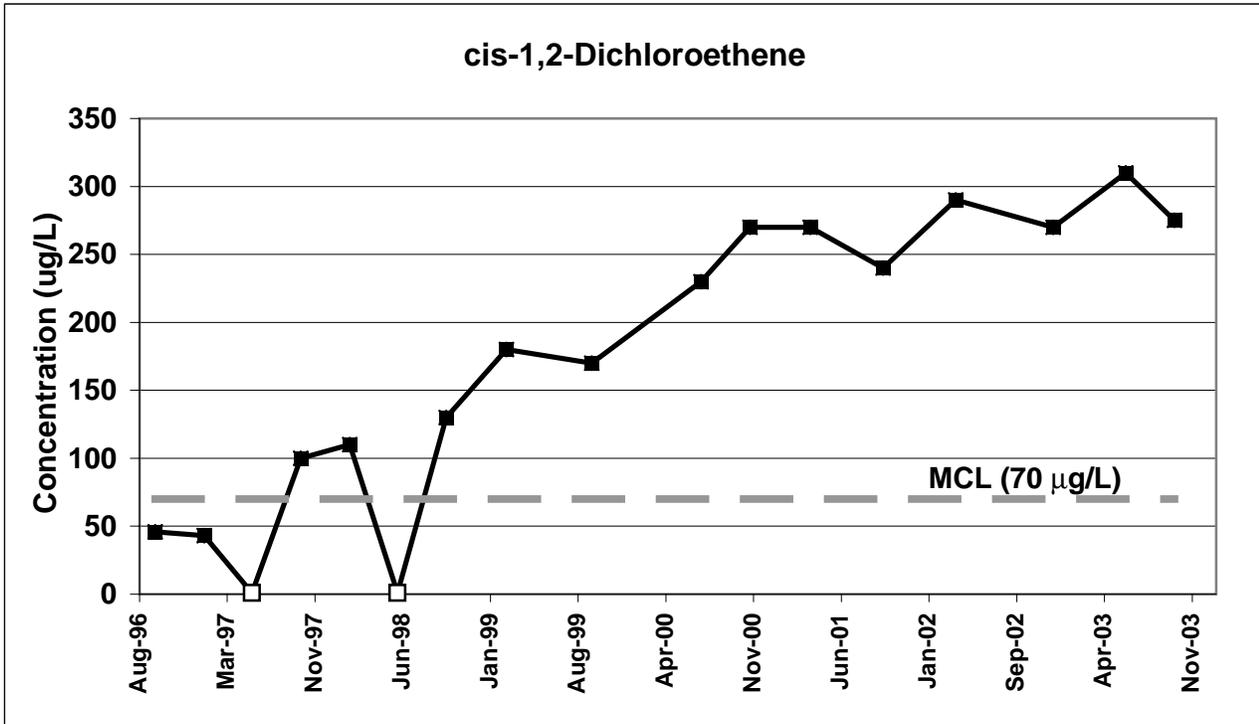
**TABLE A4-3 (Continued). ACTION-SPECIFIC ARARS
L&RR SITE**

SITE FEATURES	REQUIREMENTS	ORIGINAL STATUS	REQUIREMENT SYNOPSIS AND APPLICATION FOR THE RI/FS	FIVE YEAR REVIEW
Federal Criteria, Guidance, Advisories to be Considered	Federal Ambient Water Quality Criteria (AWQC)		Federal AWQC are health-based criteria that have been developed for 95 carcinogenic and noncarcinogenic compounds. AWQC were considered in characterizing risks to human health and aquatic organisms due to contaminant concentrations in the wetlands and Trout Brook. Because this water is not used as a drinking water source, the criteria developed for aquatic organisms were used.	CERCLA Sec. 121(d)(2)(A) specifically states that remedial actions shall at least attain federal AWQC established under the Clean Water Act if they are relevant and appropriate. Surface water monitoring is conducted on an annual basis. Several VOCs have been detected. No surface water criteria for freshwater aquatic life are available for the VOCs which have been detected.
	EPA Guidance Document - "Covers for Uncontrolled Hazardous Waste Sites" (EPA/540/2-85/002)	To be Considered	Outlines the three components that offer detailed guidance for the design of a cover system which will achieve the specified performance standards of RCRA landfill covers. These design guidance criteria were used for the preliminary cover assessment as a baseline for determining the compliance of the existing cover with RCRA requirements.	This guidance document was used during design of the cover for the landfill.

**ATTACHMENT 5
SELECTED GROUNDWATER CONTAMINANT
CONCENTRATION TRENDS**

Groundwater Contaminant Concentration Trends Over Time Monitoring Well MW-102A

Landfill and Resource Recovery Superfund Site

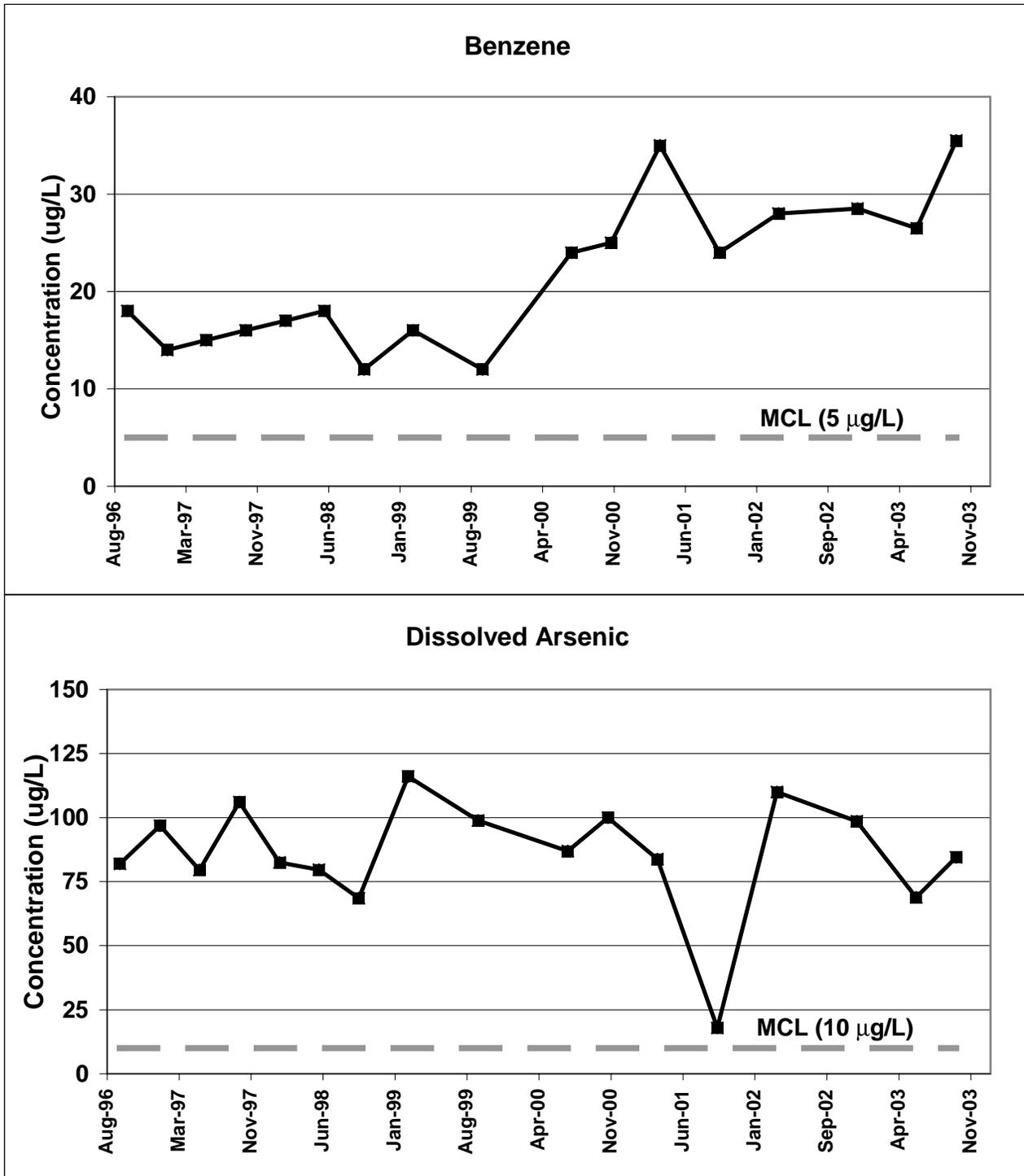


* Duplicate samples analyzed are shown as the mean of the two results

** Non-detect results are shown at the sample quantitation limit as a hollow square.

Groundwater Contaminant Concentration Trends Over Time Monitoring Well MW-104A

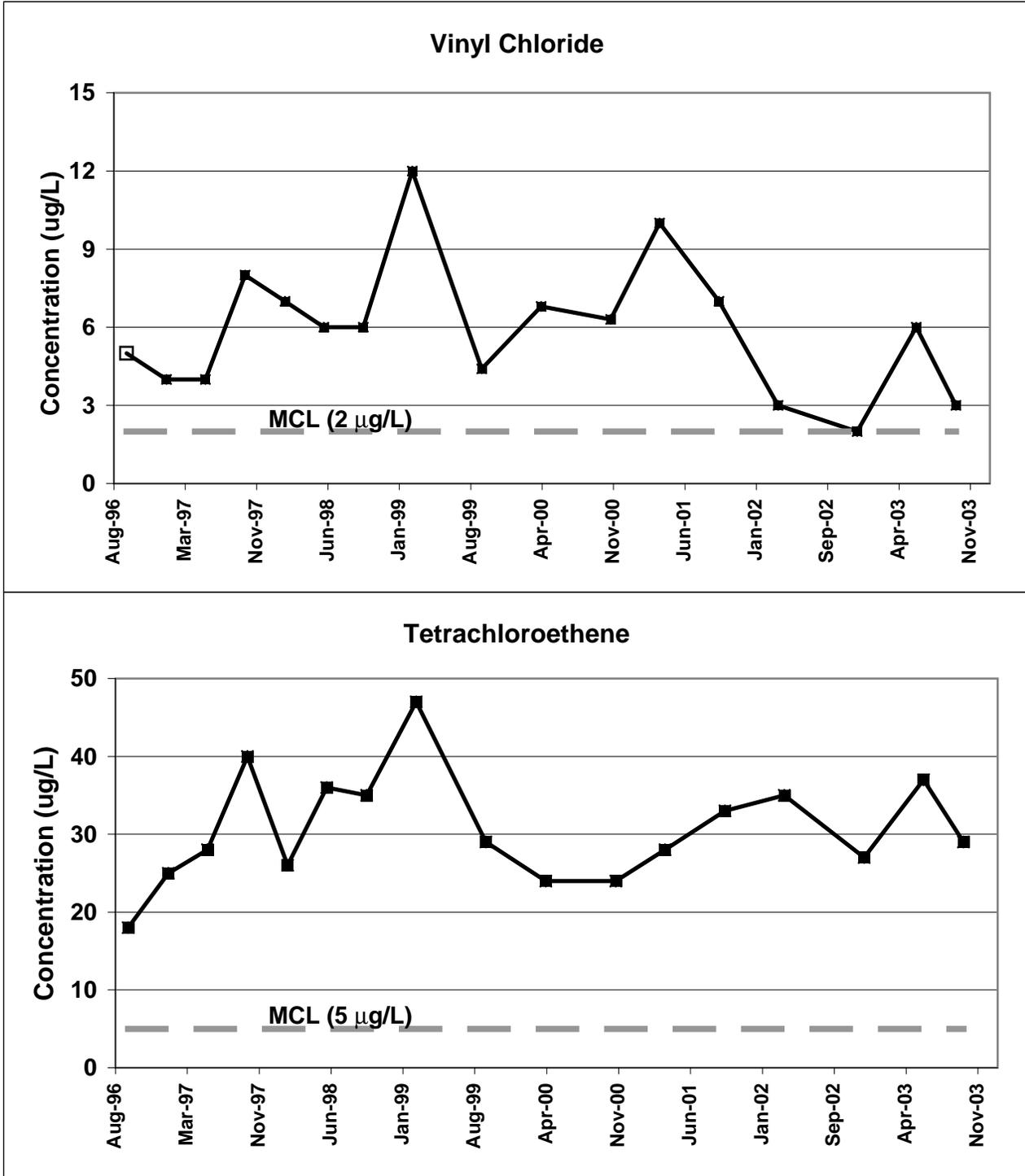
Landfill and Resource Recovery Superfund Site



* Duplicate samples analyzed are shown as the mean of the two results

Groundwater Contaminant Concentration Trends Over Time Monitoring Well CW-5B

Landfill and Resource Recovery Superfund Site



* Duplicate samples analyzed are shown as the mean of the two results

** Non-detect results are shown at the sample quantitation limit as a hollow square.